United States Department of Agriculture

Draft Environmental Impact Statement for Revision of the Inyo, Sequoia, and Sierra National Forests Land Management Plans

Volume 1: Chapters 1 through 4, Glossary, References, and Index

Forest Service Pacific Southwest Region R5-MB-297-A May 2016

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Cover Photo: Two bristlecone pines on the Discovery Trail in the Ancient Bristlecone Pine Forest, Inyo National Forest

Draft Environmental Impact Statement for Revision of the Inyo, Sequoia, and Sierra National Forests Land Management Plans

Fresno, Inyo, Kern, Madera, Mariposa, Mono, and Tulare Counties, California, and Esmeralda and Mineral Counties, Nevada

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Abstract: This draft environmental impact statement documents the analysis of four alternatives (A through D) developed by the Forest Service to revise the land and resource management plans, as amended, for the Inyo National Forest (1988), Sequoia National Forest (1988), and Sierra National Forest (1992). The revised land management plans would provide for the programmatic management of approximately 2 million acres administered by the Inyo National Forest, approximately 1.2 million acres administered by the Sequoia National Forest, and approximately 1.4 million acres administered by the Sierra National Forest. The alternatives are described in chapter 2. Alternative A is the no-action alternative, and would keep in place the management direction from the individual land and resource management plans, as amended. Alternative B is a modified version of the proposed action and is the preferred alternative. As the preferred alternative, alternative B is reflected in the accompanying "Draft Revised Land Management Plan for the Inyo National Forest," "Draft Revised Land Management Plan for the Sequoia National Forest," and "Draft Revised Land Management Plan for the Sierra National Forest," which would guide resource management activities on each respective national forest.

Alternatives B, C, and D address three revision topics that reflect the purpose and needs for the revised plans: (1) to reduce the risk of large high-intensity wildfires to communities and assets; increase the ability to manage wildfires to meet resource objectives; and reduce smoke impacts to communities; (2) to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought and climate; restore

wildlife and plant habitat and diversity; and reduce the risk of wildfire impacts to species and wildlife habitat; and (3) to provide sustainable and diverse recreation opportunities that consider population demographic characteristics; reflect desires of local communities, avoid overcrowding and use conflicts, and minimize resource damage; protect cultural resources; update direction for management of wilderness and wild and scenic rivers; and protect the values of the Pacific Crest National Scenic Trail. In addition, three areas identified as a need for change in the notice of intent are addressed but plan direction does not change between alternatives: (1) to incorporate plan direction for lands transferred to the Inyo National Forest under the National Forest and Public Lands of Nevada Enhancement Act; (2) to address benefits to people and communities; and (3) to address tribal relations and uses. These areas are incorporated in various ways throughout the alternatives.

Alternatives B through D address new information and concerns that emerged during the implementation of the current forest plans. Each alternative complies with Federal laws, regulations, and policies. These alternatives also address significant issues (unresolved conflicts with the proposed action) that were identified from comments received during our public engagement sessions and the formal 30-day comment period.

The Forest Service will use the "pre-decisional administrative review process," also referred to as the "objection process" described in the 2012 Planning Rule (36 CFR 219 Subpart B). This process gives an individual or entity an opportunity for an independent Forest Service review and resolution of issues before a final plan is approved. Subpart B identifies who may file objections to a plan revision, the responsibilities of the participants in an objection, and the procedures that apply to the review of the objection. Section 219.53 of the Planning Rule describes who may file an objection. Individuals and entities who have submitted substantive formal comments related to this plan revision during the opportunities for public comment for this decision may file an objection.

Comments: It is important that reviewers provide their comments at such times and in such a way that they are useful to the preparation of this environmental impact statement. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review. Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative or judicial reviews. Comments on the DEIS should be specific and should address the adequacy of the environmental impact statement or the merits of the alternatives discussed or both (40 CFR 1503.3).

Send Comments to: **http://tinyurl.com/earlyadoptersfpr**

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Date Comments Must Be Received: Within 90 days following publication of the notice of availability of the DEIS in the Federal Register. The notice is expected to be published on or around May 27, 2016; however, it is the commenter's responsibility to calculate the end of the 90-day period.

Contents

Preface ..... **ix**

Chapter 1. Purpose of and Need for Revising the Inyo, Sequoia, and Sierra Land Management Plans **1**
Introduction 1
Purpose of and Need for Revising the Forest Plans 6
The Draft Revised Plans 7
Decision Framework 8
Public Participation 8

Chapter 2. Alternatives, Including the Proposed Action **13**
Introduction 13
Alternatives Considered in Detail 13
Alternatives Considered but Eliminated from Detailed Study 40
Comparison of Alternatives 45

Chapter 3. Affected Environment and Environmental Consequences **55**
Introduction 55
The Relationship between Forest Plans and Site-specific Activities 55
Science and Assumptions Used in the Environmental Analyses 55
How this Chapter is Organized 56
Agents of Change: Climate, Fire, Insects, and Pathogens 57
Climate Change 57
Fire Trends 58
Insects and Pathogens 74
Combined Effects of Climate, Fire, Insects, and Pathogens 84
Revision Topic 1: Fire Management 86
Introduction 86
Fire Management 87
Air Quality 116
Revision Topic 2: Ecological Integrity 133
Background 133
Terrestrial Ecosystems 133
Aquatic and Riparian Ecosystems 263
Wildlife, Fish and Plants 305
Revision Topic 3: Sustainable Recreation and Designated Areas 460
Sustainable Recreation and Scenery 460
Heritage Resources 503
Wilderness 512
Eligible and Suitable Wild and Scenic Rivers 525
Pacific Crest National Scenic Trail 532
Tribal Relations and Uses 552
Benefits to People and Communities 564
Background 564
Forest Products and Management 564
Economic Conditions 578
Social Conditions 598
Other Required Disclosures 622
Unavoidable Adverse Effects 622

Irreversible and Irretrievable Commitments of Resources 622
Short-term Uses and Long-term Productivity 622
Laws Requiring Consultation 622

Chapter 4. Preparers, Consultation, and Coordination 625
Preparers and Contributors 625
Consultation and Coordination 633
Agencies, Organizations and Persons Sent Copies of the Draft Environmental Impact Statement 638

Glossary 639

References 655

Index 723

Tables

Table 1. Management areas by alternative, Inyo National Forest 46
Table 2. Management areas by alternative, Sequoia National Forest 47
Table 3. Management areas by alternative, Sierra National Forest 48
Table 4. Acres and miles of other designated areas by national forest (all alternatives) 49
Table 5. Other ecosystem or wildlife areas by alternative 49
Table 6. Estimated amounts of restoration activities by alternative per decade, Inyo National Forest 50
Table 7. Estimated amounts of restoration activities by alternative per decade, Sequoia National Forest 50
Table 8. Estimated amounts of restoration activities by alternative per decade, Sierra National Forest 50
Table 9. Water, aquatic, and riparian restoration activities by alternative per decade, Inyo National Forest 51
Table 10. Water, aquatic and riparian restoration activities by alternative per decade, Sequoia National Forest 51
Table 11. Water, aquatic and riparian restoration activities by alternative per decade, Sierra National Forest 51
Table 12. Comparison of sustainable recreation emphasis by alternative, all three national forests 52
Table 13. Sustainable recreation and scenery settings and activities by alternative per decade, Inyo National Forest 52
Table 14. Sustainable recreation and scenery settings and activities by alternative per decade, Sequoia National Forest 53
Table 15. Sustainable recreation and scenery settings and activities by alternative per decade, Sierra National Forest 53
Table 16. Cut and sold volume in hundreds of cubic feet (CCF) per decade[1] 54
Table 17. Acres of areas of tribal importance maintained or restored per decade 54
Table 18. Summary comparison of proposed restoration levels by alternative 67
Table 19. Summary of expected changes in fire burned area, large fire size, likelihood of large fires, and fire intensity and fire type with projected climate trends by alternative 68
Table 20. Percent change in likelihood of large fires by alternative and ecological/elevational zone 69
Table 21. Key forest insect and pathogen species of the southern Sierra Nevada 75
Table 22. Summary of percent area at risk by basal area loss categories for the Inyo, Sequoia, and Sierra National Forests 81
Table 23. Example highly valued resources and assets (HVRAs) and their relative importance values 92

Table 24. Comparative ranking of alternatives by fire management indicators and measures 114
Table 25. Summary of approach to wildfire risk management by alternative, all three national forests 116
Table 26. Table displaying baseline annual emissions in tons per year under alternative A compared to the modeled mid-century emissions with no change in management 123
Table 27. Emissions from treatments under alternative B in tons per year compared to the baseline established in alternative A 125
Table 28. Emissions from treatments under alternative C measured in tons per year and compared to the baseline established in alternative A 127
Table 29. Emissions under alternative D in tons per year compared to the baseline established in Alternative A 129
Table 30. Summary of air quality indicators and effects by alternative 132
Table 31. Area in acres by ecological zone or dominant vegetation type across each national forest, rounded to the nearest thousand acres 134
Table 32. The indicators, measures and criteria for evaluating the current condition and consequences for westside montane ecological/elevational zone (ponderosa pine, black oak, moist and dry mixed conifer) composition 140
Table 33. The indicators, measures and criteria for evaluating the current condition and consequences for eastside ecological zones and vegetation types 141
Table 34. Acres of major vegetation types, Inyo National Forest[1] 146
Table 35. Acres of major vegetation types, Sequoia and Sierra National Forests[1] 146
Table 36. Area in acres in different hardwood vegetation types by national forest, rounded to the nearest hundred acres 147
Table 37. Comparison of current conditions to desired conditions, westside vegetation types and ecological zones 147
Table 38. Comparison of current conditions to desired conditions, eastside vegetation types and ecological zones 148
Table 39. Comparison of current conditions to desired conditions, vegetation types and ecological zones in the Kern River drainage 148
Table 40. Draft forest plan desired conditions for vegetation across all vegetation types 162
Table 41. Draft forest plan desired conditions by ecological zone and major vegetation types 162
Table 42. Similarity to vegetation composition and structure desired conditions for westside foothill vegetation by alternative 168
Table 43. Similarity to vegetation composition and structure desired conditions for westside montane vegetation by alternative 168
Table 44. Similarity to vegetation composition and structure desired conditions for westside montane vegetation by alternative and location relative to the fire protection zones and focus landscapes 169
Table 45. Similarity to vegetation composition and structure desired conditions for upper montane vegetation by alternative 169
Table 46. Similarity to vegetation composition and structure desired conditions for eastside pinyon-juniper ad sagebrush by alternative 169
Table 47. Similarity to vegetation composition and structure desired conditions for eastside Jeffrey pine, mixed conifer, upper montane and subalpine forests and woodlands by alternative 170
Table 48. Application of large tree plan components across strategic fire management zones, alternative B 175
Table 49. Vegetation restoration objectives that include most or all of the westside montane zone, Sequoia and Sierra National Forests, Alternative B 182
Table 50. Indicators, criteria and thresholds used to analyze environmental consequences for the old forest special forest habitat 207
Table 51. Indicators, criteria and thresholds used to analyze environmental consequences for complex early seral habitat special forest habitat 208

Table 52. Indicators, criteria and thresholds used to analyze environmental consequences for limited habitat types special forest habitats ... 208
Table 53. Characteristics from the National Forest Sustainability Framework used in the analysis .. 210
Table 54. Summary of the similarity of current conditions to desired conditions for major indicators of terrestrial function by ecological/elevational zone ... 211
Table 55. Summary of current condition of fire regime integrity by ecological zone and vegetation type in westside areas of the Sequoia and Sierra National Forests ... 215
Table 56. Summary of current condition of fire regime integrity by vegetation type in eastside areas in the Inyo and some of Sequoia National Forests ... 216
Table 57. Overall ecosystem sustainability conditions by characteristic from National Forest Sustainability Report* by major ecological and elevational zone for the west side ... 222
Table 58. Overall ecosystem sustainability conditions by characteristic from National Forest Sustainability Report* by major vegetation types for the eastside ... 222
Table 59. Fire regime integrity for westside vegetation types by alternative ... 223
Table 60. Fire regime integrity for eastside vegetation types by alternative ... 224
Table 61. Plan direction and effects on large tree densities by location in alternative B ... 233
Table 62. Summary of conditions for characteristics of integrated sustainability by alternative ... 250
Table 63. Climate vulnerability of major vegetation types in the planning area ... 253
Table 64. Climate vulnerability of select species or species groups in the planning area ... 254
Table 65. Rating of the amount of application climate adaptation strategies by alternatives ... 256
Table 66. Summary of critical aquatic refuges and watershed conditions on the Inyo, Sequoia, and Sierra National Forest ... 267
Table 67. HUC-12 watersheds completely or partially located in the Inyo, Sequoia, and Sierra National Forests ... 283
Table 68. 303(d) Listed waterbodies within or adjacent to the Inyo, Sequoia, and Sierra National Forests ... 289
Table 69. Number of and percent of HUC 12 watersheds by condition class on the Inyo, Sequoia, and Sierra National Forests ... 291
Table 70. Summary of environmental consequences to water quality and watershed condition by alternative in comparison to current conditions[1] ... 303
Table 71. Number of federally threatened, endangered, proposed or candidate species and species with critical habitat occurring in the forest planning areas ... 307
Table 72. Number of species of conservation concern occurring in the forest planning areas ... 308
Table 73. Federally threatened, endangered, proposed, and candidate species for the Inyo, Sequoia, and Sierra National Forests ... 312
Table 74. Federally designated and proposed critical habitats for terrestrial wildlife species on the Inyo, Sequoia, and Sierra National Forests ... 313
Table 75. Mammal species of conservation concern for Inyo, Sequoia, and Sierra National Forests ... 313
Table 76. Bird species of conservation concern for Inyo, Sequoia, and Sierra National Forests ... 313
Table 77. Terrestrial amphibian species of conservation concern for Inyo, Sequoia, and Sierra National Forests ... 314
Table 78. Snail species of conservation concern for Inyo, Sequoia, and Sierra National Forests ... 314
Table 79. Butterfly and moth species of conservation concern for Inyo, Sequoia, and Sierra National Forests ... 314
Table 80. Status and threats for terrestrial salamander species of conservation concern ... 341
Table 81. Draft forest plan desired conditions for terrestrial wildlife by habitat type or ecosystem function, alternatives B, C, and D ... 348
Table 82. Draft forest plan standards and guidelines for terrestrial wildlife habitat, alternatives B, C, and D ... 349
Table 83. Draft plan components addressing the identified potential threats to at-risk terrestrial wildlife species in alternatives B, C, and D ... 350

Table 84. Plan components guiding vegetation treatments in fisher and owl habitat that differ between areas in community buffers, focus landscapes, and outside of these two areas....373
Table 85. At-risk federally listed aquatic species on the Inyo, Sequoia, and Sierra National Forests....399
Table 86. Aquatic amphibian species of conservation concern....399
Table 87. Fish species of conservation concern....400
Table 88. Aquatic invertebrate species of conservation concern....400
Table 89. Aquatic at-risk species by ecosystem type....406
Table 90. Plan components addressing the identified potential threats to at-risk aquatic species....410
Table 91. Floristic geographic subdivisions represented in the planning area (Baldwin et al. 2012)....432
Table 92. At-risk federally listed and candidate plant species in the planning area....433
Table 93. Distribution of whitebark pine in the planning area and California....434
Table 94. Numbers of plant species of conservation concern, by national forest and by life form....435
Table 95. Summary of the number of plant species of conservation concern that occur in each ecosystem type....435
Table 96. Plant species of conservation concern for Inyo, Sequoia, and Sierra National Forests....436
Table 97. Known threats to plant species of conservation concern, as documented in best available scientific information....449
Table 98. Overview comparing alternatives, with focus on identified potential threats to plant species of conservation concern....451
Table 99. Plan components addressing the identified potential threats to at-risk plants....452
Table 100. Cross-walk between Visual Management System and Scenery Management System terminology....465
Table 101. Existing recreation opportunity spectrum classes, Inyo National Forest....468
Table 102. Existing recreation opportunity spectrum classes, Sequoia National Forest....472
Table 103. Existing recreation opportunity spectrum classes, Sierra National Forest....475
Table 104. Existing (alternative A) and desired (alternatives B, C, D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Inyo National Forest....479
Table 105. Desired scenic integrity objectives by acres and percent of forest and alternative, Inyo National Forest....485
Table 106. Existing (alternative A) and desired (alternatives B, C, and D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Sequoia National Forest....487
Table 107. Desired scenic integrity objectives by acres and percent of forest and alternative, Sequoia National Forest....492
Table 108. Existing (alternative A) and desired (alternatives B, C, and D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Sierra National Forest....493
Table 109. Desired scenic integrity objectives by acres and percent of forest and alternative, Sierra National Forest....498
Table 110. Comparison of indicators by alternatives for the Inyo National Forest....499
Table 111. Comparison of indicators by alternatives for the Sequoia National Forest....501
Table 112. Comparison of indicators by alternatives for the Sierra National Forest....502
Table 113. Heritage survey for Inyo, Sequoia, and Sierra National Forests....507
Table 114. Number of heritage sites for Inyo, Sequoia, Sierra National Forests by type....507
Table 115. Number of heritage site determinations and number of historic landmarks under the National Register of Historic Places (NRHP) for the Inyo, Sequoia, and Sierra National Forests....508
Table 116. Recommended wilderness additions adjacent to existing designated wilderness, Inyo National Forest....516
Table 117. Recommended wilderness additions adjacent to existing designated wilderness, Inyo National Forest....516

Table 118. Recommended wilderness not adjacent to existing designated wilderness, Inyo National Forest ... 517
Table 119. Recommended wilderness additions adjacent to existing designated wilderness, Sequoia National Forest ... 517
Table 120. Recommended wilderness not adjacent to existing designated wilderness, Sequoia National Forest ... 518
Table 121. Recommended wilderness additions adjacent to existing designated wilderness, Sierra National Forest ... 518
Table 122. Recommended wilderness not adjacent to existing designated wilderness, Sequoia National Forest ... 519
Table 123. Percent of area in fire management zones for areas in designated wilderness by national forest, alternative A ... 522
Table 124. Percent of area in fire management zones for areas in designated wilderness by national forest, alternatives B and D ... 522
Table 125. Percent of area in fire management zones for areas in recommended wilderness by national forest, alternative B ... 522
Table 126. Percent of area in fire management zones for areas in designated wilderness by national forest, alternative C ... 523
Table 127. Percent of area in fire management zones for areas in recommended wilderness by national forest, alternative C ... 523
Table 128. Total miles of rivers in the National Wild and Scenic River System by managing entity and classification, nationwide ... 527
Table 129. Total miles of rivers in the National Wild and Scenic River System in California by classification and miles managed by the Forest Service ... 527
Table 130. Comparison of past and current wild and scenic river eligibility review findings in miles for the Inyo National Forest ... 530
Table 131. Comparison of past and current Wild and Scenic River eligibility review findings in miles for the Sequoia National Forest ... 530
Table 132. Comparison of past and current Wild and Scenic River eligibility review findings in miles for the Sierra National Forest ... 531
Table 133. Number of miles of forest trails and miles of Pacific Crest Trail within and outside of designated wilderness ... 537
Table 134. Section and entire permits issued for the Pacific Crest Trail 2013-2015 ... 538
Table 135. Wind renewable energy summary (number) by Bureau of Land Management in California, October 2015 ... 542
Table 136. Wind renewable energy summary (acres) by Bureau of Land Management in California, October 2015 ... 542
Table 137. Solar renewable energy summary by Bureau of Land Management in California, Oct 2015 ... 543
Table 138. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Inyo National Forest ... 544
Table 139. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Sequoia National Forest ... 544
Table 140. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Sierra National Forest ... 544
Table 141. Acres of Pacific Crest Trail Management Area inside and outside of wilderness, Inyo National Forest ... 545
Table 142. Acres of the Pacific Crest Trail Management Area inside and outside of wilderness, Sequoia National Forest ... 545
Table 143. Acres of Pacific Crest Trail Management Area inside and outside of wilderness, Sierra National Forest ... 545
Table 144. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Inyo National Forest ... 545

Table 145. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Sequoia National Forest 546
Table 146. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Sierra National Forest 546
Table 147. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Inyo National Forest 547
Table 148. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Sequoia National Forest 548
Table 149. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Sierra National Forest 548
Table 150. Percent of cover type of lands suitable for timber production, combined for Inyo, Sequoia, and Sierra National Forests, alternative B 568
Table 151. Projected 10-year timber harvest volumes (million cubic feet) by product type and alternative 571
Table 152. Projected 10-year harvest area in acres by management practice and alternative 571
Table 153. Economic health surrounding the Inyo, Sequoia, and Sierra National Forests 581
Table 154. Estimates of the economic contributions, 2012 583
Table 155. Summary of short-term and long-term potential effects on key national forest contributions by alternative 589
Table 156. Percent of minority populations and people living below the poverty level in the area of influence for the Inyo National Forest 608
Table 157. Percent of minority populations and people living below the poverty level in the area of influence for the Sequoia National Forest 609
Table 158. Percent of minority populations and people living below the poverty level in the area of influence for the Sierra National Forest 609

Figures

Figure 1. Map of the Inyo, Sequoia, and Sierra National Forests, which constitute the planning area for revising the forest plans for these three national forests x
Figure 2. Location of Nevada Enhancement Act lands on the Inyo National Forest 19
Figure 3. Map of changes in the predicted burned area in the next mid-century, 2035 to 2064, compared to 1961 through 1990 63
Figure 4. Predicted change in large fire size from recent (1961 to 1990) rates based on three climate models 64
Figure 5. Line graphs showing the expected change in large fire size with different future climate and vegetation restoration scenarios 64
Figure 6. Bar graph showing the change in large fire size by ecological zone with different levels of modeled restoration 65
Figure 7. Percent change in area burned at high severity (defined as greater than 50 percent overstory mortality) with future trends in climate 67
Figure 8. Photo of dead and dying ponderosa pines in the foothill zone of the Sierra National Forest, fall 2015 78
Figure 9. Drought and insect-related mortality in the southern Sierra Nevada based on aerial surveys by the Pest Management Program (from late fall 2015) 79
Figure 10. Conceptual diagram of the interaction between climate, fire, insects/pathogens and vegetation 84
Figure 11. The wildfire management continuum 90
Figure 12. Historic ignitions (Ign) and acres (Ac) burned by cause, 1992-2013, Inyo, Sequoia, and Sierra National Forests 94
Figure 13. Map showing the location of the fire management zones for alternative A 97

Figure 14. Map showing the location of the strategic fire management zones for alternatives B and D 98
Figure 15. Map showing the location of the strategic fire management zones for alternative C 100
Figure 16. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in alternative A 101
Figure 17. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in alternatives B and D 104
Figure 18. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in Alternative C 106
Figure 19. Risk location by alternative or comparison of the magnitude of net value change by strategic fire management zone 112
Figure 20. Risk source by alternative or comparison of the magnitude of net value change by strategic fire management zone 113
Figure 21. Map of air management districts in California 117
Figure 22. Graph displaying modeling results of particulate matter emissions from wildfires 122
Figure 23. Ecological/elevational zones for the Sequoia and Sierra National Forests 135
Figure 24.Ecological/vegetation zones on the Inyo National Forest 136
Figure 25. Major vegetation types from the Terrestrial Ecological Unit Inventory, Inyo National Forest 143
Figure 26. Major terrestrial vegetation types based on the California Wildlife Habitat Relationships classification, Sequoia National Forest 144
Figure 27. Major terrestrial vegetation types based on the California Wildlife Habitat Relationships classification, Sierra National Forest 145
Figure 28. Recently dead sugar pine in mixed conifer forests on the Sequoia National Forest 151
Figure 29. Occurrences of cheatgrass in vegetation plots, Inyo National Forest 158
Figure 30. Landscape ecological fire resilience by restoration scenarios 167
Figure 31. Example illustrating potential treatments in two possible focus landscapes 176
Figure 32. Example illustrating potential treatments in a possible focus landscape considering direction for wildlife 178
Figure 33. Changes in tree canopy cover from current to modeled desired conditions for a representative area 180
Figure 34. Illustration of potential changes in ecological fire resilience under alternative B 186
Figure 35. Potential changes in ecological fire resilience, alternative D 199
Figure 36. Map of fire return interval departure, Inyo National Forest 212
Figure 37. Map of fire return interval departure, Sequoia National Forest 213
Figure 38. Map of fire return interval departure, Sierra National Forest 214
Figure 39. High levels of dead and dying trees in ponderosa pine and black oak-ponderosa pine forests on the Sequoia National Forest 254
Figure 40. Floristic geographic subdivisions in the planning area 431
Figure 41. Graphic showing how the spectrum of recreation opportunity shifts from primitive to urban 464
Figure 42. The Pacific Crest National Scenic Trail 533
Figure 43. John Muir Trail Usage (which uses the same trail tread as the Pacific Crest Trail for most of its route) 539
Figure 44. Census county divisions that intersect the Inyo National Forest administrative boundary 601
Figure 45. Census county divisions that intersect the Sequoia National Forest administrative boundary 602
Figure 46. Census county divisions that intersect the Sierra National Forest administrative boundary 603

Preface

This draft environmental impact statement and supporting documents, which comprise the administrative record (also referred to as the project record) of the environmental analysis are on file at the Supervisor's Office of the Inyo, Sequoia, and Sierra National Forests and at the Regional Office in Vallejo, CA. Electronic copies of this document and other planning documents are available on the website for the Inyo, Sequoia, and Sierra National Forests plan revision.[1]. This draft environmental impact statement is organized as follows:

Volume 1

Chapter 1. Purpose of and Need for Revising the Inyo, Sequoia and Sierra Land Management Plans. This section discusses the background of the proposal, explains the purpose of and need for revising the forest plan, and briefly describes the action proposed to satisfy the purpose and need. It summarizes public participation in the environmental review process and lists preliminary environmental and social issues identified during the scoping period.[2]

Chapter 2. Alternatives, Including the Proposed Action. This section discusses the proposed action (draft revised forest plans), no action, and a range of reasonable alternatives. It also explains why other alternatives were dismissed from further consideration. It includes a summary comparison of the environmental impacts of the proposal and the alternatives in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public.

Chapter 3. Affected Environment and Environmental Consequences. This section reports the results of a multiple resource analysis of the environmental consequences of implementing the proposed action and alternatives. It describes the affected environment, by resource areas, as a baseline against which the impacts of alternatives are measured. The description of the environment is followed by disclosure of the potential direct, indirect, and cumulative effects of implementing the proposed action and each of the alternatives.

Chapter 4. Consultation and Coordination. This section lists the credentials of those who prepared this EIS and identifies the agencies, government officials, and selected other parties who were consulted regarding the proposed action.

Glossary. This section provides a glossary of terminology.

References. This section reports full citations for the sources cited in the text.

Index. This section provides page numbers for various topics related to the analysis

Volume 2 - Appendix

This volume contains evaluations of timber suitability (appendix A), wilderness (appendix B), and wild and scenic rivers (appendix C).

Volume 3 - Maps

This volume contains maps of the different alternatives as they relate to each resource analyzed. The maps are grouped by each national forest and then follow the order of the various analysis sections in chapter 3.

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[1] http://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=stelprdb5444003

[2] The time during which a proposed action has been provided to the public for review and comment so that the scope of issues related to the proposed action can be determined.

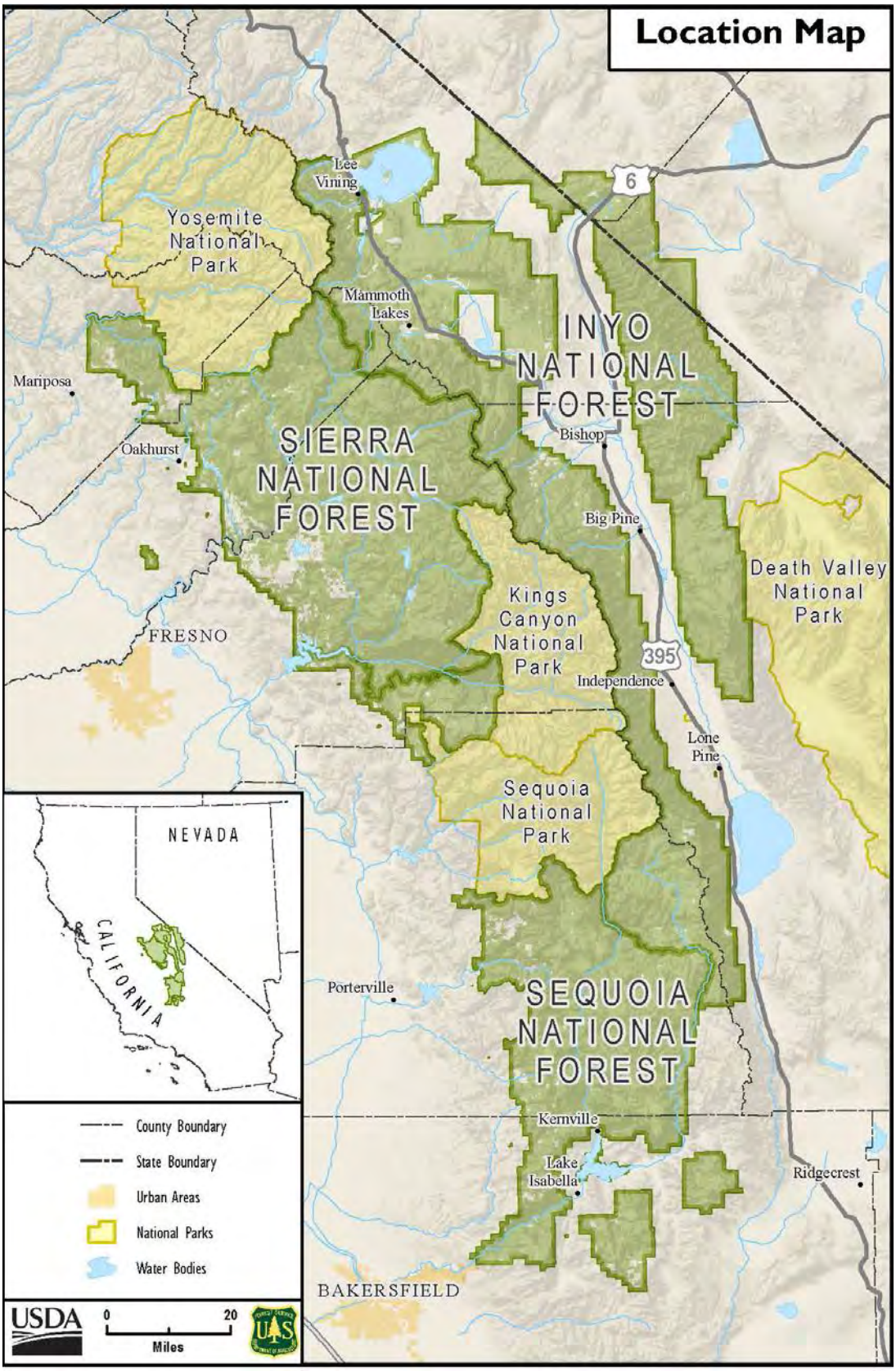

Figure 1. Map of the Inyo, Sequoia, and Sierra National Forests, which constitute the planning area for revising the forest plans for these three national forests

Chapter 1.
Purpose of and Need for Revising the Inyo, Sequoia, and Sierra Land Management Plans

Introduction

We, the U.S. Department of Agriculture, Forest Service, are proposing to revise the land and resource management plans, as amended, for the Inyo, Sequoia, and Sierra National Forests. We have prepared this environmental impact statement in compliance with the National Environmental Policy Act and its implementing regulations. This environmental impact statement discloses the potential effects of a proposed revision of the Inyo, Sequoia, and Sierra National Forest Land and Resource Management Plans (USDA FS 1988a, 1988b, 1992).

About the Inyo, Sierra, and Sequoia National Forests

Together, the Inyo, Sequoia, and Sierra National Forests encompass nearly 4.6 million acres of National Forest System lands located at the southernmost extent of the Sierra Nevada mountain range (Figure 1), including approximately 1.6 million acres of designated wilderness. These national forests are areas of great diversity—they span an altitude range from less than 1,000 feet above sea level in the western foothills of the Sequoia and Sierra National Forests to 14,494 feet at the summit of Mount Whitney on the Inyo National Forest. All three national forests share a border with Sequoia and Kings Canyon National Parks; the Inyo and Sierra National Forests border Yosemite National Park, and the Inyo National Forest also shares a boundary with Death Valley National Park and Devils Postpile National Monument. Other adjacent federal lands include the Humboldt-Toiyabe and Stanislaus National Forests and lands administered by the Bureau of Land Management's Bakersfield and Bishop Field Offices. The Tule River Indian Reservation is immediately west of the Sequoia National Forest. The Pacific Crest National Scenic Trail passes through all three national forests. Many mountain communities are located within the planning area and are surrounded wholly or in part by National Forest System lands.

The Inyo National Forest

The Inyo National Forest is located in eastern California, with a small portion in Nevada (Figure 1). The Inyo includes the crest of the Sierra Nevada from the Mono Basin to the Kern Plateau, plus the Glass, White, and Inyo Mountain Ranges. The Inyo encompasses approximately 2 million acres, excluding Mono Lake, but including about 56,481 acres of private and State lands and 26,711 acres of the Sierra National Forest and Humboldt-Toiyabe National Forests, which are administered by the Inyo National Forest. The Inyo contains the 116,200 acres of Mono Basin National Forest Scenic Area and the 29,000-acre Ancient Bristlecone Pine Forest National Protection Area (a botanical special interest area). Other land managers in the region include the Bureau of Land Management and the Los Angeles Department of Water and Power.

Forty-six percent of the Inyo, (964,360 acres) consists of nine designated wilderness areas, either wholly or partially within the administrative boundary of the national forest. These areas include: Ansel Adams (shared with the Sierra National Forest), Boundary Peak, Golden Trout (shared with the Sequoia National Forest), Hoover (shared with the Humboldt-Toiyabe National Forest), Inyo Mountains (shared with Bureau of Land Management), John Muir (shared with the Sierra),

Owens River Headwaters, South Sierra (shared with the Sequoia), and White Mountains Wildernesses.

The Inyo National Forest Supervisor's Office is centrally located in Bishop, California. The Inyo has four administrative ranger districts. The northern ranger districts, Mono Lake and Mammoth, are managed together as the "north zone." The southern ranger districts, White Mountain and Mount Whitney, are managed together as the "south zone." The Inyo comprises portions of Inyo and Mono Counties in California and Esmeralda and Mineral Counties in Nevada. The communities within and adjacent to the Inyo are relatively small and discrete. Key communities adjacent to the Inyo include: Lee Vining, June Lake, Mammoth Lakes, Bishop, Big Pine, Independence, and Lone Pine.

The Sequoia National Forest

The Sequoia National Forest is located at the southernmost end of the Sierra Nevada range in California within portions of Tulare, Kern, and Fresno Counties (Figure 1). The Sequoia lies between the Los Angeles Basin and San Francisco Bay population centers, and is accessible to these areas in 3 to 5 hours driving time. Within the national forest boundary, there are approximately 1.2 million acres of National Forest System lands and 54,155 acres of state, private and other ownerships. Elevations range from 790 feet in the Lower Kern River Valley, to 11,873 feet in the Golden Trout Wilderness.

The Sequoia National Forest contains the 328,000-acre Giant Sequoia National Monument. Since the management plan for the Giant Sequoia National Monument was approved by the Regional Forester in 2012, there is no need to change this direction and this area is not analyzed in this EIS. The Giant Sequoia National Monument Plan will be the guiding document to provide management direction to the lands within the monument.

The Sequoia National Forest Supervisor's Office is centrally located in Porterville, California. The Sequoia is divided into three ranger districts: the Hume Lake Ranger District on the north end, the Western Divide Ranger District just east of Springville, and the Kern River Ranger District at the southern end near Lake Isabella. Several communities are closely connected to the Sequoia National Forest, such as those surrounding Lake Isabella (Kernville, Lake Isabella, Wofford Heights, Mountain Mesa, and many smaller communities) and several small foothill and mountain communities located on the Kern Plateau (Kennedy Meadows), and in the Greenhorn Mountains (Johnsondale, Alta Sierra, Sugarloaf, and Beartrap). There are six designated wilderness areas either wholly or partially within the administrative boundary of the Sequoia National Forest. These areas include Domeland, Golden Trout (shared with the Inyo), Jennie Lakes, Kiavah (shared with the Bureau of Land Management), Monarch (shared with Sierra National Forest), and South Sierra (shared with the Inyo). Other land managers in the region include the National Park Service and the Tule River Indian Reservation.

The Sierra National Forest

The Sierra National Forest is located on the western slope of the central Sierra Nevada Range in California (Figure 1). It covers the eastern portions of Mariposa, Madera, and Fresno Counties. Elevations range from 900 feet at Pine Flat Reservoir to nearly 14,000 feet at the summit of Mount Humphreys along the Sierra Crest. The 1.3 million acre Sierra National Forest includes the 49,000-acre Kings River Special Management Area and the 3,200 acre Teakettle Creek Experimental Forest. Congress gave special designation to the Kings River Special Management

Area to enhance its recreational opportunities. The Sierra National Forest administers the entire Kings River Special Management Area, even though a portion of it is within the Sequoia National Forest boundary. Management of the Kings River Special Management Area is guided by the 1991 Kings River Special Management Area Implementation Plan.

The Sierra National Forest Supervisor's Office is located in Clovis, California. The Sierra has two administrative ranger districts, Bass Lake and High Sierra. The gateway communities identified for the Sierra National Forest include: Oakhurst, Coarsegold, Mariposa, Midpines, El Portal, Shaver Lake, Bass Lake, Fish Camp, Auberry, and Friant. Other communities include North Fork, Prather, Huntington Lake, and Tollhouse. There are five designated wilderness areas wholly or partially within the administrative boundary of the Sierra National Forest including: Ansel Adams (shared with the Inyo National Forest), Dinkey Lakes, John Muir (shared with the Inyo), Kaiser, and Monarch (shared with the Sequoia National Forest) Wildernesses. Other land managers in the region include the National Park Service and the Bureau of Land Management.

Regulatory Direction

In 1976, National Forest Management Act[3] directed the Forest Service to develop land and resource management plans (hereafter referred to as "forest plans") and use the direction in them to manage the natural resources and human uses of each national forest. The National Forest Management Act and its implementing regulations[4] require every national forest to revise its land management plan:

- every 10 to 15 years;
- when conditions or demands in the area covered by the plan have changed significantly;
- when changes in agency policies, goals, or objectives would have a significant effect on forest level programs; and
- when monitoring and evaluation indicate that a revision is necessary.

Today, many forest plans are over 20 years old and have not been revised within the recommended period for various reasons. The Inyo and Sequoia National Forests completed their first forest plans in 1988 and the Sierra National Forest completed theirs in 1992. The current plans have incorporated several amendments, including the 2004 Sierra Nevada Forest Plan Amendment, the 2007 Sierra Nevada Forests Management Indicator Species Amendment, and other local amendments. The Sequoia National Forest amended their forest plan in 2012 with the Giant Sequoia National Monument Management Plan.

In addition to the National Forest Management Act, there are many other laws and regulations that apply to management of the national forests including, but not limited to, the Clean Air Act, Clean Water Act, Endangered Species Act, and National Historic Preservation Act. These laws are generally not repeated or referenced in a forest plan unless there is an issue that merits citing direction in the law. Additional direction and policy for management of national forests are provided in executive orders, the Code of Federal Regulations, and the Forest Service directives system, the latter of which consists of Forest Service manuals and Forest Service handbooks. Such direction is also not repeated in a forest plan.

[3] Public law 94-588
[4] See 36 CFR 219

Plan Revision under the 2012 Planning Rule

In 2012, the U.S. Department of Agriculture issued a new rule for forest planning. The 2012 Planning Rule emphasizes that forest plans are to guide management of the national forests so they are ecologically sustainable and contribute to social and economic sustainability. The national forests are managed to provide ecosystems and watersheds with ecological integrity and diverse plant and animal communities. In addition, they are managed to have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future.

The 2012 Planning Rule describes three phases to the planning process:

- assessment;
- development, amendment, or revision of forest plans; and
- monitoring.[5]

Because the Inyo, Sequoia, and Sierra forest plans are more than 15 years old and some conditions have changed significantly, managers at the three national forests initiated the process of revising their plans in 2012 as part of a select group of national forests to implement the newly adopted planning rule.

In 2013 we completed assessments: a Bio-regional Assessment (USDA FS 2014a) of the conditions and trends of resources, uses, and public interests that are common across the Sierra Nevada. This was followed by individual national forest assessments to frame the larger context for each of the three national forests in relation to the rest of the national forests in the Sierra Nevada (from the Sequoia National Forest all the way to the Modoc National Forest near the Oregon border).

Since then, public involvement efforts have helped us identify the needs for changing the three plans as well as a proposed action and alternatives for developing the plans. Although we will plan the monitoring program as part of our proposed action, it will not be implemented until after the forest plans are revised.

Forest Plan Content

Forest plans provide a framework for integrated resource management and for guiding project and activity decisionmaking. Plans themselves do not compel any action, authorize projects or activities, or guarantee specific results. Instead, they provide the vision and strategic direction needed to move the national forest toward ecological, social, and economic sustainability.

The proposed draft revised plans include “plan components” and “other content.” Once approved, any substantive changes to plan components will require a plan amendment. A change to other content may be made using an administrative correction process, whereby nonsubstantive errors, such as misspellings or typographical mistakes, are corrected or information (such as data and maps) is updated. The public is notified of all plan amendments and administrative corrections before they become effective.

[5] See the Planning Rule at 36 CFR 219.6; 219.7; 219.12; and 219.13.

Plan Components

A forest plan is a general framework to guide the national forest staff when they propose, analyze, and decide on projects and activities. The five required components of a forest plan are desired conditions, objectives, standards, guidelines, and suitability of lands. A plan may also include goals as an optional component.

- A **desired condition** is a description of specific social, economic, or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow progress toward achievement to be determined but does not include a completion date.
- An **objective** is a concise, measurable, and time-specific statement of a desired rate of progress toward one or more desired conditions. Objectives are based on reasonable foreseeable budgets.
- A **standard** is a mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired condition, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- A **guideline** is a constraint on project and activity decisionmaking that allows for departure from its terms (more flexibility), so long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- **Suitability of lands** is determined for specific lands within the plan area. The lands are identified as suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. A plan's identification of certain lands as suitable for a use is not a commitment to allow such use but only an indication that the use might be appropriate. If a plan identifies certain lands as not suitable for a use, then that use or activity may not be authorized unless a change in the plan is made.

Optional Plan Components

- A **goal** describes an outcome that is not at the sole control of a national forest, such as the result of a partnership.

Other Plan Content

Other content in the forest plans consist of background information, general descriptions of areas to provide context to plan components, identification of watersheds that are a priority for maintenance and restoration, proposed and possible actions, and potential management approaches. Potential management approaches describe the principal strategies and program priorities each national forest intends to employ to carry out projects and activities under the plan. Potential management approaches may discuss potential processes such as analysis, assessment, inventory, project planning, or project monitoring.

The proposed plan **monitoring programs** are based in the practice of adaptive management, which is broadly recognized as critical for managing natural resources. The adaptive management cycle includes: identifying the desired conditions (forest plan); activities to help us get there (project-level implementation); monitoring whether we are achieving the results we intended (monitoring program), and using those evaluations to improve our implementation activities or to amend the forest plans.

Purpose of and Need for Revising the Forest Plans

The purpose of revising the individual forest plans is to meet the legal requirements of the National Forest Management Act and the provisions of the 2012 Planning Rule. There is a need to revise the existing forest plans to: (1) address the changing social and environmental conditions over time, and public issues described below; and (2) guide natural resource management activities on the three national forests for the next 10 to 15 years.

A prominent theme underlying the need for change is that the existing forest plans are relatively inflexible and do not provide enough opportunity to manage natural resources in a constantly changing environment. Therefore, this revision effort provides an opportunity to address a need for more flexible and adaptive land management plans.

The need for plan revision is directly correlated to six overarching "needs for change" we identified during iterative pre-revision collaborative dialogues, meetings, tribal forums, studies and assessments (see the "Public Involvement and Collaborative Planning" section on page 8). These efforts involved our forest plan revision team of interdisciplinary resource specialists and many public groups, organizations, agencies, officials, and individuals.

Three national forest assessments identified recent changes in ecological, economic, and social conditions and trends (USDA FS 2014b, 2014c, 2014d). Broader issues were identified in a "Bio-regional Assessment" (USDA FS 2014a) and "Science Synthesis" (Long et al. 2014). Using the information in these reports, the Inyo, Sequoia, and Sierra National Forests examined the current conditions and trends of ecosystems, ecosystem services, and benefits to people. Although the staff at the three national forests determined that much of the existing management direction contained in the forest plans is adequate to provide sustainable, integrated resource management, they identified several emphasis areas of management direction potentially needing change (USDA FS 2014e, 2014f, 2014g).

This forest plan revision effort provides an opportunity to coordinate the development of the three forest plans and strategically define what management direction should be consistent across the three national forests and what direction should be distinct for each national forest. While the forest plan revision effort is based on the need for change, we also took advantage of the opportunity to incorporate emerging climate change information, reclassify current standards and guidelines as desired conditions or other plan components where appropriate, and reduce duplication of Forest Service Handbook and Manual direction and existing laws, regulations, and policies.

From Needs for Change to Revision Topics

Each emphasis area we identified in the need for change was considered as a potential revision topic. Revision topics are used in the environmental impact statement to organize the features of the alternatives and to compare and contrast the differences between alternatives.

It is important to note that there is overlap in management direction developed to address each revision topic. For example, management direction developed to address needs under revision topic 2, ecological integrity, also addresses needs identified under revision topic 1, fire management.

Three of the emphasis areas we identified in the need for change were not considered to be revision topics because plan direction was the same in alternatives B, C, and D. The need for change to incorporate plan direction for lands transferred to the Inyo National Forest under the National Forest and Public Lands of Nevada Enhancement Act was addressed by incorporating plan direction that essentially continued existing management and uses. The needs for change to address benefits to people and communities and tribal relations and uses are fundamental requirements of the 2012 planning rule and were incorporated throughout desired conditions and other plan direction. Since these two areas are fundamental requirements, the consequences of the alternatives are displayed following the revision topics.

Each revision topic listed below provides a brief description and explanation of what the topic is and what needs to be revised in the plans to address the topic. Further explanations supporting the needs for changing the current plans are described in the project record.

Revision Topic 1: Fire Management

There is a need to reduce the risk of large high-intensity wildfires to communities and assets such as recreation sites and infrastructure; increase the ability to manage wildfires to meet resource objectives;[6] and reduce smoke impacts to communities.

Revision Topic 2: Ecological Integrity

There is a need to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought and climate impacts; restore wildlife and plant habitat and diversity; and reduce the risk of large high-intensity wildfire impacts to species and wildlife habitat.

Revision Topic 3: Sustainable Recreation and Designated Areas

There is a need to provide sustainable and diverse recreation opportunities that consider population demographic characteristics; reflect desires of local communities, avoid overcrowding and use conflicts, and minimize resource damage; protect cultural resources; update direction for management of wilderness and wild and scenic rivers; and protect the values of the Pacific Crest National Scenic Trail.

The Draft Revised Plans

We prepared the draft revised Inyo National Forest Land Management Plan, Sequoia National Forest Land Management Plan, and Sierra National Forest Land Management Plan, (also referred to as the “draft forest plans”) in an iterative fashion with the public over a 3-year period, beginning with the preparation of the assessments. The draft forest plans are designed to provide strategic, program-level guidance for management of each national forest, including their natural resources and uses, over the next 10 to 15 years. For each of the revision topics described above, the plan revision team, in collaboration with the public and other agencies developed proposed revised plans, that:

[6] A strategic choice to use unplanned wildfire starts to achieve resource management objectives and ecological purposes under specific environmental conditions. Such fires are monitored closely to ensure safe conditions for people, property, and other highly valued resources.

- provide a context for future, project-level planning;
- identify strategies to maintain or achieve goals (like desired conditions) over time;
- identify land areas as generally suitable or unsuitable for various uses;
- identify standards and guidelines to guide the planning of projects and activities;
- identify areas with special or unique characteristics;
- provide monitoring and evaluation requirements; and
- emphasize the use of best available science and adaptive management.

Specific details of the draft forest plans, as they evolved from the public collaborative process and internal evaluations that have occurred, are provided in chapter 2 and referenced as "alternative B." A copy of the draft revised forest plans are provided as companion documents to this environmental impact statement.

Decision Framework

The responsible officials for this proposed action are the individual Forest Supervisors of the respective national forests. After reviewing the results of the analysis evaluated in the final environmental impact statement, the responsible officials will each issue a record of decision, in accordance with agency decisionmaking procedures[7] for their respective national forest that will:

- disclose the decision (identify the selected alternative) and reasons for the decision,
- discuss how public comments and issues were considered in the decision, and
- discuss how all alternatives were considered in reaching the decision, specifying which one is the environmentally preferable alternative.[8]

Approval of the revised plans will identify management areas and will include recommendations for areas that can only be designated by statute, such as wilderness and wild and scenic rivers.

Public Participation

The Inyo, Sequoia and Sierra National Forests provided opportunities for public participation throughout the plan revision process. We used both formal and informal collaboration methods to prepare for and carry out plan revision. We developed a Collaboration, Tribal and Public Involvement Plan to guide interactions with other agencies and the public.

Early Public Engagement Sessions – Informal collaboration began even before the final Planning Rule was released with a "Sierra Cascades Dialog" public engagement session held in Sacramento, California on the topic of "Preparing for Forest Planning" in December 2011. This was followed with additional dialog sessions on collaborative planning, adaptive management and recreation, social and economic opportunities and impacts, and monitoring.

Based upon input from the public during the Sierra Cascades Dialog meeting in 2011, the Forest Service Pacific Southwest Research Station produced a science synthesis (Long et al. 2014) to

[7] 40 CFR 1505.2
[8] Environmentally preferable alternative is defined in 36 CFR 220.3.

examine the current science for a set of topics that were determined to have changed since the 1996 Sierra Nevada Ecosystem Project[9] (Centers of Water and Wildland Resources 1996). In addition, although not required, a Bio-Regional Assessment (USDA FS 2014a) was prepared to provide the context for examining resource across the entire Sierra Nevada range.

Continued Public Engagement Sessions – In 2013, we held one Sierra Cascades Dialog session to discuss the science synthesis and two dialog sessions to discuss the Bio-Regional Assessment. To allow the public to directly provide information about conditions and trends for 18 resource topics outlined in the 2012 Planning Rule, we prepared both the Bio-Regional Assessment and the national forest assessments using an open wiki site called the "Living Assessment." We used public input received between January and September 2013 to create the Bio-Regional Assessment (USDA FS 2014a), the Inyo National Forest Assessment (USDA FS 2014b), the Sequoia National Forest Assessment (USDA FS 2014c), and the Sierra National Forest Assessment (USDA FS 2014d), which were all released in December 2013.

Notice to Initiate Plan Revision – Following the assessments, we issued a notice to initiate plan revision on December 26, 2013 and developed a preliminary document outlining the need for changing the forest plans. We held tribal forums and public workshops in mid- to late-January 2014 in Fresno, Bakersfield, and Bishop to present and collect feedback on the preliminary need for change. Based on public feedback, we revised the need for change and presented an updated version along with draft desired conditions. We collected feedback at another set of tribal forums and public workshops in mid-June of 2014 in Fresno, Lake Isabella, and Bishop.

Notice of Intent and 30-day Comment Period – A notice of intent to revise the forest plans for the three national forests and to prepare this environmental impact statement was published in the Federal Register[10] on August 29, 2014, initiating a 30-day public comment period. We circulated a detailed proposed action along with the notice of intent. The detailed proposed action provided potential plan components and other plan content focused on the revision topics of the purpose and need to revise the plans. Tribal forums and public meetings were held in Fresno, Porterville, and Bishop in mid-September 2014 to provide an update on the revision process and seek public input on the development of alternatives for the draft environmental impact statement.

During the 30-day comment period, we received approximately 7,317 emails and letters from individuals, agencies, organizations, tribes and governments commenting on the purpose and need and proposed action. Of the comments received, approximately 6,603 represented form letters. All comments received were sorted, grouped by subject and analyzed to determine concerns and issues. In mid-November 2014, we held a set of tribal forums and public meetings in Fresno, Porterville, and Bishop to share a preliminary summary of the comments received and an initial set of conceptual alternatives.

Other public involvement occurred as required by the planning rule related to developing the list of species of conservation concern, evaluating the suitability of lands, and developing the monitoring program.

[9] The Sierra Nevada Ecosystem Project was requested by Congress as a scientific review of the remaining old growth in the national forests of the Sierra Nevada in California, and a study of the entire Sierra Nevada ecosystem by an independent panel of scientists, with expertise in diverse areas related to the issue.
[10] 79 FR 51536

Consultation with Federally Recognized Indian Tribes – The responsible official for each national forest regularly met with federally recognized Indian tribes to discuss the plan revision process and to engage in consultation as needed.

A description of the public participation process for forest plan revision can be found in the Forest Plan Revision Collaboration, Tribal and Public Involvement Plan in the project record.

Issues

The public, local and county governments, and State and Federal agencies submitted comments in response to the notice of intent during the 30-day comment period and at public meetings. We reviewed all the comments to identify issues and frame their associated cause-and-effect relationships. We then separated the issues into two groups: significant and nonsignificant. Significant issues are those used to develop alternatives and modify the proposed action. Nonsignificant issues are identified as those: (1) outside the scope of the proposed action; (2) already addressed by law, regulation, the proposed revised plan, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence.

Issues that Served as the Basis for Alternative Development

There are two broad categories of issues: (1) ecosystem or wildlife issues, and (2) management or use issues. Each category is followed by numbered issue topics, each of which are followed by a summarized issue statement and a description of the many concerns we heard during public comments and engagement sessions about the issue.

Ecosystem or Wildlife Issues

Issue 1: Ecological Resilience, Wildlife Habitats, and Wildfire

The amount, type, and location of thinning to improve ecosystem resilience to large, high-intensity wildfires and to reduce the threat of wildfires to communities may not provide adequate habitat for wildlife species that use forests with large trees and dense canopy cover.

There is concern about the type and extent of management activities included in the proposed action for restoring ecological resilience, particularly mechanical thinning. Based on perceptions of current vegetation conditions and resilience, some respondents stated the proposal is too aggressive, while others stated the restoration proposal is not aggressive enough. Some believe a more active management approach using thinning of trees and removing fuels to restore ecological resilience will impact too much of the dense forest that provide wildlife habitats in the short term. They prefer to use more prescribed burning and more carefully managed wildfires instead of mechanical thinning, and limit mechanical thinning to only when needed closest to communities. Others think a more active management approach that substantially increases the areas thinned will reduce impacts from large, high-intensity wildfires and ensure that the forests are resilient to climate change. They believe that active management may have short-term impacts but is needed to provide long-term sustainability of wildlife habitat and other ecosystem services.

Issue 2: Forest Resilience and Forest Density

The limitations on effectively treating enough areas to reduce the density of trees and the level of fuels because of concerns for wildlife habitats will leave too much of the forest at risk of loss or unacceptable damage from wildfires or insect attacks during droughts exacerbated by climate change.

There is a concern that there are too many tightly packed trees in much of the current forests, which makes them susceptible to being attacked and killed by bark beetles and other insects when trees are stressed by droughts. The density of trees and high level of fuels that have accumulated also makes it easier for fire to spread quickly into tree crowns where it can kill more trees than would be expected under more natural conditions. Public concern is that overemphasizing wildlife habitat needs conflicts with the need to improve resilience and sustainability of the forest.

Issue 3: Fuels Treatments and Fire Management

The amount of prescribed fire and managed wildfire used to meet resource objectives may not be sufficient to restore fire in frequent fire ecosystems. The amount of fire restored to the landscape may not be achievable without reducing existing fuels before treatment.

There is general agreement about the need to restore fire as an ecosystem function more widely on the national forests. There is a concern that in most areas, unless existing fuels are reduced beforehand, it will be difficult to conduct prescribed burning because the fire will burn hotter than desired and will have too great a potential to escape control. There is also a concern that many prescribed burns may not be accomplished because fire managers would need to wait for optimal weather where the conditions for burning and risks are acceptable. Similarly, the concern is that wildfires that might be suitable for managing to meet resource objectives will continue to be suppressed unless there are strategic pre-treated locations to provide confidence that the fire can be safely managed without undue risks to communities or unacceptable impacts to resources.

Issue 4: Watershed Restoration

The amount of watershed restoration in the proposed revised plans may not keep pace with the increased stresses to aquatic and riparian systems from drought and climate change.

There is a concern that with climate change and drought, aquatic and riparian ecosystems are under increasing stress and in need of restoration to increase their resilience. Stresses include the threats of uncharacteristically large wildfires that affect large portions of watersheds and riparian areas, decreases in available water and a resulting increase in water temperature due to increased forest density where more trees draw water to grow, and drying of meadows and unique features like fens and springs. Since aquatic and riparian systems are an essential component to sustain ecosystem integrity, the concern is that without an increased pace and scale of restoration to address these stressors, aquatic ecosystems will continue to degrade with less water and warmer water temperatures that may make it difficult or impossible for aquatic organisms to survive.

Issue 5: Protecting Aquatic Diversity

The proposed revised plans may not adequately protect areas of high aquatic species diversity.

There is a concern that if we don't identify and provide additional protection to areas of high aquatic species diversity, they may be adversely affected by the pace and scale of restoration. Maintaining and improving the resilience of these areas of concentrated species diversity is thought to be important as an adaptive strategy to address climate change.

Management or Use Issues

Issue 6: Recommended Wilderness

The proposed revised plans offer an opportunity to manage more areas as recommended wilderness to protect them from development for future generations. However, recommending additional wilderness areas in the proposed revised plans might unnecessarily prohibit and further geographically constrain management activities and uses, including tribal uses that would otherwise be allowed.

The 2012 Planning Rule and Forest Service directives provide direction during forest plan revision on a process to inventory and evaluate lands that may be identified as recommended for inclusion in the National Wilderness Preservation System. During the 30-day comment period, some individuals and groups identified areas to consider in the wilderness inventory and suggested they become recommended wilderness areas. They asked that these or other additional areas be proposed for wilderness designation to protect the values that they attach to wilderness areas. Other people requested that no additional areas be proposed for wilderness designation because this would prevent them from participating in the activities that they currently enjoy within those areas. In particular, tribes, tribal groups and organizations, and traditional cultural practitioners expressed concern that access and use of sites where resources are gathered and ceremonies are held may be restricted if areas are managed as wilderness. There is also a concern that sacred sites and cultural resources may be damaged or vandalized if recreation use increases with wilderness designation. Some commenters felt wilderness designation could also limit management activities that provide economic benefits while reducing the risks of uncharacteristic wildfire, insect, and disease disturbances.

Issue 7: Smoke

Increasing the amount of prescribed burning, and allowing the management of wildfires to meet resource objectives would produce more smoke that might impact human health and affect the tourism-based and resource-based economies of counties and rural communities.

Recent very large wildfires in Sierra Nevada national forests have demonstrated that smoke can affect not only local communities but also communities far from the fire. Smoke can affect human health and recreation opportunities. These impacts may affect other uses of the national forests and can be substantial for communities dependent upon a recreation-based economy. There is a concern that increasing the amount of prescribed burning and managing more wildfires to meet resource objectives will produce too much smoke that will affect human health and, if not carefully planned and managed, it could affect local economies.

Issue 8: Forest Products

The amount of forest management activities and forest product outputs may not adequately contribute to sustaining local and regional industry infrastructure needed to accomplish restoration objectives.

Many commenters emphasized the importance of economic and social contributions of the national forests to the surrounding communities. One concern is the importance of maintaining infrastructure (such as mills, roads, equipment, and skilled labor force) in local communities, so that the Forest Service can draw upon that infrastructure to accomplish restoration goals as well as contribute to the economic and social well-being of communities.

Chapter 2.
Alternatives, Including the Proposed Action

Introduction

This chapter describes the proposed action for revising the existing forest plans and alternatives to the proposed action. We have developed and analyzed four alternatives in this environmental impact statement; the proposed action is referenced as alternative B. Alternatives are defined by the different ways they address the revision topics and the relevant needs for change. They provide a framework for analyzing different ways of achieving the needs for changing the forest plans and for addressing the issues described in chapter 1. The alternatives show a range of options for guiding land and resource management activities on the national forests during the life of each plan. While this draft environmental impact statement identifies alternative B as the preferred alternative, the key purpose of this document is to describe in detail the environmental consequences of implementing any one of the alternatives. This chapter also presents the alternatives in comparative form, so that the differences between each alternative can be readily discerned. Summary tables are provided that compare potential future activities by alternative and abbreviate the environmental consequences associated with each alternative.

Since one environmental impact statement is being prepared, the theme of each alternative applies to each of the three national forests; however, some aspects vary due to differences in vegetation, existing settings, sites, infrastructure and opportunities and are differentiated where appropriate. The details of the draft forest plans (alternative B) are provided in the separate draft land management plans prepared for each national forest.

Alternatives Considered in Detail

Four alternatives are analyzed in this environmental impact statement: the no-action alternative (alternative A), which represents the existing plans (as amended), and three alternatives: the draft forest plans (alternative B; the preferred alternative) and two additional alternatives (alternatives C and D), which respond to the needs for change and issues identified from public involvement. The alternatives present a range of analysis options, as required by National Environmental Policy Act regulations.[11]

Alternative Development Process

We developed **alternative B**, the proposed action, to address the needs for changing the forest plans (as identified in chapter 1), as well as to carry forward existing forest plan direction that is still relevant. Information we gathered from the public and tribes during the collaborative process consisted of public comments, the Bio-Regional Assessment, the individual national forest assessments, and the Forest Service Pacific Southwest Research Station's Science Synthesis. All of this information contributed to refining the needs for change and creating a proposed action for revising the forest plans, as well as to developing the other alternatives.

The public generally agreed with the proposed action except for the following issues related to it:

[11] See 40 CFR 1502.14

1. The amount, type, and location of thinning to improve ecosystem resilience may not provide adequate habitat for wildlife species that use forests with large trees and dense canopy cover;
2. The limitations on effectively treating enough areas to reduce the density of trees because of concerns for wildlife habitats will leave too much of the forest at risk of loss or unacceptable damage from wildfires or insect attacks during droughts;
3. The amount of prescribed fire and managed wildfire used to meet resource objectives may not be achievable without reducing existing fuels before treatment;
4. The amount of watershed restoration in the proposed revised plan may not keep pace with the increased stresses to aquatic and riparian systems from drought;
5. The proposed revised plan may not adequately protect areas of high aquatic species diversity;
6. Recommending additional wilderness areas in the proposed revised plan might unnecessarily prohibit and further geographically constrain management activities and uses, including tribal uses that would otherwise be allowed;
7. Increasing the amount of prescribed burning would produce more smoke that might impact human health and affect the tourism-based and resource-based economies of counties and rural communities; and
8. The amount of forest management activities and forest product outputs may not adequately contribute to sustaining local and regional industry infrastructure.

Alternative C was developed to address Issues 1 and 5, emphasizing prescribed fire as a management tool, rather than mechanical thinning and harvest. Management focus would be on treating small-diameter trees using mechanical and hand treatment methods instead of removing trees across a range of tree diameters, and focuses on follow-up prescribed burning within treated areas.

Mechanical treatments in alternative C would emphasize vegetation and fuel reduction treatments in the wildland-urban intermix defense zone to minimize the threat of large high-intensity wildfires to communities and there would be less fuel reduction treatment in wildland areas. The treatments in the wildland-urban intermix defense zone would focus on implementing and maintaining a pattern and intensity of effective fuel reductions to lower the intensity of wildfires immediately adjacent to communities.

Alternative C complies with a 2014 court-ordered settlement agreement to include and analyze an alternative that is consistent with the findings and recommendations set forth in the “Southern Sierra Nevada Fisher Conservation Strategy” (Spencer et al. 2016); the “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands” (USDA FS 2015); and that establishes plan components that conserve key characteristics associated with the ecological integrity for post-fire, complex early seral habitat. Alternative C adds the most critical aquatic refuges on all three national forests. Direction for riparian conservation areas remains similar to alternative B, but would not include the exception to allow mechanical thinning within riparian conservation areas to facilitate burning there.

Alternative C includes the most area of recommended wilderness of all alternatives including many areas the public identified for consideration. It also includes the most areas that would be managed as critical aquatic refuges, including many areas the public identified for consideration. Alternative C also increases the size of the management area for the Pacific Crest National Scenic Trail to include areas that offer iconic views to better provide for the scenic values of the trail.

Alternative D was developed to address Issues 2, 3, and 8 by increasing the intensity of treatments and the area where fuels are pre-treated using mechanical methods in combination with strategic treatment locations to favor larger landscape prescribed burns. Like alternative B, some of the strategic treatments are concentrated in focus landscapes with more area treated and with a greater restoration toward the desired condition. This approach allows for prescribed burning across larger landscapes and provides more opportunity to manage wildfires to meet resource objectives. It allows removal of more trees, which helps managers to more rapidly address desired conditions to reduce stand density and drought-related stress on residual large and old trees and improve overall resilience of vegetation.

Alternative D emphasizes strategic mechanical thinning and prescribed burning treatments in the community wildfire protection zone, closest to communities, and the general wildfire protection zone, where fires can originate and have a high probability of reaching communities, to minimize the threat of large high-intensity wildfires. Alternative D also treats more area within the wildfire restoration zone increasing the potential to manage wildfires to meet resource objectives.

Alternative D also addresses Issue 6 by not recommending any additional areas for wilderness designation. Critical aquatic refuges are the same as alternative B. Direction for riparian conservation areas remains the same as alternative B.

Issue 4, concern regarding the pace and scale of watershed restoration is addressed by having the greatest amount of stewardship project opportunities related to the increased amount of mechanical fuel reduction. Issue 7, concern regarding the potential of smoke to affect local community health and economic sustainability, is addressed by increasing the amount of mechanical fuel reduction prior to prescribed burning and by increasing the opportunity to manage wildfires to meet resource objectives through the use of strategically located treatments and larger landscape prescribed burning.

Features Common to All Alternatives

All four alternatives have the following features in common.

Giant Sequoia National Monument (Sequoia and Sierra National Forests)

The management plan for the Giant Sequoia National Monument was approved by the Regional Forester in 2012. The Giant Sequoia National Monument Plan was created pursuant to the Presidential Proclamation establishing the monument, and provides management direction for all lands within the monument. Approximately 24,280 acres of the Giant Sequoia National Monument that overlaps within the Kings River Special Management Area is managed by the Sierra National Forest and continues to follow direction in the Kings River Special Management Area Implementation Plan. The 2012 Giant Sequoia National Monument Plan will be carried forward and will continue to govern the monument following this plan revision effort.

This includes the preliminary recommendation for including the Moses Recommended Wilderness Area as an addition to the National Wilderness Preservation System. The area would continue to be managed according to plan described in the Giant Sequoia National Monument Plan.

Features Common to Alternatives B, C, and D

Consideration of the Southern Sierra Nevada Fisher Conservation Strategy and the Interim California Spotted Owl Conservation Assessment

Although specific plan direction varies, alternatives B, C, and D include plan direction to incorporate the findings and recommendations of the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016) and the "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA FS 2015).

Following publication of a California spotted owl conservation assessment (in development) and the publication of additional key habitat information (a general technical report on the natural range of variation of mixed conifer forests), a California spotted owl conservation strategy will be developed, and may highlight management recommendations very different or similar to current standards and guidelines. While we cannot anticipate the final contents of the conservation strategy, it will seek to balance short and long term owl needs, and better address the long-term resiliency and sustainability of owl habitat across its range. Thus, additional conservation, restoration, resiliency, and sustainability-focused plan components may be added to incorporate the conservation strategy recommendations when they become available.

Complex Early Seral Habitat

Although specific plan direction varies, alternatives B, C, and D include plan components for conserving they key characteristics associated with the ecological integrity of complex early seral habitat.

Species of Conservation Concern

The National Forest Management Act requires the Forest Service to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." As such, the 2012 Planning Rule requires the Forest Service to maintain or restore ecological sustainability, integrity, and diversity as the primary approach to species conservation. In addition, the rule requires plan components to provide the ecological conditions to maintain a viable population of species of conservation concern. A viable population is defined as one "that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments." Species of conservation concern are those species that are known to occur within the plan area and for which there is a substantial concern about the species' capability to persist over the long term in the plan area. As required by the Planning Rule and agency directives, the Regional Forester has identified a list species of conservation concern for each national forest, which do not vary by alternative. These species are listed in the section "Wildlife, Fish and Plants."

Alternatives B, C, and D identify vegetation desired conditions designed to provide overall ecological integrity, including habitat for all associated species, and specifically to ensure they provide the ecological conditions necessary to maintain viable populations of species of conservation concern within the plan area. A guideline was developed to protect trees from removal that are used for nesting, denning, or roosting by at-risk species. This extends to some adjacent trees that provide necessary shade or other important habitat conditions. In addition, a guideline was developed to consider at-risk species early in the environmental planning process.

Alternatives B, C, and D identify desired conditions, standards, and guidelines for special habitats that represent small-scale habitat or vegetation types that support many at-risk plants and animals. These special habitats have plan direction to increase their consideration in project design and to help maintain and improve key ecological conditions that support several plant species of conservation concern.

For some species of conservation concern, species-specific plan components have been developed or carried forward from the existing plans and are the same across alternatives. These species include great gray owl, Sierra marten, and bat species. Species-specific plan components related to willow flycatcher are not carried forward from the existing plans. We have also developed species-specific plan components for California spotted owl, Pacific fisher, greater sage-grouse, and Yosemite toad, but these vary across the alternatives and they are described under each alternative description.

Willow Flycatcher (All Three National Forests)

Species-specific plan direction for willow flycatcher is not being carried forward into plan revision. Current direction includes survey requirements and livestock grazing direction for occupied sites. However, there is no overlap of occupied sites and livestock grazing; therefore, additional species-specific plan direction is not necessary.

Great Gray Owl (Sequoia and Sierra National Forests)

Species-specific plan direction for great gray owl would be similar to existing plan direction but only applies to the Sequoia and Sierra National Forests. Direction includes guidelines that designate a protected activity center, provide a limited operating period during the breeding season, and maintain herbaceous vegetation in meadows near nest sites for prey. It also includes a potential management approach that provide for follow-up surveys. Additional desired conditions and guidelines for forests and woodlands that comprise great gray owl habitat would provide for improved habitat quality and resilience. The great gray owl is not a species of conservation concern for the Inyo National Forest as they are not known to breed there.

Sierra Marten (All Three National Forests)

Species-specific plan direction for Sierra marten incorporates recent mapping of combined Pacific fisher and marten core habitat and information from the “Science Synthesis and Climate Adaptation Strategy for the Sierra Nevada.” Much of marten core habitat overlaps with wilderness or inventoried roadless areas and would have limited management. Additional desired conditions and guidelines address management of core habitat to restore and maintain habitat quality and resilience to climate change. Although plan direction related to other species varies by alternative and may also affect marten habitat, alternatives B, C, and D include plan direction to incorporate Sierra marten core habitat and conserving the key habitat characteristics.

Bats (All Three National Forests)

Species-specific plan direction for bats includes a standard that provides for the installation of bat gates at mines or caves with known breeding or hibernation.

Tribal Relations and Uses

Desired conditions, goals, and potential management approaches in alternatives B, C, and D address and encourage working with tribes to manage resources of tribal importance. Plan components focus on management of some sites for tribal uses such as oak stand improvements for acorn gathering,

management of pine stands for piaga (Pandora moth) on the Inyo National Forest, and other gathering site improvements and considerations.

Partnerships

An emphasis on increasing forest capacity through the use of partnerships and volunteerism is included in plan direction in alternatives B, C, and D. A variety of strategies and tools would be used to increase the use of private, public, and tribal partnerships and volunteers. Partnerships and volunteers could assist with improving and maintaining recreation trails, recreation and administrative sites and other types of infrastructure, providing information and interpretive services, as well as participating in ecological restoration that would include restoring meadows and other archeological, cultural, and ecological features. Partnerships may also provide additional funding or other resources to increase the types and levels of services offered and to support an increased pace and scale of ecological restoration. In each alternative, the type of partnership or volunteer emphasis may shift; however, the ability to maintain and increase partnerships and volunteerism will continue to exist.

Wilderness

Desired conditions and guidelines were developed to address aspects of wilderness management that were not addressed in previous wilderness direction, including plan components to provide for restoration in wilderness, invasive species, a trails component, and the undeveloped quality of wilderness character.

For the Sierra National Forest, new plan components (desired conditions and standards) apply to the Kaiser Wilderness. This direction did not previously exist in the 1992 plan; however, this direction reflects how the Sierra National Forest has been managing the Kaiser Wilderness for several years.

Wild and Scenic Rivers

A new plan component would be added for management of rivers identified as eligible for inclusion in the National Wild and Scenic River System as well as for rivers that have been found to be suitable in previous wild and scenic river studies and have previously been recommended by the Forest Service for inclusion in the National Wild and Scenic River System. The standard applies protection measures for these rivers until a decision is made through an Act of Congress or a suitability evaluation determines that an identified eligible river is not suitable.

The wild and scenic river eligibility evaluation identified an additional 869 miles of river or river segments for potential inclusion in the National Wild and Scenic River System. This includes 160 miles of eligible rivers or segments on the Inyo National Forest, 80 miles of eligible rivers or segments on the Sequoia National Forest, and 633 miles of eligible rivers or segments on the Sierra National Forest.

Nevada Enhancement Act Lands

The Inyo National Forest acquired approximately 44,600 acres of lands through the National Forest and Public Lands of Nevada Enhancement Act of 1988[12] (see Figure 2). These lands have been managed consistent with the Bureau of Land Management's Tonopah Management Plan and would be fully incorporated into the Inyo forest plan. Desired recreation opportunity spectrum classes and scenic integrity objectives are assigned to these lands reflecting the current management condition.

[12] Public Law 100-550 - Oct. 28, 1988; 102 Stat. 2749

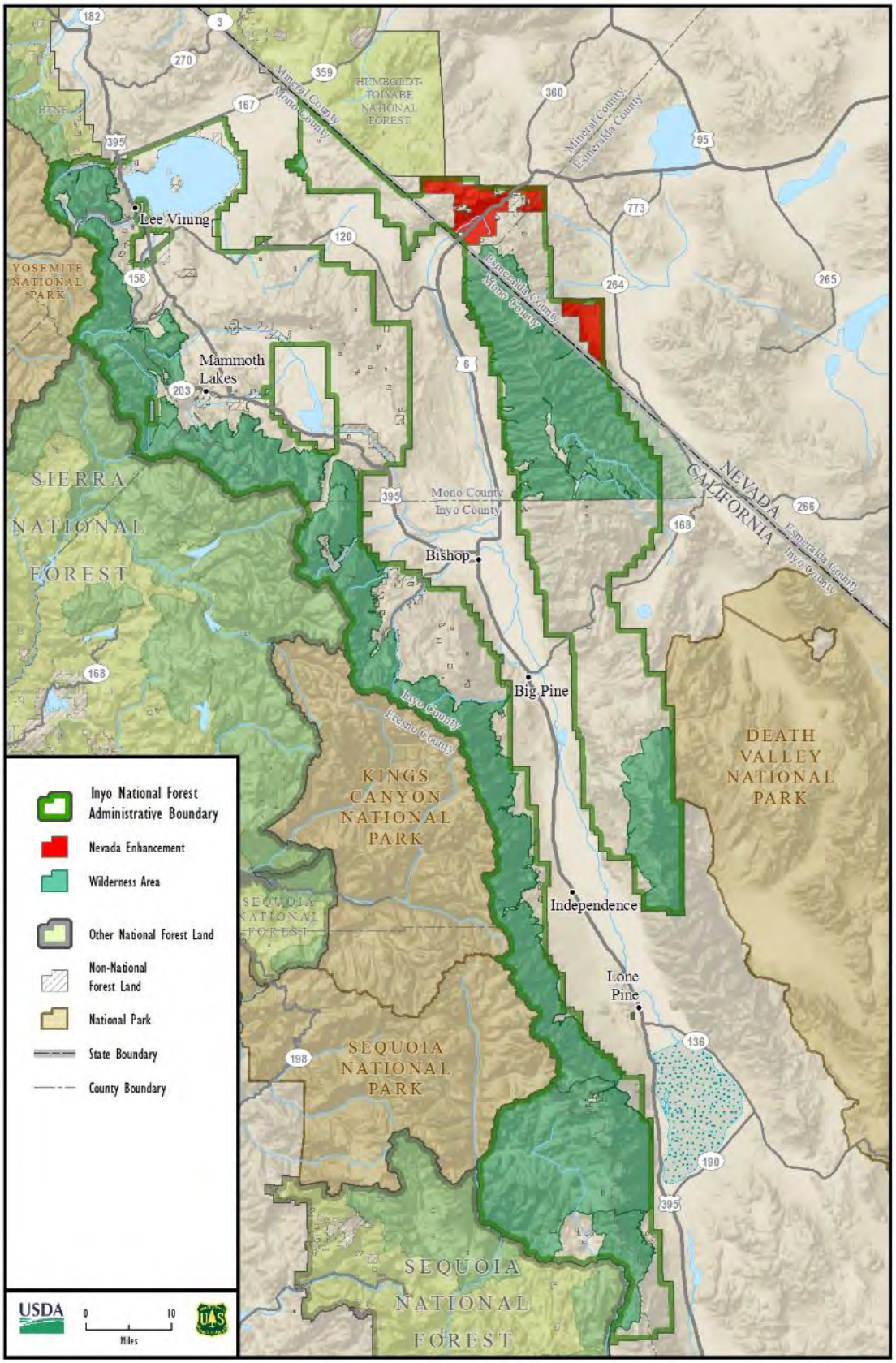

Figure 2. Location of Nevada Enhancement Act lands on the Inyo National Forest

Scenic Integrity

Scenic character would be managed using the direction of the Scenery Management System, which replaces the older visual management system in the existing forest plans. The Scenery Management System provides a systematic approach to inventory, analyze, and monitor scenic resources on National Forest System lands. It recognizes that landscapes are not static so objectives for scenery are grounded by naturally changing and evolving conditions that are described in the scenic character. The scenic character stability of the landscape becomes an element considered in implementing the management objectives related to restoration. This context ensures that objectives for scenery are linked to ecological changes rather than managing for a specific condition into perpetuity. Converting to the Scenery Management System advances the contemporary paradigm that both natural and cultural (built element) features are part of scenic character and contribute to "sense of place." Scenic integrity objectives describe the minimum thresholds for the management of the scenery resource, ranging from very high scenic integrity objectives to low. Scenic integrity objectives reflect changes in public perceptions and the importance of viewing scenery as well as integrating scenery resources with the overall management of the landscape. Sustainable recreation concepts are integrated into plan direction for restoration projects to improve and protect scenic character and contribute to improved scenic stability.

Invasive Species

The direction for invasive species is primarily focused on noxious weeds in alternative A. For alternatives B, C, and D, the direction was updated and expanded to recognize the threats to ecosystem resilience from all non-native invasive aquatic and terrestrial plants and animals likely to cause harm to ecosystems. There is an emphasis on managing invasive species by including objectives that increases the amount of area with non-native invasive plants treated.

Climate Change

The Forest Service is addressing climate change in a variety of ways from reducing the impacts of the operations of facilities to encouraging reduced impacts from permitted activities. The desired conditions for alternatives B, C, and D include adaptations for climate change where relevant. An example is the climate adaptation strategy of providing for habitat connectivity to allow animals to move across the forests easier. Although they are not specifically addressed in the current forest plans, many of these strategies can and are considered during ongoing project development.

Alternative A: Existing Plan Direction

Under alternative A, the existing plans, as amended, would continue to guide management of the Inyo, Sequoia, and Sierra National Forests. Electronic copies of the existing forest plans are provided for each national forest on the Forest Plan Revision Web site.[13]

The following sections discuss existing plan direction as it relates to each of the revision topics and needs for change.

[13] http://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=stelprdb5444003

Revision Topic 1: Fire Management

Strategic Fire Management Zones

Current forest plan management focuses hazardous fuel reduction treatment in the wildland-urban intermix defense zone and threat zone as a priority. In the defense zone (the area closest to structures and communities), there are fewer restrictions on the intensity of thinning. Within the wildland-urban intermix defense and threat zones, where fuels are heavy and could contribute to high-intensity fire, thinning is allowed within protected activity centers for California spotted owls and northern goshawks if prescribed burning designed to reduce fire risk cannot be effectively conducted. (See chapter 3, page 96 for a map and more information, and volume 3 for maps of the strategic fire management zones in each national forest.)

Managing Wildfire to Meet Resource Objectives

The current forest plans encourage the restoration of fire to the ecosystem through increased use of prescribed fire and by allowing management of some wildfires when they can meet resource objectives defined by the forest plan. The existing plans provide general direction for resource objectives related to vegetation conditions, but they do not explicitly identify resource objectives to be accomplished using wildfire as a natural process.

Smoke and Air Quality

Prescribed fire is coordinated with adjacent land management agencies to ensure that State or Federal standards for ambient air quality are not exceeded.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Current plan direction focuses on vegetation management and fuel conditions at the stand or patch scale and it does not explicitly provide a framework for increasing landscape-level treatments. Plan direction is generally prescriptive, with specific requirements and limitations on the diameter sizes of trees that can be removed and requirements to retain certain amounts of tree canopy cover. The landscape management approach is to strategically place fuel reduction treatments to interrupt the spread of large wildfires. However, because many areas are inaccessible due to steep terrain or distance from roads, and the current plans include single-species-specific habitat management direction that limits treatment options, this approach has proven difficult to implement. This has left some wildlife habitats vulnerable to damage or loss from large high-intensity fires. The current forest plans describe the need to address stand density of forests to reduce the risk of trees dying due to stresses related to prolonged droughts, but single-species-specific habitat management direction limits the amount of treatment that can occur.

Old Forests

The current forest plans contain desired conditions for old forest emphasis areas and provide standards and guidelines to generally retain all large trees and to minimize treatments within patches of dense-canopy forests with larger trees wherever they occur. The desired conditions for old forest emphasis areas provide for high levels of horizontal and vertical canopy diversity, and variability in size, species composition, and structure of roughly even-aged vegetation groups generally less than 5 acres in size. However, these desired conditions conflict in part with the

desired conditions and standards and guidelines for the California spotted owl, Sierra marten, and Pacific fisher, which generally favor retaining large contiguous areas of denser canopy cover and limit the ability to create a lot of horizontal and vertical canopy diversity. In some cases, the prescriptive plan direction for one species conflicts with direction for another species, which can limit the restoration of habitats as the most restrictive direction is applied to projects.

Wildlife and Plant Habitat Diversity

Risks to terrestrial habitat are mitigated in part by using restoration treatments (such as thinning, prescribed fire, and wildfires managed to meet resource objectives) at a landscape scale with the intent of reducing the impact of future large, high-intensity wildfires on key habitats each species needs. Despite the intent, the combination of protections for individual species often results in the inability to treat enough of the landscape to reduce the risks to habitat from wildfire.

Aquatic and Riparian Ecosystems

The current forest plans provide direction for an aquatic management strategy with desired conditions, goals, and a set of standards and guidelines organized around a set of riparian conservation objectives that includes delineation of riparian conservation areas around streams, rivers, lakes, meadows and a variety of other wetland types, and a set of critical aquatic refuges. The current standards and guidelines generally limit disturbance and impacts within riparian conservation areas and critical aquatic refuges and call for consideration of impacts to aquatic and riparian systems and resources.

Critical Aquatic Refuges

The current plans identify a set of critical aquatic refuges focused on areas with threatened and endangered species or areas of other species with population concerns. The direction that applies to riparian conservation areas, the buffer area around streams, rivers, lakes, meadows, bogs, and other wetland types, applies to the critical aquatic refuges. There are 17 critical aquatic refuges on the Inyo National Forest, 6 on the Sequoia National Forest, and 7 on the Sierra National Forest.

Watershed Resilience to Climate Change

The desired conditions for aquatic and riparian ecosystems in the current plans do not specifically consider the change in temperature and precipitation related to climate change and other climate stressors to aquatic systems. Desired conditions do not exist connecting the condition of upland vegetation with the condition of aquatic and riparian ecosystems.

At-risk Species

At-risk species in alternative A consist of federally listed species under the Endangered Species Act and Forest Service sensitive species. The current forest plans employ an approach to species management that has a particular focus on providing habitats for species associated with old forest ecosystems and with aquatic and riparian systems, two of the issue areas identified in 2001 as needing new or amended plan direction. The current plans use an approach primarily focused on limiting management activities within areas identified for wildlife management, especially protected activity centers for California spotted owl, northern goshawk, and great gray owl; home range core areas for California spotted owl; and den and rest sites for Pacific fisher and Sierra marten.

California Spotted Owl (Sequoia and Sierra National Forests)

Species-specific plan direction for California spotted owl in the current plans provides for 300-acre protected activity centers designated around territorial locations and intended to provide sufficient habitat to support nesting owls. A surrounding home range core area encompassing an additional 300 acres on the Sierra and Sequoia National Forests and an additional 700 acres on the Inyo National Forest, is identified to provide sufficient foraging and roosting habitat to support the home range needs of California spotted owls. The current forest plans do not address the "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA FS 2015); however, the terms of the Settlement Agreement applicable to project planning is followed as stipulated.

Pacific Fisher (Sequoia and Sierra National Forests)

The current forest plans include direction for minimizing disturbance and activities near den sites for forest carnivores such as fisher and marten. They also include a southern Sierra fisher conservation area with direction to maintain dense canopy cover over at least half of the areas of fisher home ranges and to retain and minimize impacts to preferred fisher habitat elements such as trees with cavities that could serve as den sites, large snags, and downed logs.

Bi-state Distinct Population Segment of Greater Sage-grouse (Inyo National Forest only)

Under the current forest plan, the Inyo National Forest would continue to follow the "Inyo National Forests Sage-Grouse Interim Management Policy" (USDA FS 2012) pending a forest plan amendment to better address the bi-state distinct population segment of greater sage-grouse. In any plan amendment developed for sage-grouse, the Inyo National Forest would consider management direction that addresses current threats and, where feasible and applicable, would amend the plan to be consistent with the "Humboldt-Toiyabe National Forest Greater Sage-Grouse Bi-State Distinct Population Segment Forest Plan Amendment" to better achieve consistency across the national forest boundaries. The Inyo National Forest would also continue to consider management direction and emphasize management actions that are consistent with the "Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment."

Yosemite Toad (Inyo and Sierra National Forests)

The current plans for the Inyo and Sierra national forests include standards and guidelines that exclude livestock grazing within toad-occupied areas during the Yosemite toad breeding and rearing season. A standard and guideline allows waiver of the livestock exclusion if a site-specific management plan is approved and incorporated into allotment plans and relevant special-use permits.

Willow Flycatcher (All Three National Forests)

The current plans include standards and guidelines that guide livestock management by defining three categories of site occupancy: occupied willow flycatcher sites, historically occupied willow flycatcher sites, and conditionally occupied willow flycatcher sites.

Great Gray Owl (All Three National Forests)

The current plans include designation of a protected activity center and standards and guidelines that provide for follow-up surveys, a limited operating period during the breeding season, and maintenance of herbaceous vegetation for all three national forests. Although there is no known

nesting of this species on the Inyo National Forest, it includes the same direction as the other national forests.

Sierra Marten (All Three National Forests)

The current forest plans include direction for minimizing disturbance and activities near den sites for forest carnivores such as marten.

Bats (All Three National Forests)

The current plans do not provide specific direction for bats.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

Current plan direction for recreation varies by national forest. The existing plan direction was based on recreation uses and recreation demand existing and projected from the late 1970s and 1980s when forest plans were first developed. The emphasis of the current plans is on improving recreation opportunities by focusing on the maintenance, development, adaptation, or alteration of dispersed and developed recreation sites consistent with the recreation opportunity spectrum class of the area. There is an emphasis to continue existing partnerships and volunteerism and to evaluate opportunities to develop new partnerships and volunteers to increase the amount of trails and facilities managed to desired standards.

Scenery

In the current plans, scenic character is managed using the 1986 Visual Management System and associated visual management objectives, which do not include specific guidance for designing projects to improve scenic character and scenic character stability within the desired landscape character.

Recommended Wilderness

Current plan direction for wilderness varies by forest. General management direction exists but many designated wilderness areas have wilderness management plans that provide more specific management guidance.

Pacific Crest Trail

The current plans manage the Pacific Crest National Scenic Trail according to direction provided by a 1982 comprehensive management plan (USDA FS 1982) and direction is focused on the trail tread and immediate surroundings. Most of the Pacific Crest Trail is within existing wilderness areas except for 13 miles on the Sequoia National Forest and 5 miles on the Inyo National Forest. In these areas, there is limited specific plan direction to guide activities adjacent to the trail that may impact the scenic and recreational values of the trail.

Alternative B: Proposed Revised Plans

Alternative B is the draft forest plans, which were developed in collaboration with the public, other agencies, government officials, and Native American tribes to respond to the need for change emphasis areas. As described in chapter 1, the draft forest plans were adjusted from what was initially produced to address issues and feedback received by the public to date. A copy of the draft forest plan for each national forest accompanies this document.

The draft forest plans provide a management direction framework to improve ecological fire resilience and restore fire as an ecosystem process. The draft forest plans establish strategic fire management zones and emphasize active management in the form of harvest, mechanical thinning, and prescribed burning to support the use of wildfire (natural ignitions) for resource benefit where it can be safely managed. The draft forest plans balance the need for a greater focus on landscapes and processes with protection for wildlife with the need for more active management. The draft plans address the fact that a prescriptive, single-species approach to forest management has significant limitations in terms of achieving long-term sustainability and diversity of ecosystems in the face of stressors and climate change, especially in areas closest to communities and where there are high concentrations of assets and values important to people. Management approaches are adjusted for scenery and recreation settings to integrate with restoration activities at a landscape scale and address adapting sites and infrastructure to the needs of shifting demographics, budgets, and climate change. Specifically, the draft forest plans strive to streamline and simplify standards and guidelines to allow for increasing the pace and scale of restoration projects designed to reduce the risks associated with large, high-intensity wildfires, drought, insect outbreaks, and climate change. They also strive to improve watershed conditions within the community wildfire protection zone and the general wildfire protection zone while providing for overall species diversity and the persistence of at-risk species, supporting recovery of federally listed species, and improving recreation sustainability.

The draft forest plans retain much of the direction from the existing forest plans; however, the draft forest plans differ from the existing plans in a number of fundamental ways that are aimed at allowing forest management to be more adaptable over time and to be able to adjust to site-specific conditions. Some concerns raised during the public comment period were incorporated into the draft plans, either by modifying existing language or by adding new language. The following sections describe how alternative B responds to each of the revision topics.

Revision Topic 1: Fire Management

Strategic Fire Management Zones

Direction in the draft forest plans would replace the current two distance-based land allocations in the wildland-urban intermix and the remaining areas that are not wildland-urban intermix with four management areas based on a fire risk analysis consistent with the National Cohesive Fire Strategy. (See chapter 3, page 98 for a broad-scale map and more information, and volume 3 for maps of the strategic fire management zones in each national forest).

- The **community wildfire protection zone** would replace the wildland-urban intermix defense zone of alternative A and includes larger geographic areas where wildfire would likely threaten communities. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning into and negatively impacting communities and community assets. Due to variations in the potential of fire, this zone is irregular in shape unlike the uniform shape of the wildland-urban intermix defense zone of alternative A. Draft plan direction emphasizes active management using thinning and prescribed fire to reduce fuels within this zone. Most wildfires would be actively suppressed to protect communities and assets, although in some instances, wildfires may be managed to meet resource objectives if conditions allow and when it could be done in a safe manner. Plan direction identifies community buffers in close proximity to structures where fuel conditions, snags, and logs would be managed to facilitate safe wildfire operations.

- The **general wildfire protection zone** would replace the wildland-urban intermix threat zone of alternative A; it is irregular in shape, covering a larger area. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning toward and negatively impacting communities and assets as well as negatively impacting natural resources in the zone. Draft forest plan direction emphasizes active fuel reduction treatments along ridgetops, roads, and other natural and manmade features that can serve as strategic anchor points for larger prescribed burns and to create areas of low fuel that can be used to manage wildfires. Due to the high likelihood of wildfire occurring in this zone and possibly spreading into the community wildfire protection zone, wildfires would most often be suppressed to reduce the threat to communities and assets. In some instances, wildfires could be managed to meet resource objectives if conditions allow and when it could be done in a safe manner.
- The **wildfire restoration zone** would be a new zone that identifies areas with low to moderate risk for communities and structures and other resource values. This zone is based on modeling potential spread and intensity of wildfires that can pose a mix of positive and negative effects to resources and some isolated assets. Thinning or prescribed burning may be needed before wildfires can safely be managed to meet resource benefits. Proposed plan direction emphasizes active fuels management treatments in strategic locations to enable larger prescribed burns and to aid wildfire management that focuses on restoring fire to the ecosystem. Many wildfires in this zone would be managed to meet resource objectives under specific conditions and when it could be done in a safe manner, although in some instances wildfires may be suppressed.
- The **wildfire maintenance zone** would be a new zone that identifies areas with very low risk. This zone is based on modeling potential spread and intensity of wildfires that pose mostly a positive effect to resources. The wildfire maintenance zone is typically in the higher elevations, wilderness, and remote areas where mechanical treatments are often not a management options, thus restoring the role of fire is important to achieve ecological sustainability. Most wildfires in this zone would be managed to meet resource objectives under specific conditions and when it could be done in a safe manner. Prescribed burning would be used here where it increases the opportunity to manage wildfires and restore fire-adapted ecosystems.

Managing Wildfire to Meet Resource Objectives

Draft forest plan direction would provide desired conditions and resource objectives that allow unplanned wildfire starts to be managed to meet resource objectives when it is safe to do so across the national forests. The conditions and opportunities to manage wildfires would vary by strategic fire management zone and plan direction would emphasize designing projects to reduce fuels in strategic locations to increase opportunities to manage unplanned wildfire starts in this way.

Smoke and Air Quality

Draft forest plan direction for prescribed fire and managing wildfires to meet resource objectives would emphasize considering the impacts of smoke locally and regionally.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Draft forest plan direction would incorporate the concepts of ecological restoration expressed in recent scientific publications such as "An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests" (North et al. 2009) and "Managing Sierra Nevada Forests" (North 2012). The draft forest plans create a management framework that allows an increase in the amount of restoration treatments using thinning, prescribed fire, and wildfires managed to meet resource objectives to make progress toward desired conditions across the landscape.

On the Sequoia and Sierra National Forests, this is accomplished in part by redefining the wildland-urban intermix defense and threat zones to the community wildfire protection zone and the general wildfire protection zone and shifting from a treatment strategy that used a pattern of disconnected strategically placed treatments across the landscape to a strategy using "focus landscape" treatments to enhance ecosystem resilience and restore heterogeneity more effectively in large landscape areas. Focus landscapes are defined during project planning as large areas generally from 10,000 to 80,000 acres in size where mechanical thinning and prescribed burning are strategically located to treat enough of the landscape to change potential wildfire behavior and to improve the resilience of vegetation within the landscape. Treatments would focus especially on areas most departed from vegetation desired conditions, typically drier sites that have grown denser than is sustainable. Focus landscapes would also emphasize areas where there is negative fire risk to highly valued resources and assets. Many of these areas overlap with portions of the community and general wildfire protection zones.

Focus landscapes would not apply on the Inyo National Forest. Proposed plan direction would emphasize mechanical thinning and prescribed burning around communities and recreation areas and other forested areas. On the Inyo National Forest, the draft forest plans increase emphasis on restoration of sagebrush ecosystems, especially to benefit the greater sage-grouse as described for "At-risk Species" on page 29.

Draft forest plan direction for all three national forests emphasizes treating along key roads and ridges and connecting natural openings like rock outcrops that can make it easier to implement larger prescribed burns and manage or suppress fires. Treatments would focus on drier sites near the roads and ridges where restoration would move vegetation toward desired conditions.

To address climate change, the draft forest plans include desired conditions and direction for improving resilience to climate change in all vegetation types. In subalpine and alpine systems there is additional direction that focuses on the unique threats that these usually long-lived and slow-growing ecosystems (such as bristlecone pine) face as temperature and precipitation patterns change. The draft plans include direction to manage for increased risk of insects and diseases and changed fire patterns and cycles in these ecosystems.

The draft forest plans add desired conditions for old forests, including the desired densities of large trees and large snags, and the desired proportion of the landscape that should be in old forest conditions. They include direction to increase the resilience of old forests and large or old trees to drought, climate change, and large, high-intensity wildfires, which acknowledges that the variation of forest types requires some flexibility in determining the best approach to improve resilience on the ground. The draft plans focus on managing for the key characteristics of ecological integrity for certain at-risk species such as the California spotted owl and Pacific fisher

with species-specific guidance to provide for habitat elements such as heterogeneity, snags, down logs, and large trees as important attributes of old forest structure.

Complex Early Seral Habitat

Alternative B would include plan components to provide for key characteristics that are important to the ecological integrity of complex early-seral habitats after large fires or in large areas where trees have been killed by drought, insects, pathogens, wind or other events. This includes desired conditions for complex habitat characteristics, wide-spread distribution of snags, logs, and live trees, while considering the need for other resource objectives such as hazard tree removal, reforestation, and strategic fuel treatments.

Wildlife and Plant Habitat Diversity

The draft forest plans adopt the approach to species management of providing for ecological diversity and ecological integrity of habitat as the primary means to ensure the persistence of most species. Like the existing plans, the draft forest plans contribute to the recovery of federally listed threatened and endangered species and do not jeopardize proposed or candidate species, including the incorporation of relevant provisions of the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016) and "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA FS 2015) in the form of plan components. Proposed objectives moderately increase restoration treatments to trend terrestrial habitat toward the desired conditions at a moderate pace. There is an increased emphasis on restoring fire as an ecosystem process in fire-adapted ecosystems with frequent fire-return intervals (in ponderosa and Jeffrey pine, and mixed conifer stands). Additional desired conditions for vegetation provides for increased habitat heterogeneity for multiple species at both the fine scale as well as at landscape scales. Specific desired conditions and guidelines for individual vegetation types, old forest, and sagebrush provide ecological integrity of habitat for multiple species.

Aquatic and Riparian Ecosystems

Proposed direction for riparian conservation areas and critical aquatic refuges is nearly identical to that contained in the existing plans, with the following changes. Some of the direction was changed to streamline and consolidate direction that is similar in nature; remove direction that repeats laws, regulations, or policies; drop the term "riparian conservation objectives" because of the potential for confusion with plan component "objectives;" and modify direction to allow prescribed burn ignitions and, where necessary, mechanical and hand treatments to restore ecological integrity and improve the resilience of riparian ecosystems to fire, drought, and climate change.

Critical Aquatic Refuges

The Inyo National Forest draft forest plan adds one additional critical aquatic refuge to their 17 existing refuges. The Sequoia National Forest will continue to manage their 6 existing critical aquatic refuges. The Sierra National Forest draft forest plan adds 11 critical aquatic refuges to their existing 7. The proposed additions are based on locations of at-risk aquatic species.

Watershed Resilience to Climate Change

The desired conditions for aquatic and riparian ecosystems in the draft forest plans recognize changes in temperature and precipitation related to climate change and other climate stressors on aquatic systems. Desired conditions are for restored vegetation conditions within watersheds, which in turn improves the quantity of water available to improve aquatic systems and to be

available for other uses. Draft forest plan direction emphasizes improving watershed resilience to wildfire and climate change by treating vegetation and reducing fuels over larger areas to lower the intensity of wildfires. Restoration emphasizes thinning to reduce the effects of past management that has resulted in very dense forests, and mitigating impacts from unmaintained roads when they impair watershed function.

At-risk Species

The 2012 Planning Rule defines two categories for at-risk species: (1) species that are federally recognized threatened, endangered, proposed, and candidate species; and (2) species of conservation concern. Species of conservation concern are native, are known to occur in the plan area, and are species with a substantial concern for their capability to persist over the long term in the plan area. The 2012 Planning Rule requires plan components to provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area.

As part of the plan revision process, coarse-filter plan components such as desired conditions were developed that describe the desired outcomes and conditions for terrestrial vegetation, riparian habitats and features, and aquatic habitats and features within the three national forests planning area. For most at-risk species, meeting and maintaining these desired conditions within the planning area and applying other standards or guidelines would help provide the habitat and key ecological conditions that would provide for their persistence and viability within the planning area. For a few species, additional species-specific plan components (desired conditions, standards, guidelines, and goals) were developed to better provide the habitats and key ecological conditions that provide for persistence and viability within the planning area.

The list of species of conservation concern identified by the Regional Forester for which the draft forest plan direction has been developed is described in the “Wildlife, Fish and Plants” section. Because the list of species of conservation concern is based on plant and animal species known to occur within each national forest, the list of species differs slightly between the three national forests.

California Spotted Owl (Sequoia and Sierra National Forests)

California spotted owl-specific plan direction in the draft forest plans for the Sequoia and Sierra National Forests is similar to the existing plans for protected activity centers and home range core areas. California spotted owl direction is removed from the Inyo forest plan since no California spotted owls occur on the Inyo National Forest. Updates have been made per the “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands” (USDA FS 2015) including the desired condition to reflect findings emphasizing vegetation heterogeneity. Management direction for focus landscapes was developed to address long-term habitat resilience. To reduce wildfire and insect and disease risks in current densely vegetated conditions, vegetation treatments may occur in up to one-third of spotted owl protected activity centers, focused on locations in dry vegetation types, while continuing to support species persistence. The existing plan direction to conduct surveys for California spotted owls and apply one-quarter-mile limited operating periods when breeding individuals are discovered is changed in the draft forest plans to guidelines that ensure adequate consideration is given to the effects of disturbance that might cause breeding failure. Vegetation treatments may also occur in protected activity centers in community buffers in the immediate vicinity of structures and along ridges and roads in the two wildfire protection zone management areas.

Pacific Fisher (Sequoia and Sierra National Forests)

Species-specific draft plan direction for the Pacific fisher includes incorporating the relevant findings and recommendations of the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016) on the Sequoia and Sierra National Forests. Specifically, plan direction would change from a strategy based on identification of a large southern Sierra fisher conservation area and den site buffers to a strategy that uses habitat and occupancy modeling to identify areas important to maintain and restore Pacific fisher habitat and to support a persistent population in the southern Sierra Nevada. The fisher conservation strategy area is based upon a refined analysis of habitat likely to contribute substantially to the Pacific fisher population over the next 15 to 30 years and approaches to increase habitat resilience and restore habitat quality (heterogeneity). Consistent with the fisher conservation strategy area findings, additional desired conditions and plan direction would be applied to two specific areas: 2,500-acre fisher target cells and fisher linkage areas. Direction for fisher den site buffers would be replaced by management of fisher denning habitat within larger occupied fisher habitat core areas.

Draft plan direction allows some departure from the fisher conservation strategy in community buffers immediately near structures and in focus landscape areas to meet long-term vegetation and habitat resilience objectives. Up to half of any suitable fisher target cell could be treated in these focus landscapes, provided that no more than one-third of the suitable fisher target cells are treated in any 10-year period. Outside of the focus landscapes or community buffers, no more than 13 percent of a fisher target cell could be treated in any 5-year period and plan direction would limit the extent of treatment in adjacent target cells. Currently unsuitable fisher target cells would be treated to move them to become suitable within three decades so there is a net increase in suitable habitat over time. Additional proposed plan direction emphasizes reducing other contributing sources of Pacific fisher mortality, especially risks associated with rodenticides and collisions with vehicles.

Bi-state Distinct Population Segment of Greater Sage-grouse (Inyo National Forest)

Species-specific plan direction is added for the bi-state distinct population segment of greater sage-grouse on the Inyo National Forest. The proposed plan direction is based on the existing "Inyo National Forest Sage-Grouse Interim Management Policy" and, where appropriate, additional management direction has been developed consistent with the "Humboldt-Toiyabe National Forest Greater Sage Grouse Bi-State Distinct Population Segment Forest Plan Amendment." The draft Inyo forest plan also includes management direction and emphasize management actions that are consistent with the "Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment." There would be more acres of treatments allowed to remove encroaching pinyon-juniper within sage-grouse habitat than what is allowed in the existing Inyo forest plan.

Yosemite Toad (Inyo and Sierra National Forests)

Species-specific proposed plan direction for Yosemite toad is similar to what is in the existing plans for the Inyo and Sierra National Forests. This species does not occur on the Sequoia National Forest.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

Recreation opportunity spectrum classes have been updated and the management approach for recreation settings is integrated with ecological restoration approaches. The draft forest plans include desired conditions to manage developed recreation sites for ecological, social, and economic sustainability and an objective for fuel treatment restoration activities to protect recreation site infrastructure. Management of opportunities, sites and infrastructure are adjusted to respond to changing demographics, budgets and deferred maintenance, as well as climate change.

Scenery

The draft forest plan direction identifies scenic integrity objectives for the plan areas using the Scenery Management System. Scenery setting management would be integrated with ecological integrity and restoration to improve scenic character stability within the desired landscape character. The draft forest plans include plan components that require desired scenic integrity objectives be considered in the design of restoration projects.

Recommended Wilderness

Alternative B would make a preliminary administrative recommendation to include four additional areas in the National Wilderness Preservation System on the Inyo National Forest (South Sierra; Piper Mountain Addition; White Mountains East; and White Mountains West). These are also referred to as “recommended wilderness areas.” All four areas are adjacent to existing designated wilderness area boundaries and total 37,039 acres. No additional areas would be recommended on the Sequoia or Sierra National Forests.

Pacific Crest Trail

The draft forest plans would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor of the visual foreground landscape zone (up to one-half mile from the centerline of the trail where visibility is not obscured by terrain) as defined by the Scenery Management System. Management area-specific desired conditions, standards, and guidelines and a management approach would be included to protect the nature, purposes, and resource values of the trail from degradation by activities and development.

Alternative C

Alternative C emphasizes wilderness values and a passive management approach to restore fire as an ecosystem process, primarily using prescribed fire and natural disturbance processes (such as managing wildfire for resource benefit) to achieve landscape-level desired conditions.

Alternative C was developed to address concerns about whether the draft forest plans provide adequate short-term protections for wildlife habitat. It includes direction to minimize the effects of treatment on habitats by preserving specific structural components such as large trees and canopy cover for the California spotted owl and Pacific fisher consistent with the findings and recommendations set forth in the “Southern Sierra Nevada Fisher Conservation Strategy” and the “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands”. This direction is also consistent with the findings and recommendations for Sierra marten in the Climate Change Adaptation Strategies for Focal Resources of the Sierra Nevada. Like alternative A, this alternative’s plan direction would

emphasize minimal active management in fisher and owl habitat to address restoration needs. In some cases, the prescriptive plan direction for one species limits the extent of achieving the desired condition for another species, as the most restrictive direction is applied to projects. Like alternative B, alternative C includes plan components for conserving key characteristics associated with the ecological integrity for post-fire, complex early seral habitat. Also, additional critical aquatic refuges are identified around areas of high aquatic species diversity.

Revision Topic 1: Fire Management

Strategic Fire Management Zones

In alternative C, the fire management zones would retain the distance-based wildland-urban intermix defense zone around communities from the existing plans and would have the same risk-based wildfire maintenance zone as alternative B. The remainder of the forest would be called the general wildfire zone. (See chapter 3, page 99 for a map and more information, and volume 3 for maps of the strategic fire management zones in each national forest.)

- Similar to the existing plans, the **wildland-urban intermix defense zone**, closest to communities, would remain a high priority for hazardous fuel reduction treatment to reduce the intensity of wildfires in these areas while avoiding or minimizing mechanical thinning treatments in habitats for the spotted owl and fisher. Maintenance treatments using prescribed fire instead of mechanical treatments would be the preferred management method whenever possible.
- Similar to the draft plans in alternative B, the **wildfire maintenance zone**, identifies areas with very low risk based on modeling potential spread and intensity of wildfires that pose mostly a positive effect to resources. In this zone, restoring the role of fire is important to achieve ecological sustainability and most wildfires in this zone would be managed to meet resource objectives under specific conditions and when it could be done in a safe manner. Prescribed burning would be used here where it increases the opportunity to manage wildfires and restore fire-adapted ecosystems.
- The remainder of the forest would be the **general wildfire zone** and would be managed to meet resource objectives the same as the wildfire maintenance zone in alternative B. Wildfires that occur in the general wildfire zone where fuel conditions are close to desired conditions may be managed to meet resource objectives when conditions allow and when it could be done in a safe manner. There would be less strategic treatment using mechanical methods as a precursor to larger prescribed burns.

Managing Wildfire to Meet Resource Objectives

Like alternative B, alternative C would provide desired conditions and resource objectives that allow wildfires to be managed to meet resource objectives when it is safe to do so across the national forests. The conditions and opportunities to manage wildfires would vary by strategic fire management zone, and plan direction for the wildfire maintenance zone would be the same as for alternative B. Species-specific plan direction to provide for habitat conditions for certain wildlife species would override direction for strategic treatments designed to increase the opportunity to manage wildfires to meet resource objectives.

Smoke and Air Quality

Alternative C would include the same guidance for designing projects to minimize the impacts of smoke on communities as alternative B.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Alternative C is designed to manage the forest landscape to minimize short-term impacts on habitats from management activities while accepting the risk of large high-intensity wildfires that could affect mature and old forests. Alternative C focuses vegetation and fuel reduction treatments within the wildland-urban intermix defense zone and seeks to restore vegetation desired conditions in the larger landscape with limited, strategic use of mechanical thinning and a heavier emphasis on the use of prescribed fire and wildfire managed primarily for resource objectives where safe and consistent with desired conditions. Alternative C would not use the focused landscapes approach described in alternatives B and D.

Alternative C would include additional plan components for the California spotted owl, Sierra marten, and Pacific fisher to incorporate relevant provisions of the California spotted owl interim recommendations, fisher conservation strategy, and Climate Change Adaptation Strategies for Focal Resources of the Sierra Nevada, which would limit the application of mechanical treatment to address vegetation resilience. This would include standards and guidelines that prohibit treatments in spotted owl protected activity centers and prohibit mechanical treatment with designated owl habitat unless there are short-term benefits to owls. It would establish diameter limits for harvest and require retaining certain levels of tree canopy cover and certain levels of understory cover for vegetation treatment projects, especially within important habitat areas for Pacific fisher and California spotted owl. These standards and guidelines would emphasize reducing the risk of short-term impacts to wildlife species that use larger and denser canopied forests, prioritizing these species needs over other resource management objectives. There is an emphasis on maintaining connectivity of dense canopied forests throughout the montane and upper montane landscapes. Alternative C would allow mechanical fuel reduction on areas outside of important habitat areas for the California spotted owl and outside of habitat areas important to the Pacific fisher to address concerns related to large high-intensity wildfires.

Like alternative B, alternative C adds desired conditions for old forests, including the desired densities of large trees and large snags, and the desired proportion of the landscape that should be in old forest conditions. It includes direction to increase the resilience of old forests and large or old trees important to wildlife habitats to drought, climate change, and large, high-intensity wildfires by restoring landscape heterogeneity that emulates patchy habitat that results from active, low- to mixed-severity wildfire.

Complex Early Seral Habitat

Like alternative B, alternative C would include plan components to provide key characteristics that contribute to the ecological integrity of complex early-seral habitats after large fires. However, alternative C would generally limit post-fire management to cutting burned trees that are a hazard to people and leaving them in place unless they pose a substantial hazard as downed logs. Direction in alternative C would vary from alternative B to leave most burned areas to recover naturally with no direct management action (no planting), even after very large fires. Where possible, efforts to treat half of the burned areas with prescribed fire would be planned 10 years after the initial fire to reduce accumulations of fuels and to maintain a frequent fire interval as a part of forest succession.

Wildlife and Plant Habitat Diversity

Desired conditions and other plan components for California spotted owl and Pacific fisher habitat would result in landscape conditions in the upper end of the moist mixed-conifer vegetation desired conditions. This is in contrast to alternative B and D which would strive for desired conditions within the natural range of variation for all habitat types. Prescribed burning would be the preferred method of treatment.

Aquatic and Riparian Ecosystems

Proposed direction for riparian conservation areas and critical aquatic refuges is nearly identical to that contained in alternative B, with the following changes.

Critical Aquatic Refuges

Alternative C would add the most critical aquatic refuges of all alternatives. There would be 8 new critical aquatic refuges on the Inyo National Forest, 2 on the Sequoia National Forest, and 27 on the Sierra National Forest. Management direction would be the same as in alternative B.

Watershed Resilience to Climate Change

Alternative C would differ from alternative B because it would not modify current direction to allow prescribed fire ignitions and, where necessary, mechanical treatments within riparian conservation areas. Alternative C would allow prescribed fire in riparian areas where it was historically prevalent to restore desired fuel conditions, to the extent it could occur with limited or no mechanical preparation.

At-risk Species

Alternative C emphasizes reducing the short-term consequences of restoration treatments to wildlife. For wildlife associated with old forests, as described in revision topic 1, it emphasizes retaining larger sized trees, minimizing reductions in forests with existing dense canopy cover, and retaining habitat elements such as high densities of large snags and downed logs, and retaining larger trees with cavities or deformities that can be used for nests or dens across the landscape.

California Spotted Owl (Sequoia and Sierra National Forests)

Draft species-specific plan direction in alternative C for the California spotted owl incorporates the relevant “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands” (USDA FS 2015). There are currently no California spotted owls on the Inyo National Forest so this alternative provides no specific plan direction for the California spotted owl there.

Several specific changes would be made from the current direction in the existing forest plans and are only included in alternative C. In particular, the current strategy based on two habitat zones (the protected activity center and home range core area) would be changed to a strategy based on four zones: protected activity center, territory, home range area, and landscape, with all designated habitat areas only on National Forest System lands.

- The **protected activity center** would be delineated similar to the current protected activity center, and would be a 300-acre area of the highest quality nesting habitat surrounding the best location detected for a territorial or presumed territorial spotted owl.

- The **territory** would be somewhat analogous to the current home range core area and it would provide additional nesting and foraging habitat within an 800-acre circular area surrounding the activity center that would be assumed to be used exclusively and not shared with adjacent owls.
- The **home range area** would provide for some additional suitable habitat within a 1.5-mile circle surrounding the activity center.
- Additional vegetation management direction for mature forest habitat in the **broader landscape** outside of the three main zones for the California spotted owl would be included to more intensively evaluate habitat at 10,000 to 30,000-acre subwatershed scales when planning projects to better define habitat restoration opportunities for designated spotted owl habitats.

Mechanical treatments would generally be prohibited within designated owl habitats (protected activity centers, territories, and home range areas) but hand treatments and protection of nest and roost trees would be allowed when preparing for prescribed burning. In all four areas, there would be desired conditions to maintain and restore specific levels of closed-canopied mature forest. There would continue to be standards for retention of all large trees 30 inches in diameter or greater, as well as pines 27 inches in diameter or greater. This is also consistent with the fisher conservation strategy (see below).

Fisher (Sequoia and Sierra National Forests)

Like alternative B, species-specific plan direction for the Pacific fisher in alternative C would include incorporating the relevant findings and recommendations of the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016). Alternative C would use the same fisher strategy area, fisher target habitat, linkage areas, fisher core areas, and suitable fisher target cells described for alternative B. However, alternative C would include longer limited operating periods and treatment would be limited to less than 13 percent of suitable fisher target cells within any given 5-year period. There would be no exceptions to rendering adjacent fisher target cells unsuitable at the same time, as allowed in the focus landscapes of alternative B and D. Currently unsuitable fisher target cells would be treated so they could become suitable within three decades similar to alternative B. Like alternative B, additional plan components would emphasize reducing other contributing sources of fisher mortality, especially risks associated with rodenticides and collisions with vehicles.

Unlike alternative B, there would be no revised plan direction to allow departure from the fisher conservation strategy near communities and structures and in focus landscape areas to meet long-term vegetation and habitat resilience objectives. (As described earlier in this section, alternative C does not incorporate focus landscapes.) There would be standards for retention of all large trees greater than 30 inches diameter and greater than 27 inches diameter for pine trees in all areas. This is in contrast to alternative B where desired conditions for large trees are emphasized in the wildfire protection zones and there are no diameter limits.

Bi-state Distinct Population Segment of Greater Sage-grouse (Inyo National Forest)

Species-specific plan direction would be added for the bi-state distinct population segment of greater sage-grouse on the Inyo National Forest the same as alternative B, except the objective for acres of sage-grouse habitat maintained, improved, or restored would be increased slightly. This increase is due to less competition for funding resources with other ecological restoration projects as a result of increased restrictions on mechanical thinning to provide for the Sierra marten.

Yosemite Toad (Inyo and Sierra National Forests)

Species-specific proposed plan direction for Yosemite toad is the same as alternative B.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

The range of recreation opportunity spectrum classes would shift with larger areas allocated to primitive and semi-primitive nonmotorized recreation settings and less area allocated to motorized recreation settings in alternative C.

Scenery

Alternative C uses the same Scenery Management System as described for the draft forest plans. The emphasis on improving scenic character stability would be tempered by plan direction to maintain and improve denser forests conditions for California spotted owl and Pacific fisher, which accepts the risk of some effects to scenic stability from large wildfires.

Recommended Wilderness

Alternative C would make a preliminary administrative recommendation to include the following areas in the National Wilderness Preservation System:

- On the Inyo National Forest 24 areas totaling 315,531 acres would be recommended. This would include nine areas (70,278 acres) adjacent to existing designated wilderness and 15 areas (245,253 acres) that are not.
- On the Sequoia National Forest 18 areas totaling 206,904 acres would be recommended. This would include 11 areas (86,105 acres) adjacent to existing designated wilderness and seven areas (120,799 acres) that are not.
- On the Sierra National Forest 17 areas totaling 220,641 acres would be recommended. This would include 12 areas (133,943 acres) adjacent to existing designated wilderness and five areas (86,698 acres) that are not.

Pacific Crest Trail

Alternative C would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor that includes the same visible foreground (up to one-half mile of centerline of the trail where visibility is not obscured by terrain) of alternative B and also includes lands inventoried as “Scenic Attractiveness A” in the Scenery Management System within the trail’s viewshed. The plan direction assigned to the corridor would be the same as alternative B.

Alternative D

Alternative D includes an emphasis on an increased pace and scale of restoration in response to the issues of improving resilience to fire, drought, climate change, insects, and diseases, while enhancing economic and social sustainability. Like alternative B, it emphasizes long-term habitat conservation, accepting that short-term impacts to species associated with dense forests would be offset by reducing the risk of habitat damage or loss from large high-intensity wildfire. However, alternative D includes additional focus landscapes, eliminates diameter limits, and expands operating periods to allow more active management to move vegetation toward desired conditions more than the draft forest plans. It emphasizes additional mechanical treatment on strategic

ridgetops, roads, and other natural and manmade features, and adjacent areas to increase the amount of landscape-scale prescribed burning to restore fire in the ecosystem.

Revision Topic 1: Fire Management

Strategic Fire Management Zones

Alternative D uses the same strategic fire management zones and similar direction as the draft forest plans of alternative B. Although desired conditions for old forest conditions would be the same, there would be no diameter limits for removing large trees across all three national forests, in contrast to alternative B where diameter limits do not apply in the community and general wildfire protection zones but apply elsewhere. (See chapter 3, page 98 for a map and more information, and volume 3 for maps of the strategic fire management zones in each national forest.)

Managing Wildfire to Meet Resource Objectives

Alternative D uses the same approach as alternative B to emphasize an increased management of wildfires to meet resource objectives when it is safe to do so. More areas are designed and treated using mechanical treatments and prescribed burning to create more opportunities to manage wildfires to meet resource objectives safely.

Smoke and Air Quality

The emphasis for managing wildfires to meet resource objectives would consider the impacts of smoke locally and regionally as in alternative B. However, the additional opportunity for pre-treating areas prior to prescribed burning and additional focus areas treated to trend toward desired vegetation conditions would reduce the potential for community smoke impacts from uncharacteristic wildfire.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Alternative D is very similar to the draft forest plans except it doubles the pace and scale of restoration to have a greater likelihood of reducing the impact of future high-intensity wildfires. It uses the same landscape strategies and approaches as the draft forest plans with the following changes:

- Alternative D emphasizes the strategic use of mechanical treatments where it is physically and economically feasible to facilitate greater management of wildfire to a greater extent than the draft forest plans—both the active use in prescribed burning at greater landscape scales as well as through managing wildfires to meet resource objectives when conditions allow and when it can be done in a safe manner. There is more emphasis on strategic treatment of ridgetops and along strategic road locations in the wildfire restoration zone that would facilitate more landscape prescribed burning and serve as anchor points for managing wildfires to meet resource objectives.
- On the Sequoia and Sierra National Forests, there would be more focus landscapes treated than in the draft forest plans, increasing the concentrated area where fuels would be reduced, which would have the potential to influence future fire behavior on the landscape.

These focus landscape treatments would be designed to move toward vegetation desired conditions and to improve the resilience of treated stands to insects and disease, especially associated with drought and climate change. On the Inyo National Forest, there would be more areas treated than in the draft plans.

- Like the draft forest plans, there would be more emphasis on providing variability within tree patches during treatments to increase heterogeneity and increasing resilience to drought.

Alternative D would manage old forests the same as the draft forest plans, focusing on increasing the resilience of existing areas with old forest conditions and emphasizing landscapes that meet desired composition of seral stages and include old forest components throughout.

Alternative D retains similar direction as the draft forest plans for the management of burned areas following a large fire, except it increases the emphasis on salvage for economic return and reforestation of portions of large fires that burn at high severity. This includes desired conditions for reforestation when needed to address sustainability of forests given the length of time it could take to reestablish forests dominated by large and old trees with natural reforestation, forest connectivity, and species composition and seed sources considering climate change.

Complex Early Seral Habitat

Like the draft forest plans, alternative D would include plan components to provide for the key characteristics that provide for the ecological integrity of complex early seral habitats after large fires. This includes desired conditions for complex habitat characteristics, wide-spread distribution of snags, logs, and live trees while considering the need for other resource objectives such as hazard tree removal, reforestation, and strategic fuel treatments. Alternative D would emphasize economic recovery of burned forest while still contributing to desired conditions for this habitat.

Wildlife and Plant Habitat Diversity

Alternative D incorporates the same direction regarding at-risk species as the draft forest plans; however, plan direction emphasizes restoring enough area across the landscape to increase climate adaptation, and reduce the risk of large, high-intensity wildfires to important at-risk wildlife species habitat, while also continuing to manage a portion of the landscape as high-quality habitat for at-risk species. This alternative accepts some short-term risk to species to manage more areas for vegetation desired conditions to provide for greater sustainability of habitats over time. Alternative D focuses on the long recovery time for habitats of many at-risk species and is designed to lessen the rate of habitats adversely affected by large high-intensity wildfires. Restoration treatments would occur at an increased level sufficient to trend terrestrial habitat toward the desired conditions at a moderate to high pace.

Aquatic and Riparian Ecosystems

Critical Aquatic Refuges

Alternative D includes the same direction for riparian conservation areas and critical aquatic refuges as the draft forest plans.

Watershed Resilience to Climate Change

Alternative D incorporates the same aquatic management strategy direction as the draft forest plans. Maintenance and restoration would occur on more roads due to the increased area of

restoration treatments and increased stewardship opportunity. Restoration would emphasize reducing the legacy effects of past management that continue to degrade watershed function, especially reducing or eliminating sediment risks from roads and restoring hydrologic connectivity of habitat for amphibians and fish.

At-risk Species

Plan direction for species of conversation concern would be the same as the draft forest plans.

California Spotted Owl (Sequoia and Sierra National Forests)

Direction would be the same as the draft forest plans except:

- The one-quarter-mile limited operating period would allow activities after June 1 for portions outside of the protected activity center to increase the number of days where restoration activities can occur during the summer.
- The limited operating period would also allow more early-season prescribed burning within and adjacent to spotted owl protected activity centers.

Pacific Fisher (Sequoia and Sierra National Forests)

Direction would be the same as the draft forest plans to allow up to 50 percent of a fisher target cell to be treated within focus landscapes or community buffers, except the total number of suitable fisher target cells that could be treated to this extent within a 10-year period would increase from no more than one-third to no more than one-half of all suitable fisher target cells.

Bi-State Distinct Population Segment of Greater Sage-grouse (Inyo National Forest)

Like alternative B, species-specific plan direction is added for the bi-state distinct population segment of greater sage-grouse on the Inyo National Forest, except the objective for acres of sage-grouse habitat maintained, improved, or restored is increased the same as alternative C. This increase is due to increased stewardship funding opportunities and an increase in landscape-scale restoration treatments overall.

Yosemite Toad (Inyo and Sierra National Forests)

The standards and guidelines that exclude livestock grazing within areas occupied by Yosemite toads during the breeding and rearing season, except where a site-specific management plan is developed would change to a new system to determine appropriate management strategies. In the new system, either a known Yosemite toad occupied site, designated critical habitat, or the results of an empirically derived occupancy probability model would be used in combination with meadow habitat conditions to guide a matrix of grazing management strategies. These strategies would range from no grazing to the current forestwide grazing standards in alternative A.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

The range of recreation opportunity spectrum classes would shift with fewer areas allocated to primitive and semi-primitive nonmotorized recreation settings and more area allocated to motorized recreation settings in alternative D. Improvements in recreation settings would be associated with larger treatment areas to improve landscape resilience to fire and climate change rather than emphasizing treatments around individual sites and infrastructure.

Scenery

Alternative D uses the same Scenery Management System as described for the draft forest plans.

Recommended Wilderness

Alternative D would not make any additional preliminary administrative recommendations to the National Wilderness Preservation System.

Pacific Crest Trail

Alternative D would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor 1/4 mile from the centerline of the trail. The plan direction assigned to the corridor would be the same as the draft forest plans.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by the National Environmental Policy Act to rigorously explore and objectively evaluate reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received during the plan revision process provided suggestions for the proposed revised plan. Some of these suggestions may not have been part of identified needs for change, were duplicative of the alternatives considered in detail, or were determined to contain components that would cause unnecessary environmental harm.

A number of alternatives were considered, but dismissed from detailed consideration for reasons as summarized in the following paragraphs.

Alternative Eliminated 1:
Restore over half of the landscape within 10 to 15 years

An alternative was suggested that uses substantially more active vegetation management including thinning, selective harvest, and prescribed fire to restore forest resilience to fire, drought, insect and pathogen outbreaks, and climate change as quickly as possible. This alternative was not considered in detail because it would require more workforce and budget than is feasible for the agency given budgets received in recent years. More than half of the landscape on the three national forests is within special designated areas such as wilderness, monuments or wild and scenic river corridors that limit or prohibit the use of mechanical equipment. Another 25 percent of the national forests have limitations on roaded access, such as inventoried roadless areas, which limit getting equipment into areas as well as making it difficult to transport staff or workers into these areas by motor vehicles.

There are areas of particularly steep grades where restoration using equipment can be difficult as it must be designed to avoid causing unacceptable ecological damage due to accelerated erosion risks. There are other areas where sensitive ecological conditions and endangered species require restraint and caution in the amount of treatment and the rapidity of that treatment. Scientific knowledge is continuing to provide new insights into the biology of at-risk species in these forests and there is a concern about balancing rapid change in habitat from active management with changes in habitat that may occur without treatment in terms of the consequences to wildlife.

Another limitation to rapid restoration related to forest thinning is the capacity of industry to do the work and use materials. Currently there is a limited infrastructure to process the timber resulting from restoration efforts. If restoration outpaces infrastructure capacity then the Forest Service costs increase and the agency's capability to fund restoration will decrease. Therefore there is a limitation on the capability of the Forest Service to restore forests that is directly related to the limited capacity of the industry infrastructure.

The alternatives being considered increase the use of prescribed fire over current levels and recognize there are limits imposed by air quality restrictions, current forest conditions and forest capacity and resources to conduct more prescribed burning. Smoke and its impact on the health of rural communities is also a concern and can be a limitation on the number and acres and timing of prescribed burning.

One of the identified needs for plan revision is "to improve recreation facilities, settings, opportunities and access and their sustainability." Although it is true that rapidly addressing landscape restoration will contribute toward long-term recreation sustainability, during the time of rapid restoration there would be a great impact on recreation and the recreation experience, whether it would be from more smoke or fire on the landscape from prescribed fire, more crews and big trucks, or closed and restricted access to campgrounds while tree cutting and equipment operations are going on. The proposed level of restoration would limit the ability to meet the purpose and need for recreation as access and recreation opportunity would be substantially diminished during the plan period.

Alternatives B and D increase the amount of restoration but the amount would still affect only about 20 to 40 percent of the treatable portions of the national forests per decade. The amount of restoration accomplished by managing wildfires to meet resource benefits would increase this, but it is entirely dependent upon actual wildfires that can only be estimated and not planned. It is expected that this pace may adjust in the future if capacity for active management increases.

Alternative Eliminated 2:
Include all areas identified by the public as recommendations for additions to the National Wilderness Preservation System

Various groups and individuals submitted feedback specific to the wilderness inventory and evaluation processes, suggesting additional areas that should be included in the preliminary administrative recommendations for additions to the National Wilderness Preservation System. These areas were considered during the inventory and evaluation following the 2012 Planning Rule and associated implementation directives as described in appendix B.

Forest Supervisors used the wilderness evaluation narratives and public input to identify which specific areas, or portions thereof, to carry forward into the draft environmental impact statement analysis in one or more alternatives as recommended wilderness. Although many areas suggested by the public were brought forward for analysis in alternatives B and C, not all lands included in the inventory or suggested by the public were analyzed in detail because we determined they lack wilderness characteristics, had substantially noticeable human impacts, represented a departure from apparent naturalness due to improvements, had pervasive impacts that would influence a visitor's opportunity for solitude including pervasive sights and sounds from outside the area, or were determined to be unmanageable to preserve their wilderness characteristics. In particular, areas with motor vehicle designations from recent travel management decisions were considered but then excluded from polygon boundaries carried forward for analysis in the draft

environmental impact statement. See appendix B for the full description of the inventory, evaluation, and analysis processes and findings.

Alternative Eliminated 3:
Identify critical aquatic refuges around all areas of high aquatic species diversity

An alternative was suggested that identifies areas of high aquatic species diversity and recommended these areas be delineated and managed as critical aquatic refuges. This proposal identified 58 areas across the three national forests, 15 on the Inyo National Forest, 7 on the Sequoia National Forest, and 36 on the Sierra National Forest. These areas were evaluated by staff at each national forest and all but 21 areas were included in at least one alternative considered in detail. Of the 21 areas not included, 7 are on the Inyo National Forest, 5 are on the Sequoia National Forest, and 9 are on the Sierra National Forest. These areas were not included because they were either a proposed expansion that would not substantially increase the habitat protection of the existing critical aquatic refuge, were in portions of the national forest with a complex land ownership pattern, were located primarily on lands owned or managed by others, were identified for terrestrial and not aquatic species, or were already within watersheds that are a priority for maintenance or restoration. The evaluation of each area recommended for consideration as a critical aquatic refuge is included in the project record. Since these additional proposed critical aquatic refuges would not increase habitat protection, including all of them in an alternative would have substantially similar effects as alternative C and therefore adding them as part of an alternative was not necessary.

Alternative Eliminated 4:
Evaluate an alternative that has minimal active management and “let nature take its course”

An alternative was suggested that has minimal active management of vegetation and allows nature to take its course in shaping the vegetation and conditions in the forest. It was suggested that wildfires would reduce built up fuels and regenerate forests while creating early seral habitats for species that depend upon them. It was also suggested that natural mortality would thin weakened trees leaving more resources for the remaining trees and vegetation.

However, this type of “hands-off” approach is contrary to the best available science that recommends restoration efforts for many of the ecosystems that are outside their natural range of variation on the three national forests. Alternatives B, C, and D address long-term vegetation health in the desired condition statements of how the various vegetation types on the three national forests should look and function. Management action is necessary to trend these ecosystems toward the desired conditions and strengthen ecosystem resilience in the face of expected climate changes in the western United States.

This alternative also would not meet the requirements of the 2012 Planning Rule, which requires plans to be developed that are ecologically, socially, and economically sustainable. Nor would this alternative achieve various aspects of the purpose and need. For example this alternative would not:

- improve ecosystem resilience to fire and climate change;
- decrease the threat of large, undesirable fires;

- increase the ability of forests to store and sequester carbon;
- improve ecological conditions for the California spotted owl and restore and maintaining greater sage grouse habitat on the Inyo National Forest;
- support local economies by maintaining levels of forest product and biomass production that support an economically-viable forest products industry, and encourages local hiring;
- support economic opportunities in tribal communities; incorporate traditional ecological knowledge; and increase collaboration with the agency to meet restoration goals; or
- improve recreation facilities or improve and protect scenic character.

Because this alternative is not in alignment with the best available science of the best methods of achieving desired conditions and it does not meet the stated needs for revision it was not analyzed in detail.

Alternative Eliminated 5:
Apply the Aquatic Conservation Strategy from the 2001 Sierra Nevada Forest Plan Amendment

An alternative was suggested that requested that the revised plans incorporate the aquatic conservation strategy from the 2001 Sierra Nevada Forest Plan Amendment (USDA FS 2001) as plan direction. The fundamental principle of the 2001 Sierra Nevada Forest Plan Amendment aquatic management strategy was "to retain, restore, and protect the processes and landforms that provide habitat for aquatic and riparian-dependent organisms, and produce and deliver high-quality waters for which the national forests were established." In order for the aquatic management strategy to function as a comprehensive strategy there are a suite of interrelated actions that work together to manage and conserve aquatic habitats. These actions include:

- a description of the desired condition of aquatic, riparian, and meadow habitats developed from the aquatic management strategy goals;
- an array of land allocations (such as critical aquatic refuges and riparian areas) that delineate aquatic, riparian, and meadow habitats and emphasize specific actions in these areas;
- a set of standards and guidelines that specify appropriate land uses and activities within different land allocations;
- ecosystem analysis that enables managers to collect and evaluate relevant data and information over nested geographic zones (such as watersheds within river basins) for the purpose of considering current landscape conditions and results in appropriate, site-specific management decisions, including restoration of degraded areas; and
- adaptive management program that includes monitoring and research activities intended to assess planned management activities and provide information needed to adjust future management activities, as appropriate.

The 2001 Sierra Nevada Forest Plan Amendment aquatic management strategy was incorporated into the 2004 Sierra Nevada Forest Plan Amendment (USDA FS 2004), which amended the existing forest plans with only a few changes directed at clarifications and simplifications to eliminate repetition of law, regulation, and policy in forest plan direction. These changes were analyzed in the 2004 Sierra Nevada Forest Plan Amendment. Therefore, the essential components of the original 2001 aquatic management strategy are included in alternative A.

Alternative Eliminated 6:
Consider the document "National Forests in the Sierra Nevada: A Conservation Strategy" as an Alternative

A group of respondents submitted a Conservation Strategy for National Forests in the Sierra Nevada with the request that it be analyzed as an alternative in detail. The Conservation Strategy contains several concepts and strategies related to sustainability and resilience of forests within the Sierra Nevada. Some of these concepts are already in place under the current forest plans (such as community fire planning, various collaborative efforts, and completion of travel analysis), some will be incorporated into the planning process and documents (such as a science consistency review will be conducted before the final environmental impact statement is prepared), and others are largely consistent with the draft forest plans. In most instances where the draft forest plans are not in agreement with the Conservation Strategy, concepts and direction similar to those in the Conservation Strategy are included as part of another alternative (C or D) that was analyzed in detail.

The Multiple Use Sustained Yield Act[14] states "it is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes." Similarly, the 2012 planning regulations require that plans "provide for social, economic, and ecological sustainability."[15] This is accomplished by including plan components, including standards and guidelines, "to guide the plan area's contribution to social and economic sustainability."[16] While the Conservation Strategy would meet many of the requirements for ecological sustainability, it does not adequately meet the requirements of the Multiple Use Sustained Yield Act or the Planning Rule requirements for social and economic sustainability because it does not include plan components for sustainable recreation, range, timber and other renewable and nonrenewable energy and mineral resources.

For these reasons, we concluded that a detailed analysis of an alternative based on the Conservation Strategy was not needed.

Alternative Eliminated 7:
Allow Existing Motorized and Mechanized Uses to Continue in Recommended Wilderness

Public feedback on the recommended wilderness inventory and evaluation asked the Forest Service to consider an alternative that allowed existing motorized and mechanized recreation activities to continue in recommended wilderness areas. Although Forest Service policy does allow decisionmakers to consider allowing existing uses to continue, they can do so "only if such uses do not prevent the protection and maintenance of the social and ecological characteristics that provide the basis for wilderness designation."[17] Cole and Hall (2009) found that by controlling the setting (environmental, social, and managerial conditions), managers influence the nature and quality of [wilderness] experiences to a substantial degree. Thus, this environmental impact statement assesses the impacts of forest management that may impact recommended areas' inherent wilderness characteristics (undeveloped, naturalness, opportunity to provide

[14] Public Law 86-517
[15] 36 CFR 219.8
[16] 36 CFR 219.8 (b)
[17] Forest Service Handbook 1909.12, chapter 74.1

primitive and unconfined recreation, and natural ecosystem) that could detract from future consideration of the area as wilderness.

The use of motorized and mechanized transportation in recommended wilderness areas affects the wilderness characteristic of undeveloped settings where wilderness is essentially without permanent improvements or modern human occupation. In addition, the use of motorized and mechanized transport is not compatible with the desired condition of a primitive recreation opportunity, which, specifically in designated wilderness, has largely been interpreted as travel by horse, foot, and canoe (Landres et al. 2005). Also the presence, volume, and type of other users and the sounds and smells associated with motorized vehicles have all been identified by the public as affecting the personal subjective sense of solitude.

Some forests have taken a management approach to allow motorized and mechanized transportation to continue in recommended wilderness areas as long as the ecological and social characteristics were protected and maintained. However, this requires monitoring of a number of factors including level of existing use at the time of recommendation, levels of use over time (increase, decrease, or neutral), and the effects of the continued use on wilderness character over time. This is a challenging monitoring effort in a fiscally constrained environment.

Because of the potential impacts to wilderness character, which may prevent the protection and maintenance of the social and ecological characteristics that provide the basis for future wilderness designation, and the difficulty of monitoring continued motorized and mechanized uses in recommended wilderness, this alternative was eliminated for detailed analysis.

Comparison of Alternatives

This section compares how the alternatives are different with respect to the issues to be resolved and their key indicators and management areas. In addition, forest plan objectives are also compared across alternatives.[18]

Comparison of Management Areas by Alternative

Table 1, Table 2 and Table 3 describe management areas or designated areas applicable by alternative for each of the three national forests. In alternative A, areas with specific plan components were called land allocations, which is the equivalent to the 2012 Planning Rule definition for a management area. The management areas for wilderness, wild and scenic rivers, and the Pacific Crest National Scenic Trail are also designated areas. For other designated areas see Table 4.

[18] Note: For the Sequoia National Forest, all tables in this section refer to the portion of the national forest outside of the Giant Sequoia National Monument.

Table 1. Management areas by alternative, Inyo National Forest

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
Wildland-urban Intermix Defense Zone (acres)	22,031	0	22,031	0
Wildland-urban intermix Threat Zone (acres)	191,843	0	0	0
Community Wildfire Protection Zone (acres)	0	170,987	0	170,987
General Wildfire Protection Zone (acres)	0	372,312	0	372,312
Wildfire Restoration Zone (acres)	0	570,235	0	570,235
General Wildfire Zone (acres)	0	0	1,016,668	0
Wildfire Maintenance Zone (acres)	0	870,419	945,253	870,419
Designated Wilderness (acres)	967,039	967,039	967,039	967,039
Existing Recommended Wilderness (acres)	0	0	0	0
New Recommended Wilderness (acres)	0	37,029	315,531	0
Designated Wild and Scenic Rivers (miles)	17.4	17.4	17.4	17.4
Existing Recommended Wild and Scenic Rivers (miles)	0	0	0	0
Existing Eligible and Recommended Wild and Scenic Rivers (miles)	128.3	128.3	128.3	128.3
New Eligible and Recommended Wild and Scenic Rivers (miles)	0	159.8	159.8	159.8
Pacific Crest National Scenic Trail (miles)	86	86	86	86
Pacific Crest National Scenic Trail Management Area (acres)	116	39,973	130,350	22,052
Critical Aquatic Refuges (acres)	170,600	191,567	322,518	191,567

Table 2. Management areas by alternative, Sequoia National Forest

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
Wildland-urban Intermix Defense Zone (acres)	18,585	0	18,585	0
Wildland-urban intermix Threat Zone (acres)	170,549	0	0	0
Community Wildfire Protection Zone (acres)	0	80,124	0	80,124
General Wildfire Protection Zone (acres)	0	77,177	0	77,177
Wildfire Restoration Zone (acres)	0	317,475	0	317,475
General Wildfire Zone (acres)	0	0	444,868	0
Wildfire Maintenance Zone (acres)	0	335,904	347,226	335,904
Designated Wilderness (acres)	314,448	314,448	314,448	314,448
Existing Recommended Wilderness (acres)	15,110	15,110	15,110	15,110
New Recommended Wilderness (acres)	0	0	206,904	0
Designated Wild and Scenic Rivers (miles)	124.0	124.0	124.0	124.0
Existing Recommended Wild and Scenic Rivers (miles)	1.0	1.0	1.0	1.0
Existing Eligible Wild and Scenic Rivers (miles)	75.9	75.9	75.9	75.9
New Eligible Wild and Scenic Rivers (miles)	0	75.9	75.9	75.9
Pacific Crest National Scenic Trail (miles)	47	47	47	47
Pacific Crest National Scenic Trail Management Area (acres)	61	20,883	46,384	12,261
Critical Aquatic Refuges (acres)	188,843	188,843	248,393	188,843

Table 3. Management areas by alternative, Sierra National Forest

Management Area	Alternative A	Alternative B	Alternative C	Alternative D
Wildland-urban Intermix Defense Zone (acres)	51,253	0	51,253	0
Wildland-urban intermix Threat Zone (acres)	273,284	0	0	0
Community Wildfire Protection Zone (acres)	0	189,684	0	189,684
General Wildfire Protection Zone (acres)	0	172,066	0	172,066
Wildfire Restoration Zone (acres)	0	353,904	0	353,904
General Wildfire Zone (acres)	0	0	665,730	0
Wildfire Maintenance Zone (acres)	0	576,394	575,065	576,394
Designated Wilderness (acres)	553,683	553,683	553,683	553,683
Existing Recommended Wilderness (acres)	0	0	0	0
New Recommended Wilderness (acres)	0	0	220,641	0
Designated Wild and Scenic Rivers (miles)	27.0	27.0	27.0	27.0
Existing Recommended Wild and Scenic Rivers (miles)	66.5	66.5	66.5	66.5
Existing Eligible Wild and Scenic Rivers (miles)	0	0	0	0
New Eligible Wild and Scenic Rivers (miles)	0	633.5	633.5	633.5
Pacific Crest National Scenic Trail (miles)	27	27	27	27
Pacific Crest National Scenic Trail Management Area (acres)	42	15,033	86,631	8,084
Critical Aquatic Refuges (acres)	42,440	154,275	199,367	154,275

Table 4 indicates which other designated areas occur on each national forest. Some management areas such as wilderness, wild and scenic rivers, and the Pacific Crest National Scenic Trail are also designated areas but are included in Table 1, Table 2, and Table 3 above.

Table 4. Acres and miles of other designated areas by national forest (all alternatives)

Type of Designated Area	Inyo National Forest	Sequoia National Forest	Sierra National Forest
National Scenic Area (acres)	51,352	0	0
National Protection Area (acres)	31,825	0	0
Experimental Forest (acres)	0	0	4,490
Inventoried Roadless Area (acres)	836,583	263,751	145,717
National Historic Landmark (acres)	0	20.6	0
National Recreation Trails (miles)	80	42	29
Research Natural Areas (acres)	15,301	4,626	4,471
Scenic Byway – Forest Service (miles)	39	0	112
Special Management Area (acres)	0	0	26,597
Wild Horse and Burro Territories (acres)	286,500	0	0

Table 5 indicates which ecosystem-based or wildlife-based areas apply to which alternative across all three forests. In alternative A, areas with specific plan components were also called land allocations but they are not considered management areas under the 2012 Planning Rule for alternatives B, C, or D.

Table 5. Other ecosystem or wildlife areas by alternative

Area Name	Alternative A	Alternative B	Alternative C	Alternative D
Old forest emphasis areas	Yes	No	Yes	No
California spotted owl protected activity center	Yes	Yes	Yes	Yes
California spotted owl home range core area	Yes	Yes	No	Yes
California spotted owl territories	No	No	Yes	No
California spotted owl home range area	No	No	Yes	No
Goshawk protected activity center	Yes	No	No	No
Great gray owl protected activity center	Yes	No	No	No
Marten den sites	Yes	No	No	No
Fisher den sites	Yes	No	No	No
Southern Sierra Fisher Conservation Area	Yes	No	No	No
Southern Sierra Fisher Strategy Area	No	Yes	Yes	Yes
Fisher target habitat	No	Yes	Yes	Yes
Fisher linkage areas	No	Yes	Yes	Yes

Comparison of Alternatives by Restoration Activities

Estimated number of wildfires and acres managed to meet resource objectives come from fire occurrence and accomplishment reporting data for the last 10 years for alternative A. For alternatives B through D they are estimated from modeling of natural wildfire ignitions assuming wildfires burning with positive outcomes under different energy release component levels: alternative B is less than or equal to 90 percent; alternative C is less than or equal to 85 percent; and alternative D is less than or equal to 95 percent.

Table 6. Estimated amounts of restoration activities by alternative per decade, Inyo National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of mechanical treatments (TERR-FW-OBJ-01)	20,000	20,000 - 25,000	10,000 - 15,000	25,000 - 30,000
Acres of prescribed burning (TERR-FW-OBJ-02)	18,000	20,000 - 25,000	15,000 - 35,000	20,000 - 25,000
Estimated number of wildfires managed for resources	8	18	2	30
Estimated acres of wildfires managed for resources	10,300	49,000	18,000	93,000
Acres of non-native invasive plants treated (INV-FW-OBJ-01)	n/a	300	300	300
Acres of sage-grouse habitat maintained, improved, or restored	1,500 - 7,450	1,500 - 14,900	7,450 - 22,350	7,450 - 22,350

Table 7. Estimated amounts of restoration activities by alternative per decade, Sequoia National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of mechanical treatments (TERR-FW-OBJ-01)	9,000	9,000 - 15,000	2,500 - 4,500	20,000 - 30,000
Acres of prescribed burning (TERR-FW-OBJ-02)	8,000	5,000 - 15,000	2,000 - 6,000	10,000 - 15,000
Estimated number of wildfires managed for resources	10	15	8	24
Estimated acres of wildfires managed for resources	31,000	83,000	41,000	145,000
Acres of non-native invasive plants treated (INV-FW-OBJ-01)	n/a	300	300	300

Table 8. Estimated amounts of restoration activities by alternative per decade, Sierra National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of mechanical treatments (TERR-FW-OBJ-01)	35,000	35,000 - 70,000	9,000 - 17,500	70,000 - 105,000
Acres of prescribed burning (TERR-FW-OBJ-02)	15,000	50,000 - 60,000	20,000 - 40,000	100,000 - 150,000
Est. number of wildfires managed for resources	4	33	3	53
Est. acres of wildfires managed for resources	5,000	170,000	14,000	297,000
Acres of non-native invasive plants treated (INV-FW-OBJ-01)	n/a	600	600	600

Comparison of Alternatives for Water, Aquatic and Riparian Ecosystem Restoration Activities over 10 years

Based on past and ongoing forest management efforts, we anticipate riparian vegetation restoration is closely tied with upland restoration projects. Therefore, there would be increased restoration funds in alternatives B and D; more stewardship opportunities for watershed restoration in alternative D, then B, then A; and little to no stewardship opportunity in alternative C.

Table 9. Water, aquatic, and riparian restoration activities by alternative per decade, Inyo National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of riparian vegetation improved (MA-RCA-OBJ-01)	300-400	400-500	400-500	500-600
Number of meadows maintained, enhanced or improved (RCA-MEAD-OBJ-01)	3-5	5-10	20-25	5-10
Miles of streams maintained or restored (RCA-RIV-OBJ-01)	10-20	10-20	20 - 30	10 - 20

Table 10. Water, aquatic and riparian restoration activities by alternative per decade, Sequoia National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of riparian vegetation improved (MA-RCA-OBJ-01)	300-400	500-1,000	300-400	1,000-1,500
Number of meadows maintained, enhanced or improved (RCA-MEAD-OBJ-01)	3-5	10-15	20-25	15-20
Miles of streams maintained or restored (RCA-RIV-OBJ-01)	5-10	15-25	20 - 30	15-25
Number of high priority barriers to aquatic organism passage eliminated or mitigated (RCA-RIV-OBJ-02)	1	1	1-4	1-2

Table 11. Water, aquatic and riparian restoration activities by alternative per decade, Sierra National Forest

Type of Restoration	Alternative A	Alternative B	Alternative C	Alternative D
Acres of riparian vegetation improved (MA-RCA- OBJ-01)	500	500-1,000	500-1,000	1,000-1,500
Number of meadows maintained, enhanced or improved (RCA-MEAD-OBJ-01)	3-5	5-10	10-15	15-20
Miles of streams maintained or restored (RCA-RIV-OBJ-01)	10	15-25	20-30	15-25
Number of high priority barriers to aquatic organism passage eliminated or mitigated (RCA-RIV-OBJ-02)	0	1	1-4	1-2

Comparison of Alternatives for Sustainable Recreation and Scenery Activities over 10 years

Table 12. Comparison of sustainable recreation emphasis by alternative, all three national forests

Management Emphasis	Alternative A	Alternative B	Alternative C	Alternative D
Partnerships[1]	Decreases	Increases	Increase in wilderness stewardship partnerships	Increases more

1. Management emphasis on partnerships is focused on decreasing deferred maintenance, enhancing operational service quality, and increasing public stewardship

Table 13. Sustainable recreation and scenery settings and activities by alternative per decade, Inyo National Forest

Setting or Activity	Alternative A	Alternative B	Alternative C	Alternative D
Primitive Recreation Settings (Percent)	53	55	67	55
Semi-primitive Non-Motorized Recreation Settings (Percent)	12	11	5	11
Semi-primitive Motorized Recreation Settings (Percent)	14	18	14	18
Roaded Natural Recreation Settings (Percent)	15	12	11	12
Roaded Modified Recreation Settings (Percent—Only on the Inyo)	2	2	2	2
Rural Recreation Settings (Percent)	not applicable	1	1	1
Acres of restoration focused on recreation settings (REC-FW-OBJ-01)	not applicable	200	200	200
Percentage of existing recreation sites converted to group sites. (REC-FW-OBJ-02)	not applicable	10%	10%	10%
Trail miles (5 year average) that meet standard (REC-FW-OBJ-03)	969	1,100 - 1,300	1,100 - 1,300	1,100 - 1,300
Acres of vegetation treated to maintain or achieve scenic integrity objectives (SCEN-FW-OBJ-01)	not applicable	500	500	500
Number of cultural resource products produced (CULT-FW-OBJ-01)	not applicable	5 - 10	5 - 10	5 - 10

Table 14. Sustainable recreation and scenery settings and activities by alternative per decade, Sequoia National Forest

Setting or Activity	Alternative A	Alternative B	Alternative C	Alternative D
Primitive Recreation Settings (Percent)	30	30	53	30
Semi-primitive Nonmotorized Recreation Settings (Percent)	5	5	5	5
Semi-primitive Motorized Recreation Settings (Percent)	16	22	12	23
Roaded Natural Recreation Settings (Percent)	48	41	28	41
Rural Recreation Settings (Percent)	1	2	2	2
Acres of restoration focused on recreation settings (REC-FW-OBJ-01)	not applicable	200	200	200
Percentage of existing recreation sites converted to group sites. (REC-FW-OBJ-02)	not applicable	10%	10%	10%
Trail miles (5 year average) that meet standard (REC-FW-OBJ-03)	214	300 - 500	300 - 500	300 - 500
Acres of vegetation treated to maintain or achieve scenic integrity objectives (SCEN-FW-OBJ-01)	not applicable	2000	2000	2000
Number of cultural resource products produced (CULT-FW-OBJ-01)	not applicable	5 - 10	5 - 10	5 - 10

Table 15. Sustainable recreation and scenery settings and activities by alternative per decade, Sierra National Forest

Setting or Activity	Alternative A	Alternative B	Alternative C	Alternative D
Primitive Recreation Settings (Percent)	45	43	59	43
Semi-primitive Non-Motorized Recreation Settings (Percent)	3	3	1	3
Semi-primitive Motorized Recreation Settings (Percent)	3	4	1	4
Roaded Natural Recreation Settings (Percent)	43	40	31	40
Rural Recreation Settings (Percent)	6	9	9	9
Acres of restoration focused on recreation settings (REC-FW-OBJ-01)	not applicable	200	200	200
Percentage of existing recreation sites converted to group sites. (REC-FW-OBJ-02)	not applicable	5%	5%	5%
Trail miles (5 year average) that meet standard (REC-FW-OBJ-03)	502	600 - 800	600 - 800	600 - 800
Acres of vegetation treated to maintain or achieve scenic integrity objectives (SCEN-FW-OBJ-01)	not applicable	2000	2000	2000
Number of cultural resource products produced (CULT-FW-OBJ-01)	not applicable	5 - 10	5 - 10	5 - 10

Comparison of Alternatives for Benefits to People

Table 16. Cut and sold volume in hundreds of cubic feet (CCF) per decade[1]

National Forest	Alternative A	Alternative B	Alternative C	Alternative D
Inyo (TIMB-FW-OBJ-01)	40,000	40,000 - 60,000	10,000 - 20,000	60,000 - 120,000
Sequoia (TIMB-FW-OBJ-01)	80,000	80,000 - 160,000	20,000 - 40,000	160,000 - 280,000
Sierra (TIMB-FW-OBJ-01)	250,000	250,000 - 500,000	50,000 - 100,000	500,000 - 800,000

1. Divide CCF by 2,000 to convert to million board foot (MMBF)

Comparison of Alternatives of Tribal Relations and Uses

Table 17. Acres of areas of tribal importance maintained or restored per decade

National Forest	Alternative A	Alternative B	Alternative C	Alternative D
Inyo (TERR-FW-OBJ-03)	not applicable	1 - 5	1 - 5	1 - 5
Sequoia (TERR-FW-OBJ-04)	not applicable	3 - 10	3 - 10	3 - 10
Sierra (TERR-FW-OBJ-03)	not applicable	3 - 10	3 - 10	3 - 10

Chapter 3.
Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the physical, biological, social, and economic environments of the planning area and the potential environmental consequences that may occur on those environments by implementing each alternative. It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2. In some cases where indicated, more detailed information, including methodology, assumptions, and effects analyses, can be found in the specific resource supplemental report located in the planning record located at the Pacific Southwest Regional Office, Vallejo, California.

The Relationship between Forest Plans and Site-specific Activities

The focus of this analysis is to examine the implications or longer term environmental consequences of managing the national forests under the programmatic framework provided by the draft revised forest plans and alternatives. Forest plans do not authorize, fund, or carry out any project or activity described in the effects analyses. Instead, they provide a programmatic framework that guides site-specific actions that may be carried out in the future.

Because a land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. The draft forest plans set the stage for what future management actions are needed to achieve desired outcomes (for example, desired conditions and objectives), and provide the sideboards (such as suitability, standards, and guidelines) under which future activities may occur to manage risks to ecological, social, and economic environments. The draft forest plans also identify potential management approaches that may be used to help achieve desired conditions. To actually plan and proceed with a site-specific project, project-level planning, environmental analysis, and decisions must occur (for example, the draft forest plans contain direction to thin vegetation and reduce fuels to benefit ecosystem resilience; however, a subsequent site-specific analysis and decision must be made for each proposal that involves vegetation treatment or fuel reduction activity in a chosen area).

Science and Assumptions Used in the Environmental Analyses

During development of the environmental analyses that follow, the planning team used the best available scientific information, which is documented in the planning record. The environmental analyses focus on the needs for changing the existing plans and the issues identified through the scoping process; they also examine potential effects to programs and resources on the Inyo, Sequoia, or Sierra National Forests.

The discussions in chapter 3 refer to the potential for consequences to occur, realizing that in many cases, they are only estimates. To estimate the consequences of alternatives at the programmatic plan level, we must assume that the kinds of resource management activities allowed under the prescriptions will occur to the extent necessary to achieve the objectives and move toward or achieve the desired conditions of each alternative. In many cases the nature of the consequences are similar across each national forest but the magnitude of the consequences may vary by the difference in plan objectives or opportunity. In these cases, the consequences are presented in general first and then specifically for each national forest as appropriate. This method of analysis is useful when comparing and evaluating alternatives on a forestwide basis but it is not to be applied to specific locations on a national forest.

Several assumptions made in the analyses of alternatives, include:

- Law, policy, regulations, and applicable best management practices would be followed when planning or implementing site-specific projects and activities.
- Plan components (such as desired conditions, objectives, standards, guidelines, management areas, and suitability) would be followed when planning or implementing site-specific projects and activities.
- Goals and potential management approaches would influence collaborative efforts and be considered in developing programs of work.
- Plan objectives are generally stated as a range (from low to high). The actual level of accomplishment would depend on environmental conditions, budgets, and staffing.
- Implementation of a land management plan would facilitate progress toward the attainment of desired conditions for each resource. As movement toward or achievement of desired conditions is made, forest ecosystems would become healthier and more resilient and would continue to provide for species diversity, goods, and services.
- The planning period is 10 to 15 years; other timeframes may be used to compare expected future trends. Plans are expected to be revised at least every 15 years.
- Plan monitoring would occur and the land management plan will be amended, as needed.

How this Chapter is Organized

First, a general analysis of environmental consequences of drivers and stressors of climate, fire, insects, and pathogens are described since they can affect many resource areas. Then, environmental consequences are organized under each revision topic. Finally, an analysis of the benefits to people and communities and consequences to tribal relations and uses is provided at the end of this chapter to evaluate how the alternatives contribute to economic and social wellbeing.

Agents of Change: Climate, Fire, Insects, and Pathogens

Drivers and stressors are recurring events, processes, or actions that affect ecosystems. These effects are important to ecosystem condition. For example, fire creates variation in habitat, which is important for biodiversity—it keeps vegetation density and surface fuels low and patchier; it is a "driver" of ecosystem condition. Fire can be a stressor when it is more severe than usual and outside its natural range of variation, either occurring less frequently or more frequently than in the past.

The context in which fire occurs is also important. For example, because the scenery around the Mammoth Lakes area is important to this recreation place, high-severity fire can decrease the scenic character and lower the recreation value. Scenery impacts from fire can be short term if they cover small areas and are visually absorbed as vegetation recovers, or they can be long term if they cover wide visible expanses dominated by burned forest.

Other important drivers and stressors are insects and pathogens, climate change, and air pollution. Climate is a fundamental process that strongly influences other drivers and stressors in the Sierra Nevada, including fire, invasive species, insects, pathogens, water development and diversion, air pollution, and land use patterns.

In this section, three aspects of drivers and stressors are covered broadly. These include: climate; trends in fire with climate; and insects and pathogens. In later sections, response of specific vegetation types, habitats (such as old forest), and ecosystem functions (such as carbon storage) to drivers and stressors is discussed. Invasive plants are one of the most important, widespread stressors on the Inyo National Forest and lower elevations of the Sequoia and Sierra National Forests. Invasive animals and insects are increasingly important stressors that are addressed in the "Terrestrial Ecosystems," "Aquatic and Riparian Ecosystems" and "Wildlife, Fish and Plants" sections. Fire management is covered in revision topic 1. Air pollution impacts are covered in the "Air Resources" section.

Although climate change is an important theme in this section, it is also woven throughout many sections in the document because it influences and affects many aspects of national forests. There is a specific subsection focused on ecological vulnerabilities to climate and analysis of climate adaptation strategies proposed for each alternative at the end of the "Terrestrial Ecosystems" section.

Climate Change

This section summarizes current and future trends of climate to form a foundation for other analyses in this chapter.

Background

Climate change is anticipated to have lasting, large-scale impacts to a variety of ecological, social, and economic resources in national forests of the southern Sierra Nevada. Carbon sequestration and greenhouse gas emissions are not covered in this section but are addressed in the "Air Resources" and "Terrestrial Ecosystems" sections. The effects of climate change on specific social, cultural, and biological resources (such as cultural resources and species of special concern) are also covered in each relevant section of this chapter.

This section summarizes the more detailed analysis of climate, ecological vulnerability and adaptation found in the final bio-regional and forest assessments (USDA FS 2013a, 2013b, 2013c, 2013d) and the snapshots of the Living Assessment used to develop the final assessments (USDA FS 2013e, 2013f, 2013g, 2013h).

Recent Past and Current Trends

Mean annual temperatures in the planning area have increased in the last several decades, mostly with increased nighttime temperatures (Meyer et al. 2012, Mallek et al. 2012). Unlike much of the rest of the Sierra Nevada, overall precipitation has remained steady at higher elevations but there have been some decreases at lower elevations. There has been a decrease in the amount of snow at low to mid-elevations and an increase in year-to-year variability (wetter wet years and drier dry years). At higher elevations, overall snowfall and spring snow water equivalent (amount of water in snowpack) have remained steady in most southern Sierra Nevada areas, but snowmelt occurs earlier in the year.

Changes in temperatures and amounts and timing of precipitation have led to earlier peak stream flow rates in most Sierra Nevada streams, with higher spring flows and lower summer flows. Warming temperatures are leading to glacial recession across the southern Sierra Nevada.

Projected Future Trends in Climate and Hydrology

Although climate change models vary in their projections for the latter half of the 21st century, all predict significant warming in the Sierra Nevada. Most expect precipitation to remain similar or slightly reduced compared to today (Safford et al. 2012). Most models also agree that summers will be drier (causing higher evapotranspiration rates) on average. Although snowpack in the higher elevations (higher than 7,500 feet) of the southern Sierra Nevada has generally remained steady (or risen) over the past half-century (Meyer et al. 2012, Mallek et al. 2012), continued warming is likely to decrease snowpack in much of the high southern Sierra Nevada.

Most models project a continuously increasing rain-to-snow ratio and earlier runoff dates for the next century, especially at higher elevations. Under most climate scenarios, models project higher winter-to-early spring runoff and lower spring-to-summer runoff, as higher temperatures hasten the onset of snowmelt. This could increase downstream flood potential due to earlier peak flow rates and the increased proportion of precipitation falling as rain. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk in downstream areas.

Fire Trends

This section summarizes trends in fire with climate and general vegetation conditions. These trends are important to understanding conditions and fire effects to terrestrial, riparian and aquatic ecosystems, and social and economic conditions.

Background

Fires have been increasingly large and severe throughout the western U.S. (Calkin et al. 2005, Westerling et al. 2006) and California (Miller et al. 2009, Miller and Safford 2012) over the last several decades. The effects of these fires are often seen by people as overwhelmingly negative. In much of the wildlands of the western U.S. and the analysis area, fire has played a central role

in shaping ecosystems. Both the beneficial and destructive aspects of fire are important to understand. The analysis examines different characteristics of fire, which can have implications for the wildlands in areas we live in and use.

In this section, the trends in burned area and fire size are addressed in response to climate change and scenarios that represent different levels of vegetation restoration. The fire responses to the scenarios are used to describe the consequences of the alternatives on large fire size and burned area. The impacts of fire to vegetation and other ecological aspects of fire are covered in more detail in the "Terrestrial Ecosystems" section. Aspects of fire related to impacts on communities, people, and infrastructure (such as water systems or powerlines) are covered in the "Fire Management," "Economic Conditions," and "Social Conditions" sections. The projected trends in fire in this section provide a common basis for assumptions on fire trends for all other analysis sections in this document.

Analysis and Methods

This section is based primarily on a quantitative analysis of fire-climate trends conducted by the University of California (UC) in Merced as part of a cooperative agreement with the Forest Service (Westerling et al. 2015). Other scientific literature used is found in the Fire-climate supplemental report.

Climate scientists at UC Merced conducted a study to predict trends in wildfire with climate change under a broad range of different levels of vegetation restoration. The predictions are based on data from recent and past wildfires, associated vegetation condition, and climate data. The methodology was established in previously published research by Westerling and others (Preisler et al. 2008, Holmes et al. 2008, Bryant and Westerling 2014, Preisler et al. 2015). This research applies a statistical approach to predicting wildfire, in contrast to mechanistic models, such as FARSITE. They are well suited for broad analysis that takes into account trends in wildfire with climate change.

Scientists made projections of climate using several different climate models, since common trends in different models would indicate a more certain trend. The results presented here are primarily for the Geophysical Fluid Dynamics Laboratory A2 climate scenario, as well as some results from the Centre National de Recherches Météorologiques (CNRM) and Community Climate System Model (CCSM) A2 climate scenario (Westerling et al. 2015). The differences between wildfire predictions for the selected climate scenarios were small compared to the effects of the restoration treatments scenarios. The Geophysical Fluid Dynamics Laboratory climate model was emphasized because it yielded mid-century increases in wildfire activity between the CNRM and CCSM models.

Vegetation conditions were based on LANDFIRE vegetation condition class data (LANDFIRE 2012). The conditions are derived from remote sensing data on existing vegetation density and species composition and derived differences with historic conditions based on fire history research and biophysical models of vegetation type and historic fire regime groups.[19] Where there is a large departure in historic fire regime (that is, fire patterns and intensities are very different from what they used to be) and vegetation conditions are different than what they would have been under a historic fire regime, then the condition class is considered "highly departed." The range of classes include:

[19] http://www.landfire.gov/NationalProductDescriptions12.php

- vegetation condition class 1: no to low departure;
- vegetation condition class 2: moderate departure; and
- vegetation condition class 3: high departure.

An example of the conditions would be ponderosa pine or eastside Jeffrey pine that is currently dense but historically would have been maintained as open forests due to frequent, historic fire. Exploratory analysis revealed that fire patterns (large fire size, extent and burned area) varied with vegetation condition class. The vegetation condition class is a broad classification and was determined to be well suited to the programmatic plan and array of different combinations of individual vegetation desired condition components that would be the result of restoration.

Restoration treatments were modeled by changing potential treatment areas that are currently in vegetation condition class 3 or 2 to vegetation condition class 1. This is needed because previous exploratory analysis had shown that it was too difficult to discern differences in predicted fire trends between more subtle changes in vegetation condition class 3 to class 2 (Westerling 2015, personal communication February 2015). The restoration treatments were not modeled in a specific spatial pattern but as a broad level pattern to assess impacts at a programmatic level. These are referred to as "restoration scenarios." The restoration scenarios included 15 percent, 30 percent, 60 percent, and 100 percent of the area restored, with an emphasis in the Sierra Nevada foothill and montane, and Great Basin ecological zones (see "Terrestrial Ecosystems" section). The priority was on areas with vegetation heavily departed from historic conditions near roads but otherwise were randomly located. More detail on the analysis can be found in the final report (Westerling et al. 2015).

A summary of fire impacts in the "Affected Environment" section was based on a combination of recent observed and future projected changes in fire in the planning area and entire bio-region. Recent fire trends were based upon data assembled for the area for other predictions made for the State of California and include the time periods from 1961 to 1990. This does not take into account very recent large fires, including the Rim and King Fires, but they were incorporated into the analysis using other information. Future projected changes focus on three periods, including early century (2010 to 2040) and mid-century (2040 to 2070) projections. These longer time periods are ideal in the analysis of climate change-related fire effects in land management planning efforts (Peterson et al. 2011).

Indicators and Measures

The primary indicators measured in this analysis are burned area, large fire size, and smoke and carbon emissions. The smoke and carbon emissions are described in the "Air Resources" section. Other important indicators that are based upon inferences on large fire size, burned area, and vegetation conditions (like density and fuel levels) include fire intensity, fire type, and large areas of vegetation burned at high severity. A combination of a qualitative assessment using scientific literature and quantitative analysis using fire behavior modeling and sensitivity analysis of the statistical fire-climate model for selected areas were used to make inferences on fire intensity, fire type, and occurrence and size of large patches of high severity.

Fire intensity refers to how hot a fire burns, or the amount of heat per unit area. Fire type refers to how the fire burns in relation to the height and type of vegetation it is burning in. A surface fire, burns in the understory of forests or shrub lands or chaparral. In contrast, a crown fire burns in the tops of the crowns or tops of trees or shrubs. Fire severity refers to the effects of fire on vegetation or soil or other ecosystem components and is often measured at the landscape scale

using remote sensing data (Miller et al. 2009). In vegetation, fires that have higher top kill and high levels of tree or plant death are considered high severity. See the "Terrestrial Ecosystems" section for more details.

Assumptions

The analysis of fire includes several assumptions.

- The use of models predicting fire trends based on past climate-fire patterns may under-predict future trends in fires because the models are based on observations occurring under milder fire weather conditions. Because future climate is expected to exceed these conditions there is uncertainty in the fire projections.
- Some fires exhibit a fire-atmospheric interaction where the fire influences the local weather affecting the fire. There is uncertainty around the extent that this may occur but it can dramatically alter fire size, intensity, and large patches of high severity such as seen on the Rim Fire 2013 and the King Fire 2014 (Coen et al. 2015) in the central Sierra Nevada. These phenomena may be increased with continued drought and climate trends.
- High fire intensity in dry, hot conditions is expected to be reduced to moderate or low intensity or a mosaic of intensities when at least 40 percent of a landscape area is in a low or reduced fuel condition. A variety of landscape theory, fire modeling, and fire behavior case studies support this (Turner 1989, Parisien et al. 2008, 2010, 2012, Fites-Kaufman 2014, Coen et al. 2015). Based on this information, for this analysis we assume that at least 12,000 acres or more needs to have at least 40 percent of its area restored to result in changes in fire probability, extent, and large fire size. See Fire-Climate supplemental report for more detail.

Affected Environment

Recent Past and Current Trends

Prior to European settlement, fire was widespread throughout the bio-region and California (Sugihara et al. 2006b, Stephens et al. 2007). The frequency, spatial pattern, and severity varied by ecosystem (van Wagtendonk and Fites-Kaufman 2006, Brooks and Minnich 2006). Most fires were low to moderate in intensity over large areas. This resulted in a mosaic of mostly surface fire, sweeping into the understory shrubs, herbs, small trees, and grasses, with small clumps or patches of fire making its way into the crowns of trees (crown fire). In chaparral and sagebrush, larger patches of crown fire would occur that reached the tops of the plants, killing them outright or top-killing them and stimulating new sprouts. Pinyon-juniper forests also typically experienced crown fire. See the "Terrestrial Ecosystems" section for more details on the historic and current fire regimes by major ecological zone and vegetation type. Overall, in the last century far less area has burned than did historically (Stephens et al. 2007) but the severity has increased (Collins and Skinner 2014, Mallek et al. 2013).

For thousands of years, Native Americans used fire to manage the landscape for a variety of beneficial uses (Anderson 2006). European settlement in the bio-region greatly intensified with discovery of gold in the Sierra Nevada in 1848 (Beesley 1996). At the same time, there was intensive logging to fuel steam-generated equipment and to build housing, along with extensive grazing by livestock. These early settlers affected fire directly and indirectly in numerous ways (Safford 2013). Overall, widespread fire decreased.

Prior to the advent of modern fire suppression capability, fire was more widespread and less intense (van Wagtendonk and Fites-Kaufman 2006, Stephens et al. 2007). In the last 45 years, fires have become larger, and larger fires more frequent across the western U.S. (Calkin et al. 2005, Westerling et al. 2006). In the Sierra Nevada (including the analysis area), the area burned annually in federally managed forests has increased by more than 24,700 acres per decade during this period (Westerling et al. 2015). Fire size has also changed, especially in recent years where some extremely large fires (such as McNally Fire 2002, Rim Fire 2013, and King Fire 2014) have burned, compared to the historical record. Since 1990, 9 out of the 10 largest recorded fires have occurred and 8 of those have been since 2000 alone (Steel et al. 2015).

Over 100 years of fire exclusion (fire suppression and lack of extensive intentional burning), along with other land uses, changed how fire burns. Now fires burn with higher intensity, greater amounts of crown fire, and with larger areas of high severity (Miller et al. 2009, Miller and Safford 2012, Mallek et al. 2013, Steel et al. 2015). Most recently, some fires have moved very rapidly, burning at high intensity, in single days, across large swaths. This includes the Rim Fire on the Stanislaus National Forest and King fire on the Eldorado and Tahoe National Forests. These types of fire behavior are more likely when the fire burns over large areas with multiple fire fronts and creates its own “fire weather.” Extensively burning areas create their own high winds that accelerate the fire and multiple fire fronts burn toward each other (Coen 2005, Viegas et al. 2012). In the case of the King Fire, the very dry, uniformly dense overstory and understory vegetation across large areas combined to create three separate fronts or heads of the fire and an actively burning area of over 6,000 acres (Fites-Kaufman 2014). The heat from the three separate areas interacted and became one very large, several-miles-wide actively burning front and created winds of more than 40 miles per hour in front of the fire. After that, it grew to 50,000 acres burning intensely and fast. Similar vegetation conditions (such as large areas of dense understory and overstory vegetation and fuels) are common and with drought, longer fire seasons, and increasing temperatures, very large fires are likely to repeat. It is not certain exactly where and when similar fires will occur, but it is highly likely that they will occur and that the impacts will be similar to those seen in recent very large fires that burned in similar conditions.

Climate (precipitation and temperature) and fire have always been linked (Swetnam 1993). Today, changes in land use and associated changes in vegetation (that is, fewer fire-tolerant species and denser vegetation) magnify the effects of a warming climate on fire behavior.

Projected Future Trends

The projected future trends are based primarily on the statistical fire-climate models (Westerling et al. 2015).

Burned Area

There has been a trend of increased burn area associated with low winter snowpack in the western U.S. in recent decades (Westerling et al. 2006). Predictions for the analysis area and all of the Sierra Nevada are that the burned area will double or quadruple over the next 20 to 30 years (Westerling et al. 2015). This would not be detrimental if the fires were low intensity, but much of the area is expected to burn at high intensity due to the current vegetation density patterns and drier, longer fire season weather. Most of this increase is associated with larger fires.

Figure 3 shows a map of changes in the predicted burned area in the next midcentury period, 2035 to 2064, compared to 1961 through 1990, a period prior to the advent of widespread very large high-intensity wildfires. The change is shown in colors labeled on a scale at the bottom of the figure, below the outline map of California. Light green depicts no change or a decrease in the

amount of burned area. Yellow to orange represents an increase of more than 1 to 2 times the amount of burned area. Red colors depict a tripling of burned area, and the darkest maroon colors represent a quadrupling of burned area.

The greatest increases are expected in the upper montane and subalpine areas. The montane zone, where mixed conifer, ponderosa and Jeffrey pine forests occur show double to triple area burned. The least changes are in the lowest elevations on the west and east slopes, in the foothills on the west, and in the Great Basin sagebrush and pinyon-juniper on the east. These areas are shown in orange and still have one and a half to two times the area burned.

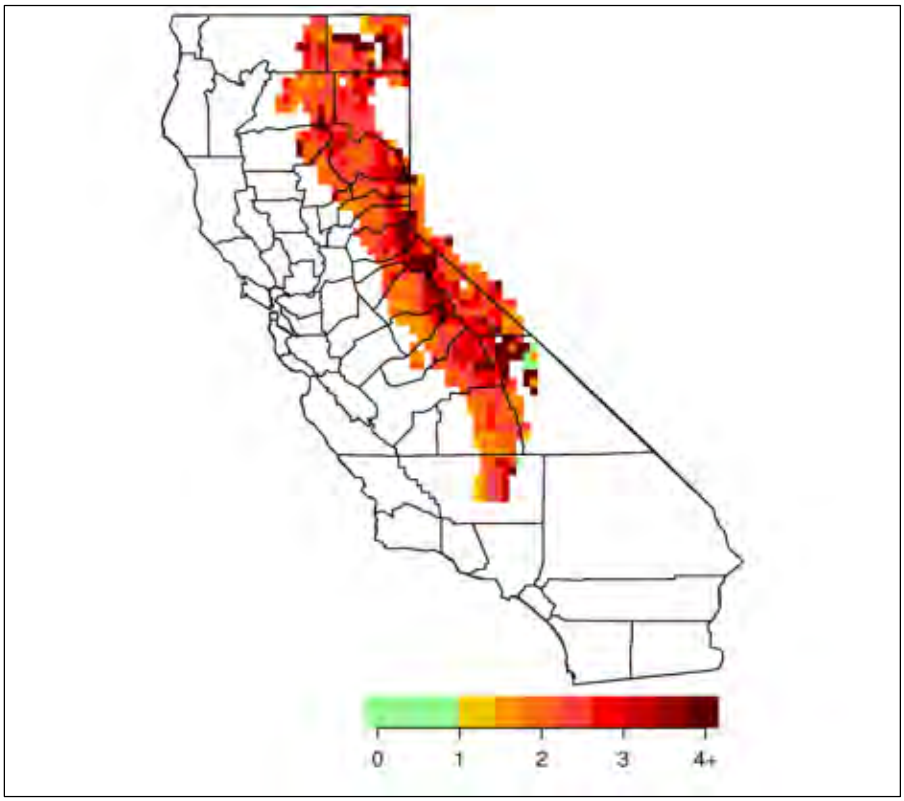

Figure 3. Map of changes in the predicted burned area in the next mid-century, 2035 to 2064, compared to 1961 through 1990

Fire Size and Likelihood of Very Large Fires

Average fire size is expected to increase by 13 to 20 percent by mid-century with climate change in the absence of additional treatments to restore vegetation and reduce density and surface fuels (Westerling et al. 2015). The likelihood of very large fires is increasing as well. The likelihood of fires becoming larger than 24,700 acres increases between 23 and 52 percent by mid-century. The average size of large fires is projected to increase between 15 and 25 percent in the coming decades. None of these predictions account for the growing prevalence of very large fires driven by fire-atmospheric interactions, as discussed above. Increases in fire-atmospheric interactions would contribute to an even greater increase in the size and probability of large fires.

Figure 4 shows a line graph of the expected change in large fire size with different future climate scenarios. This is based solely on changes in climate as no changes in vegetation from restoration treatments were included in this calculation. The first graph shows the predicted trends in large

fire size between 2035 and 2064 for the three different climate models. The blue line is based on the Community Climate System model (CCSM). The red line is based on the Geophysical Fluid Dynamics Laboratory (GFDL) model and the green line is based on the Centre National de Recherches Météorologiques (CNRM) model. The y-axis shows the percent change in large fire size, which is predicted to increase by 13 to 20 percent over the time period.

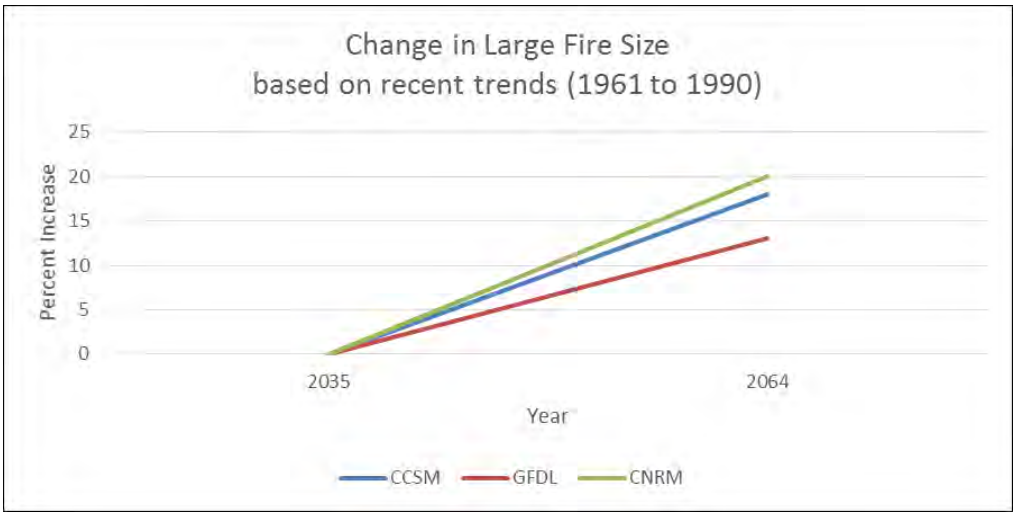

Figure 4. Predicted change in large fire size from recent (1961 to 1990) rates based on three climate models

The second line graph in Figure 5, shows predicted trends when different amounts of the mid- and low-elevation landscapes are modeled as restored (from vegetation condition class 2 or 3 to class 1).[20] There is a predicted trend of increasing large fire size for all restoration scenarios except for 60 percent, which stays nearly constant with current large fire size, and 100 percent, which shows a decrease in large fire size. This is consistent with other research predicting increases in fire with climate change (such as Moritz and Stephens 2008).

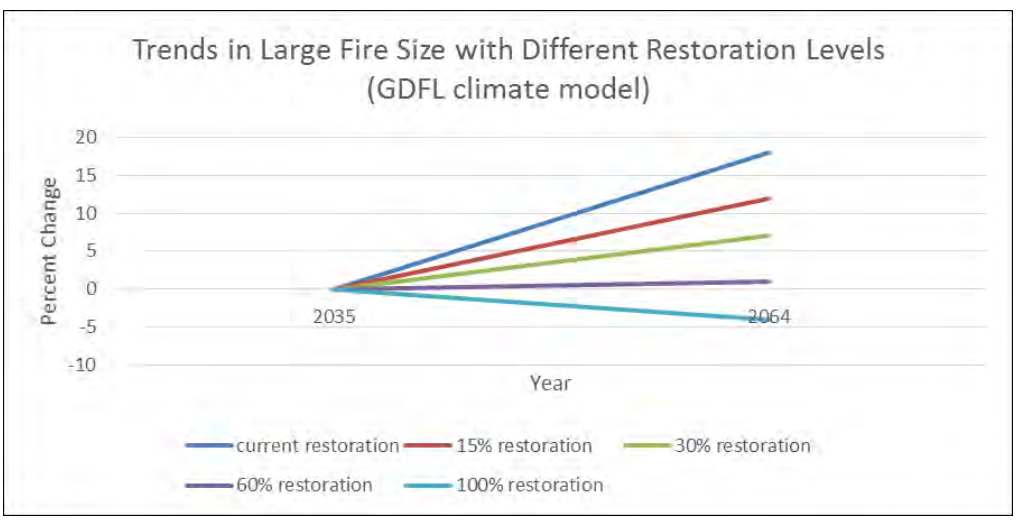

Figure 5. Line graphs showing the expected change in large fire size with different future climate and vegetation restoration scenarios

[20] Using the Geophysical Fluid Dynamics Laboratory or GFDL model

The amount of predicted change in area burned in large fires varies across the planning area somewhat aligned with differences in ecological and elevational zones. The montane and upper montane landscapes have the greatest increase in likelihood of large fires, with a 30 to 55 percent increase, respectively.

Figure 6 shows predicted trends in area burned in large fires separated out by ecological zone as modeled by the Geophysical Fluid Dynamics Laboratory A2 model (or GFDL A2). It is only shown for one climate scenario because the relative differences between the ecological zones are the same across the other climate models. The increase in probability of large fires remains above 10 percent for the montane zone until the 60 percent scenario, where the trends decrease for all ecological zones except for the upper montane zone. This is because climate will have more effect on increasing fire in the upper montane zone and most treatments were prioritized in the lower elevation montane and foothill zones because they are closest to communities and have the most values at risk (homes and infrastructure). These lower elevation areas are most deviated from the desired condition and natural range of variation.

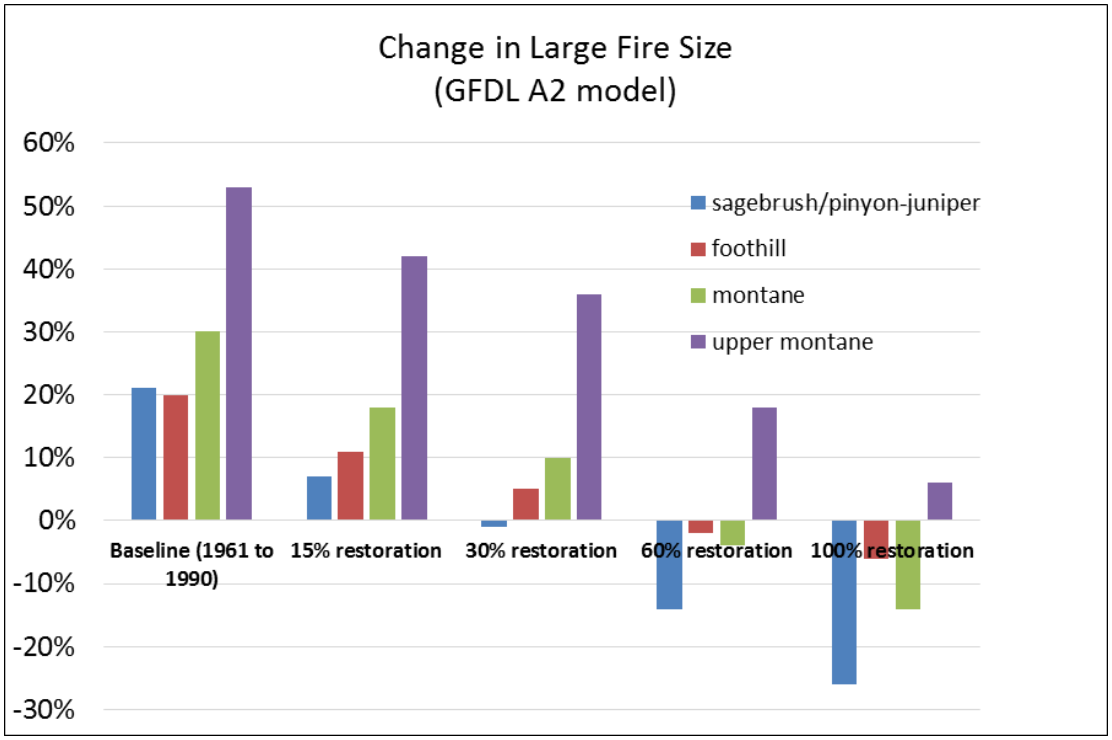

Figure 6. Bar graph showing the change in large fire size by ecological zone with different levels of modeled restoration

Fire Intensity, Fire Type and Severity

Changes in fire extent and large fire size are likely to be correlated with higher intensity and higher levels of crown fire. Increased crown fire is expected because of large areas of the landscape with dense vegetation and fuels that can cause more intense and larger fires (Collins and Skinner 2014); such fires have the potential for more fire-atmospheric interactions (Coen 2005, Werth et al. 2011) and predicted drier and warmer fire weather conditions (Westerling et al. 2015).Warmer and drier environments cause lower fuel moisture levels and more intense fires. Once a crown fire starts, it is likely to spread in nearby areas with dense crown fuels. As described above, this can accelerate rapidly and cover very large areas in a short time if fire-

atmospheric interactions occur (Werth et al. 2011), or if one part of the fire interacts with another causing a "mass fire" (Finney and McAllister 2011, Viegas et al. 2012). More information on potential fire types, including crown fire, are found in the "Terrestrial Ecosystems" section, under "Fire Resilience."

The amount and patch size of high-severity fire is most important for evaluating the consequences to ecosystems, particularly in vegetation types that historically had low- and mixed-severity fire regimes. High-severity fire is difficult to predict because it depends on the interaction of vegetation composition (size and species) and structure, and fire intensity and duration. Available research on predicting high fire severity at the landscape scale focuses on statistical analysis of fire size with fire severity (Westerling and Keyser 2016). An analysis of fires and large areas and patches of high fire severity in the Sierra Nevada and southern Oregon, (Farris 2015, personal communication) found that there is a correlation between very large fires (such as the Rim Fire) and both the amount of and size of large patches of high severity. This may partly be because larger fires can have larger patches of high severity whereas smaller fires physical can't. However, short but intense fire runs can burn a lot of area, particularly under extreme weather conditions, such as on the Rim and King Fires. Statistical modeling shows that high fire severity areas show similar trends with climate to the trends in burned area (Westerling et al. 2015, Westerling and Keyser 2016). The model predicted that fire severity was more sensitive to changes in restoration scenarios than burned area alone. In other words, with restoration, fire severity declines more sharply than burned area.

Modeling of trends in high fire severity with climate change and restoration scenarios by UC Merced show increasing total area burned with higher fire severity (greater than 50 percent of overstory vegetation killed) and increasing size of high fire severity patches. Figure 7 shows that in the map on the left with no fuels treatments, the area burned at high severity is expected to increase between 100 and 200 percent across most of the analysis area. The map in the middle shows the 30 percent restoration scenario, where most areas show decreases in the trend, but overall there is still a 50 to 100 percent increase in predicted area burned at high severity across the analysis area. High elevation areas show little change with the restoration scenario because most of the areas are in wilderness and wildfire managed to meet resource objectives was not modeled. The map on the right shows the 60 percent restoration scenario, where there are large landscape areas that show levels less than 20 and 40 percent growth, and some with reductions. The reductions are in areas where larger concentrations of simulated restored areas occurred. The legend on the bottom ranges from a reduction of -20 percent (green) to an increase of 300 percent (dark red) on the right.

Environmental Consequences to Fire Trends

The consequences of the alternatives were based largely on the UC Merced fire-climate modeling and how the results varied with four different restoration scenarios. Table 18 provides a summary comparing restoration levels by alternative and Table 19 and Table 20 provide an overall summary of the consequences of the alternatives.

Each alternative has proposed restoration levels of different treatment types (mechanical, prescribed fire, wildfire managed to meet resource objectives) that are described in acres that would be treated and fire ignitions that would be managed. These proposed restoration levels fall in between the restoration scenarios used in the fire-climate modeling. For example, proposed restoration objectives for alternative B (TERR-FW-OBJ-01 to 04; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OGJ-01) are mostly expressed in ranges that correspond to a restoration

of 15 to 30 percent of the low and mid-elevation landscape. The proposed restoration levels for the alternatives vary by ecological zone. For example, there is little restoration planned in the subalpine/alpine zone except for wildfires managed to meet resource objectives. The table below describes how the restoration levels in the scenarios were cross-walked to the restoration levels in the alternatives for this analysis.

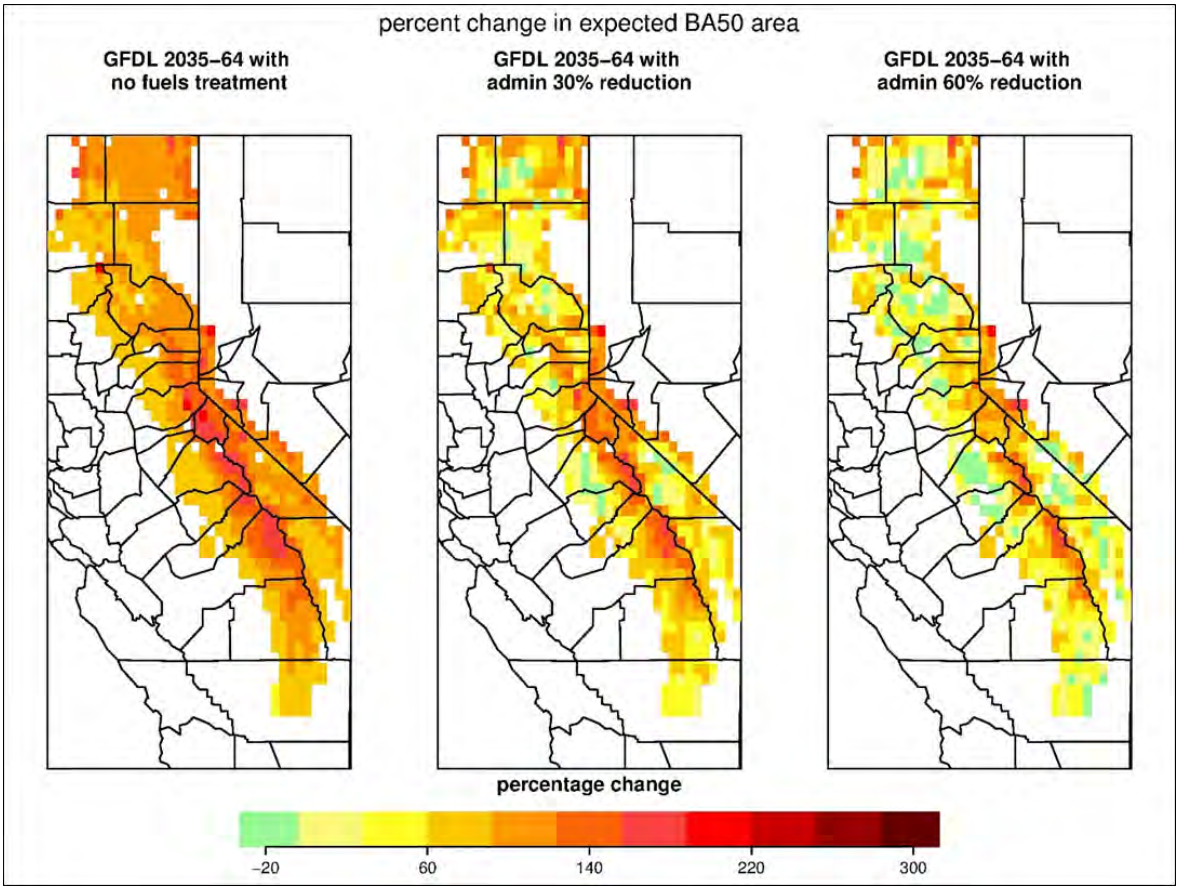

Figure 7. Percent change in area burned at high severity (defined as greater than 50 percent overstory mortality) with future trends in climate

Table 18. Summary comparison of proposed restoration levels by alternative

Restoration Modeling Scenario	Alternative A	Alternative B	Alternative C	Alternative D	Kern Drainage
Current levels (historic or baseline scenario)	Yes	No	Yes except for upper montane	No	No
15 percent	No	Yes	No	No	No
30 percent	No	Yes	Yes in upper montane	Yes	No
60 percent	No	No	No	Yes	Yes
100 percent	No	No	No	No	Yes

In general, alternative A is represented by the historic scenario, with restoration rates remaining the same at 5 to 10 percent of the landscape. Alternative B is represented by the range of conditions between the 15 and 30 percent restoration scenarios. Alternative C is represented by the range of conditions between the historic and 15 percent restoration scenarios. Alternative D is represented by the range of conditions between the 30 and 60 percent scenarios. The amount of restoration depends upon the location and is described in the narrative below. For example, on the Sequoia National Forest in the Kern River drainage, the restoration level varies between 40 and 90 percent because of the remoteness and high levels of managed fire in the past 15 years. In Kern River drainage, 30 percent or more of the area has been restored through managing fires. In areas where there is a prevalence of both California spotted owl and Pacific fisher habitat, the level of restoration will be lower in alternatives where more restrictive plan direction limits the intensity (alternative B outside of focus landscapes, and alternative C) or extent (alternative C) of restoration.

Table 19 below summarizes the expected changes in fire burned area, large fire size, likelihood of large fires, and fire intensity and fire type with projected climate trends by alternative. The information is based primarily upon the analysis by UC Merced (Westerling et al. 2015). The values are for the Geophysical Fluid Dynamics Laboratory (GFDL) model which represents the median model projections amongst the three climate models described earlier. More details on all three simulations are in Westerling et al. (2015). Table 20 shows the change in likelihood of large fires by alternative and by ecological and elevational zone for all areas. Both of these tables are referenced in the analysis of environmental consequences by alternative below.

Table 19. Summary of expected changes in fire burned area, large fire size, likelihood of large fires, and fire intensity and fire type with projected climate trends by alternative

Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Large fire size (percent change)	(23 percent increase	12 to 17 percent increase	Similar to alternative A	3 to 12 percent increase
Fire intensity and type (crown versus surface fire) in hot, dry conditions	High; decreased in areas of recent large wildfires	High, except decreased to moderate in some areas (15 to 25% of montane forest)of concentrated restoration (focus landscapes, large prescribed fires, managed fire areas)	High, except decreased in limited areas (large prescribed fire and managed fire areas)	Moderate to high, decreased in some areas (30 to 50% of foothill and montane forests) of concentrated restoration (focus landscapes, large prescribed fires, managed fire areas, some other areas))
Large patches (more than 1,000 acres) of very high intensity and severity (based on increases in large fire size)	At least 23 to 30 percent increase	At least 10 to 18 percent increase	Similar to alternative A	At least 4 to 11 percent increase

Table 20. Percent change in likelihood of large fires by alternative and ecological/elevational zone

Ecological/Elevation Zone	Alternative A	Alternative B	Alternative C	Alternative D
Foothill	17 to 22 percent increase	2 to 14 percent increase	Same as alternative A	8 percent increase to 6 percent decrease
Montane	23 to 31 percent increase	3 to 18 percent increase	Similar to alternative A	10 percent increase to 11 percent decrease
Upper Montane	55 percent increase	38 to 43 percent increase	Similar to B but less than D	19 to 38 percent increase
Kern River Drainage, Sequoia National Forest	4 to 11 percent decrease	Decrease of 11 to 22 percent	Same as alternative B	Same as alternative B
Great Basin	14 to 24 percent increase	1 to 10 percent increase	Less than A but more than B	1 increase to 6 percent decrease

Consequences Common to all Alternatives

Although there is uncertainty in all the alternatives about how much prescribed fire and wildfire managed to meet resource objectives will occur, we anticipate that management direction would support planned levels (Table 6 through Table 8, chapter 2). Spring burning is when much of prescribed fire can be safely done in the dry and warmer fuel conditions that occur more frequently than in the past. In all alternatives, there are uncertainties in how much fire would occur for several other reasons. First, drier fuel conditions and longer fire seasons decrease the available window to conduct prescribed burns to safely meet burn objectives. Secondly, limited operating periods for the California spotted owl (SPEC-CSO-GDL-03), Pacific fisher (SPEC-PF-GDL-04), great gray owl (SPEC-GGO-GDL-02), deer fawning (SPEC-FW-GDL 2), and sage-grouse (SPEC-SG-STD-06, -07) would make spring burning unlikely in many areas in the montane and ponderosa pine areas. Similarly, restrictions on burning in riparian area habitat for federally listed species such as yellow-legged frog and Yosemite toad would make spring burning more difficult in many areas. Lastly, there are uncertainties about the ability to conduct prescribed burning because of air quality constraints. Because of these uncertainties, the amount of restoration using prescribed fire may be overestimated for all alternatives.

Consequences Specific to Alternative A

Average annual burned acreage, large fire size, and fire intensity are expected to continue to increase under alternative A. Limited amounts of vegetation restoration, including mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives would occur in most areas. Based upon the projected trends with climate change, burned area would increase by two to four times. Much of the change would be in increasingly larger fires. These are likely to have large patches of high-intensity fire and high-severity fire effects. This is expected because of projected increases in temperature, decreased precipitation, and a resulting longer fire season. The greatest changes would be in the montane and upper montane forests, except in the Kern River drainage (including the Kern Plateau) on the Sequoia National Forest. Here, there would be similar patterns of burned area but decreased fire sizes and intensities as fires burn into other recent fires from the last 15 years. There would be a continued trend of increased fire on the eastside in the pinyon-juniper, sagebrush and desert ecosystems. Fire size would continue to increase in these eastside areas, especially where extensive invasions of the non-native cheatgrass or red brome have occurred.

Consequences Specific to Alternative B

In alternative B, there would be an increase in the amount of vegetation restoration that would reduce the likelihood of large fires, burned area, and large patches of high fire severity (TERR-FW-OBJ-01 to 04; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OBJ-01). There would be a continued trend of increasing burned area, large fire size, and fire intensity with climate trends (Figure 7); however, the rate of increase is lower (12 to 17 percent increase) than current rates of increase (23 percent) represented by alternative A (Figure 6, Table 20). The proposed restoration levels would vary with location in the landscape. Treatments would be prioritized in the montane, foothill (TERR-FW-OBJ-01), and sagebrush (SPEC-SG-OBJ-01) or pinyon-juniper areas, including around communities (MA-CWPZ-GOAL-01 to 02) and other high value areas. In addition to restoration objectives, the following potential management approaches in this alternative emphasize priorities in these areas:

> Areas that historically supported more frequent fire, like ponderosa pine and Jeffrey pine-dominated forests, and areas with high existing levels of understory fuels are prioritized for treatment.
>
> Prioritize fuel treatments in areas that pose the greatest threat to communities and highly valued resources.
>
> Prioritize ecological restoration of California spotted owl protected activity centers that have departed furthest from protected activity center and/or vegetation desired conditions, and that promote the greatest ecological resilience of the protected activity center. Also consider prioritizing protected activity centers with the highest wildfire risk in the community buffers, such as on upper slopes or ridge tops or in canyons with large areas of chaparral below. Consider the risk of large high-intensity wildfire to clustered protected activity centers, degree of departure from desired condition, and whether some should be managed to reduce wildfire risk and increase overall resilience of protected activity centers and vegetation in an area.

On the west side of the Sierra Nevada on the Sequoia and Sierra National Forests, at least half of the restoration would occur within focus landscapes, as described in the management approach below:

> Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.

In some areas, such as the focus landscapes in west side mixed conifer and ponderosa pine forests and Jeffrey pine forests on the Inyo National Forest (which does not use a focus landscapes approach) there would be increases in restoration over current levels (chapter 2, Table 6). These areas would represent approximately 15 to 25 percent of the montane, forested areas. In these areas, where at least 40 percent of the area is restored to desired conditions, there would be a decrease in fire intensity (Coen et al. 2015), high fire severity (Wimberly et al. 2009) and size of large patches of high severity. There may be some effect of decreasing large fire size overall when fires burn into treated areas, but this is more likely when larger treatments areas are concentrated within a landscape (that is, greater than 12,000 acres; see analysis assumptions above). Guidelines (FIRE-FW-GDL-02) and management approaches emphasize treating larger landscape areas, using mechanical treatments and larger prescribed fires:

> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.

> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.
>
> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed to meet resource objectives.

The ability to conduct treatments within these prioritized areas affects the likelihood that sufficient treatments would occur to result in changes in large, high-intensity size and high fire severity areas from future fires. There is a moderate level of uncertainty that the levels of projected prescribed fire treatments would occur due to limited operating periods for wildlife described above in consequences for all alternatives. There is an ability to waive the limited operating periods for 5 percent of California spotted owl sites per year (SPEC-CSO-GDL-03b), but this may not be sufficient to reach the increased objectives for prescribed fire. However, limited operating periods for Pacific fisher are waived in the focus landscapes, so there may be an increased likelihood of prescribed fire treatments. Further, there are reduced limitations for both prescribed fire and mechanical treatments on the number of fisher cells and spotted owl protected activity centers that can be treated in focus landscapes (SPEC-CSO-GDL-07; SPEC-PF-STD-02). Without prescribed fire in mechanical treatment areas, it is less likely that all of the desired conditions for vegetation are attained, particularly for small tree density, understory vegetation vigor, and surface fuels. This may mean that the mechanical treatment restorations are less effective in changing fire behavior during hot and dry conditions (Wimberly et al. 2009).

Changes in fire management toward a risk-based approach (strategic fire management zones, see "Fire Management" section) would result in more wildfire that is managed to meet resource objectives in some areas, especially in the wildfire maintenance zone (MA-WMZ-GOAL-01; MA-WMZ-STD-01 to 02) and in some portions of the wildfire restoration zone (MA-WRZ-DC-02 to 03; MA-WMZ-GOAL-01). This would result in decreased fuels, increased vegetation resilience, and has been shown to reduce future fire size and severity (Collins et al. 2009, Ewell et al. 2012, Vaillant 2009), but most of these fires would occur at higher elevations in more remote locations. Implementing the plan management strategy of emphasizing ecological restoration along ridges and some roads would improve the ability to reduce the intensity and spread rate of wildfires, manage fires, and conduct prescribed fires (MA-CWPZ-GDL-02; MA-GWPZ-GDL-02; MA-WRZ-STD-01; MA-WMZ-STD-02). It would contribute to fire suppression success and allow more wildfires to be managed to meet resource objectives but to an unknown degree because there are other factors influencing fire management decisions including weather, fuel conditions (how dry fuels are) and proximity to communities or values at risk (see "Fire Management" section).

In alternative B, there would continue to be large, high-intensity fires, with large patches of high intensity and severity, driven by fire-atmospheric interactions where fires generate their own weather and accelerate winds and fire intensity and spread (Coen et al. 2015). The likelihood of this would be reduced in the focus landscapes and other areas greater than 12,000 acres where at least 40 percent of the area has been restored (see assumptions above). Greater effectiveness of vegetation restoration is projected in the sagebrush and pinyon-juniper areas, where model projections show that treating one-third of landscape areas has benefits in reducing the likelihood of large fires (Figure 6). However, there is uncertainty in the effects of restoration treatments because continued invasion and establishment of non-native, annual grasses can cause increases in fire spread and fire size in other untreated areas.

Consequences Specific to Alternative C

The consequences of alternative C would be similar to alternative A but there are uncertainties associated with potential restoration amount and intensity in alternative C (chapter 2, Table 6 through Table 8). The proposed area treated with prescribed fire and wildfire managed to meet resource objectives would increase and potentially double on the Inyo and Sierra National Forests. On the Sequoia National Forest, the proposed area treated with prescribed fire would decrease because of limitations associated with prescribed fire in fisher habitat that occupies most of the analysis area on that national forest. Mechanical treatment on all three national forests would decrease by 25 to 75 percent. In addition to changes in the relative amounts of different treatment types, the intensity of treatments would be similar to alternative A and less than alternative B. Vegetation restoration is likely to be low treatment intensity because of an emphasis on retaining high canopy cover and greater tree basal area for the California spotted owl and Pacific fisher over much of the montane landscape, and on retaining greater sage-grouse and other wildlife habitat on the eastside.

There are fewer strategic fire management zones in alternative C, with more area emphasizing restoration of wildfire for resource objectives, but the fire risks remain the same as in the other alternatives so it is expected that fire management decisions would be the same as alternative A, except in the wildfire maintenance zone. With this alternative, less area would have mechanical restoration and those actions would be less intense in reducing fuels and reducing fire risk. Alternative C strives to use more prescribed burning to reduce fuels and achieve desired conditions but the amount of burning may be limited in some areas by the higher difficulty of burning areas with higher fuel loading and the same limited operating period constraints listed above in consequences common to all alternatives. There are additional limited operating periods for fisher denning habitat that were waived in the focus landscapes in alternative B but apply to alternative C. This makes it less likely prescribed fire could be applied to fisher habitat where additional restrictions apply for other wildlife. There would likely be less ecological restoration along ridges and some roads using mechanical treatment alone or in combination with prescribed fire, which would make it more difficult to manage wildfire to meet resource objectives. On the east side, there are fewer acres that would be restored in Jeffrey pine, pinyon-juniper, and sagebrush using mechanical treatment, prescribed fire, or wildfire managed to meet resource objectives. There would continue to be increases in the size and area in large, high-intensity fires.

Consequences Specific to Alternative D

Alternative D is proposed to have the greatest level of restoration treatments of all kinds (Table 6 through Table 8, chapter 2). Proposed plan direction guiding restoration treatments and fire management would be mostly similar to alternative B. There would be an emphasis on restoration in focus landscapes on the west side but the number of focus landscapes in westside mixed conifer and pine forests would double. Other treatment areas outside of focus landscapes would double as well. An estimated 30 and 50 percent of landscape areas would be restored in much of the westside montane and foothill landscapes. On the east side, a greater area is also restored, up to 30 percent. These increases in restoration are to levels where the fire-climate models predict there would be a leveling off or decrease in the current increasing trend of fire size and likelihood of very large fires (Table 20; Westerling et al. 2015). Given the combination of more restored areas that would be less susceptible to high-intensity fire, there is expected to be a decrease in the amount of crown fire and large patches of high-severity fire toward the natural range of variation. This would especially be likely in the focus landscapes, where it is expected that at least 40 percent of the area would be restored (see analysis assumptions). There would be substantially more ecological restoration of ridges and roads that that can provide more opportunities to

conduct large prescribed fires in steep areas (like in canyons) and to manage wildfire to meet resource objectives. This would increase the likelihood that more area is burned under low- to moderate-intensity conditions that decrease fuels, provide ecological benefits and further decrease the likelihood of large, high-intensity fires beyond the natural range of variation. There is uncertainty about how much smoke regulations and air quality management would affect this potentially greater amount of prescribed fire and wildfires managed to meet resource objectives.

Cumulative Effects

There are cumulative effects spatially, from the management of adjacent landowners, and into the future with foreseeable trends in climate, human populations, and fire. Climate trends are influenced by many factors outside of the direct influence of projects and indirect influence of the forest plan alternatives. Trends in large, high-intensity fires are influenced by restoration treatments in adjacent areas and in the numbers and types of ignitions and fire management policy. Large adjacent land managers include the National Park Service, managing Sequoia, Kings Canyon and Yosemite National Parks, and the Bureau of Land Management. There are also large areas of private land adjacent to and within the national forests in the analysis area. The Park Service emphasizes fire restoration and has cooperated with the Sequoia National Forest numerous times on management of wildfires to meet resource objectives in the Kings River Drainage (Meyer 2015). There are also smaller private in-holdings and adjacent private lands where restoration treatments may occur. The draft forest plans emphasize an all-lands-management and shared-stewardship approach and this would occur with alternatives B, C and D (FIRE-FW-DC-04 to 05; LAND-FW-DC-02; TRIB-FW-DC-02; LOC-FW-DC-02; FIRE-FW-GOAL-02 to 03; LOC-FW-GOAL-02; VIPS-FW-GOAL-01). This includes the following potential management approaches:

> Work with adjacent land management agencies to identify methods to reduce costs and increase effectiveness in restoring fire to the landscape.
>
> Prior to and during the fire season assess conditional thresholds under which desired conditions can be met for the strategic fire management zones (see management areas section in this chapter). Work with tribes and adjacent landowners to identify areas and resources of value considered in the assessments.
>
> Develop a partnership and volunteer strategy to define the types of projects suitable for partnership and volunteer opportunities, potential partners and volunteers, and the mechanisms for developing partnerships and volunteer agreements.

The cumulative effect has been that on adjacent National Park Service and Sequoia National Forest lands there is a high level of restoration that has been accomplished in the last 15 years, greatly reducing the probability of large, high-intensity fires in this area. The Bureau of Land Management manages fires similarly to the Forest Service although with more of an emphasis on fire suppression. There has been little wildfire managed to meet resource objectives on National Forest System lands near Bureau of Land Management lands. Trends in large, high-intensity fires are the same on lands managed by both agencies. There is little difference in the cumulative effects on lands adjacent to Bureau of Land Management land as a result.

In the low and mid-elevations, the invasion of non-native annual grasses into large areas of sagebrush and pinyon-juniper vegetation on the Inyo National Forest, is expected to continue. This will likely increase the frequency and size of fires. Non-native annual grasses are more flammable and create more continuous fuel conditions that make fire spread more extensively (Brooks and Minnich 2006, Klinger et al. 2006). Areas adjacent to the Inyo National Forest managed by the Bureau of Land Management and the Los Angeles Department of Water and

Power are both at risk of non-native plant invasions, spread, and associated increased fire size. The cumulative effect would be more fires burning across jurisdictional boundaries.

Population growth in California, and increases in visitors to the national forests in general are likely to result in more human-caused ignitions. Over 90 percent of unplanned wildfires are ignited by people (see "Fire Management" section). Some of the fires with the largest size and highest intensity that have occurred in the analysis area and nearby were caused by human ignitions. This includes the Rim (2013) and King (2014) Fires in the central Sierra Nevada. These types of fires become very large, very fast, and burn much of the area at very high intensity because of the combined effects of uniformly dense vegetation and high fuel loads, warming climate, drought, and increased human development in the wildland-urban intermix.

Natural ignitions may also increase in the Sierra Nevada with climate change, but future projections in lightning strike density are highly uncertain. This would have a cumulative effect of increasing the likelihood of large, high-intensity fires but to an unknown degree.

Analytical Conclusions

Under all alternatives, trends in climate remain the same but the landscape vegetation density and fuel levels would differ because levels and intensity of restoration differ by alternative. As a result of both of these factors, the likelihood of large, high-intensity fires differs among alternatives, even with climate trends that result in more severe fire weather. The likelihood of large high-intensity fires continues to increase under all alternatives in low and mid-elevations on the west side of the analysis area except in alternative D. In alternative D, levels of large, high-intensity fires may stay the same or may decrease because of the higher proportion of landscapes that are restored (Table 20). On the east side, with both alternatives B and D, there is a high likelihood that the trend in large, high-intensity fires may not get any worse (Table 20). On the west side in the foothills and montane forests, there is a reduction in the likelihood of large high-intensity fires in the focus landscapes with alternative B, but the trend is still increasing with climate change. Focus landscapes are only treated on a portion of the overall landscape on the Sequoia and Sierra National Forests.

There is more uncertainty in alternative B that larger landscape prescribed burning would occur compared to alternative D due to less understory fuels reduction in fewer mechanically treated areas and due to fewer available days for prescribed burning due to limited operating periods established for wildlife species. This increases the uncertainty that there would be enough treatment to decrease the trend in large fire size or area burned in large fires. In alternatives C and A there is a high likelihood that the current trend of increasing occurrence of large, high-intensity fires will continue or worsen. In all of the alternatives, any large area (greater than 12,000 acres) that has extensive restoration (greater than 40 percent) is likely to have a substantially lower probability of large, high-intensity fires and high-severity fire effects (Turner 1989, Wimberly et al. 2009, Parisien et al. 2008, 2010, 2012, Fites-Kaufman 2014, Coen et al. 2015, Westerling et al. 2015). This situation currently occurs in the Kern Plateau and is likely to continue and expand across more of that area.

Insects and Pathogens

Background

Native insects and pathogens are an integral part of forest dynamics and process of change in the southern Sierra Nevada. Pathogens, often called "diseases," are naturally occurring fungi or

plants and can play important roles creating cavities or snags used by wildlife. This section focuses on the insects and pathogens that affect trees.

Environmental factors such as drought, wildfires, or vegetation conditions strongly influence behavior of native insects and pathogens. While native insects and pathogens affect their host plants to varying degrees, some are considered key species due to their ability to cause wide-spread or severe losses. Species that can kill the most trees are listed in Table 21. In the table, "H" indicates relatively high ability to kill host trees; "L" indicates secondary or lower ability to kill host trees; and "O" indicates occasional hosts. White pine blister rust is a non-native invasive pathogen that is very deadly to white pines. Bark beetles are the leading cause of dying trees, and the recent outbreaks across western North America are the largest and most severe in recorded history (Bentz 2005). A 2009 update report from Western Forestry Leadership Coalition stated that between 2002 and 2003, acres affected by bark beetles increased from 4 million to 10 million acres across the west (Western Forestry Leadership Coalition 2009). Future projections estimate that bark beetle and other forest insect activity will increase because of climate changes such as elevated temperatures, frequent drought, and current high risk conditions (dense vegetation) of western forests (Bentz et al. 2010).

Table 21. Key forest insect and pathogen species of the southern Sierra Nevada

Key Pest Species	Host Trees
Western Pine Beetle	High: ponderosa pine
Mountain Pine Beetle	High: sugar pine, lodgepole pine Low ponderosa pine
Jeffrey Pine Beetle	High: Jeffrey pine
Fir Engraver	High: white fir, red fir
Pinyon Ips	High: single-leaf pinyon pine
Pine Engravers *(Ips* spp.*)*	High: ponderosa pine, Jeffrey pine, sugar pine, 5-needled pines*, single-leaf pinyon pine, lodgepole pine
California Flatheaded Borer	High: Jeffrey pine
Red Turpentine Beetle	Low: ponderosa Pine, Jeffrey pine, sugar pine, 5-needled pines*, single-leaf pinyon pine, lodgepole pine
Douglas-fir Tussock Moth	High: white fir
Dwarf Mistletoes	High: ponderosa pine, Jeffrey pine, sugar pine, lodgepole pine, white fir, red fir Low: 5-needled pines*, single-leaf pinyon pine
Heterobasidion Root Disease	High: white fir, red fir Low: ponderosa pine, Jeffrey pine, sugar pine, 5-needled pines*
Black Stain Root Disease	High: single-leaf pinyon pine
Armillaria Root Disease	Low: sugar pine, 5-needled pines*, lodgepole pine, white fir, red fir, incense cedar, giant sequoia, California black oak; Occasional: ponderosa pine, Jeffrey pine
White Pine Blister Rust	High: sugar pine, 5-needled pines*

* These include sugar pine, whitebark pine, and bristlecone pine

In 2011, the Forest Service produced a western bark beetle strategy to develop future prevention management strategies to mitigate the wide-spread epidemic of bark-beetle-killed trees occurring all through the western states (USDA FS 2011). The strategy is based on three primary goals: human safety, forest recovery, and long-term forest resiliency. High levels of bark-beetle-killed

trees create public safety concerns, due to the risk of hazardous trees falling on the public and damaging property. The rapid loss of trees affects ecosystem integrity, dramatically altering the structure and composition of vegetation and distribution of trees, which decreases stability of forests, and alters ecological function. After significant bark beetle infestations, forest stands may or may not return back to original conditions; dead trees can increase wildfire potential; and loss of keystone tree species affect associated wildlife or vegetation. Thinning treatments to reduce forest density toward the natural range of variation can make stands more resilient and reduce the likelihood of high levels of bark beetle mortality. Salvage logging after infestations can recover economic losses and create openings for reforestation, or improve overall human safety and recreational opportunities.

Analysis and Methods

There have been numerous research studies examining how forest conditions affect the likelihood and level of insect and pathogen impacts to trees. This includes measures of stand density, suitable diameter classes, or forest composition as potential risk factors for pest attack, especially bark beetles. Higher numbers of dying trees are often correlated with areas of densely growing trees for most bark beetles and their respective hosts. Drought conditions are included as a factor of likelihood that attacks will occur.

Despite measures that gauge insect and pathogen activity, discussions of environmental consequences of alternatives will be qualitative assessments. Insect and pathogen activity viewed at forest-level scales is addressed qualitatively since monitoring information is primarily based on general trends across the larger forested landscape. The levels of insect and pathogens were compared with information on reference conditions, or what is within the natural range of variation (Safford et al. 2013; see “Terrestrial Ecosystems” section). These are referred to as “background levels.”

Indicators and Measures

Effects and impact severity due to forest insects and pathogens are often measured by several factors: affected acres, trees killed per acre, or percentage of trees affected. Annual aerial surveys are conducted by the Forest Health Monitoring Program under the Forest Service’s State and Private Forestry Program, which visibly detects and records areas of dying trees caused by forest insects and diseases on the landscape. The Forest Service’s Forest Health Protection Program has multiple tools in which to evaluate measures. Numbers of trees dying that are higher than background levels are often indicators of increasing pest activity or areas of growing infection by diseases. Unusual patterns of dead trees with particular host plants can also indicate pest presence. Compilation of acres affected or trees killed can provide indications of trends emerging on the landscape.

Forest Health Technology Enterprise has developed computer modeling tools that assess loss risks from forest pests based on current stand conditions (USDA FS 2012a). Gradations of risk are assessed up to greater than 25 percent basal area lost; considered the highest risk over a span of 15 years. Maps of specific locations or forests can be developed which assess levels of risk.

Assumptions

Most forest insects and pathogens are native. Current conditions of dense forested stands or predominance of shade-tolerant trees have significantly changed forests from the historic range of natural variation (Safford 2013; Meyer 2013a, 2013b, Slaton and Stone 2013a, 2013b). In

general, bark beetles target dense stands because the host trees in these conditions are often stressed and weakened due to high competition for water. Drought further stresses trees, triggering increased bark beetle attack. These trees are less able to produce resins that they use to fend off bark beetles that drill into the bark. For ponderosa pines in California, studies determined that stands with highest densities are most often first infested (Oliver 1995, Hayes et al. 2009). If droughts become more frequent, of greater intensity, or last longer in the future, higher levels and more wide-spread bark beetle-caused mortality should be expected.

Trees killed by insects and pathogens do provide important contributions to ecosystem function when they are at levels within the natural range of variation. Bark beetles and wood boring insects provide forage for wildlife (such as woodpeckers). Dead trees, standing or down, create essential habitat and organic biomass for forests. Trees killed by native insects and pathogens can result in small-scale disturbances that keep forests dynamic and regularly changing, by creating small openings and increasing heterogeneity (Fettig 2012). Native insects and pathogens are also used by Native American tribes. For example, in eastside forests, tribes use Pandora moth larvae as a traditional food source. Mushrooms, the fruiting bodies of pathogens, are used as food and medicine by Native American tribes as well.

Restoration treatments in forests to reduce tree density can restore forests to conditions similar to the natural range of variation, and associated background levels of insect and pathogen-related tree mortality (Fettig 2012). Reduced tree density, more varied structure, and diverse tree composition will significantly reduce susceptibility of trees to attack and infection and improve individual resistance mechanisms (Smith 2007, Fettig et al. 2007). One measure of forest density that is used to evaluate susceptibility to bark beetles, is stand density index. This measure is weighted by tree size, so forests dominated by small trees have higher index levels. This is because more small trees can “crowd” into the same space as fewer large trees. Light thinning, and especially thinning limited to small trees, may not reduce stand density index sufficiently to alter conditions that attract bark beetles (Oliver 1995). Prescribed fires alone may not reduce stand density index sufficiently if they are low intensity and can create situations that make trees more vulnerable to attack in the short term (Fettig et al. 2008). However, large wildfires managed to meet resource objectives can result in significant reductions in forest density and reduced susceptibility to insect attack (see “Affected Environment” section below). This is evident in the current outbreak where lower levels of dying trees are occurring on the Kern Plateau where extensive managed fires have occurred in the last 15 years (Meyer 2015). Heterogeneity across the landscape can also disrupt the expansion of insect activity. Variation of tree size, age, or species composition may limit the amount of suitable host material and, thus, reduce the number of dying trees (Fettig 2012).

The effects of treatment on insect and pathogen levels and susceptibility vary some by treatment type and combinations. Combinations of mechanical and prescribed fires have been found to be less attractive to bark beetles than prescribed fire treatments alone, as well as improving overall tree health and growth (Feeney et al. 1998, Wallin et al. 2008). Fire may result in heightened bark beetle activity due to the nature of injury that fire causes. Crown and bole scorch severity are two of the primary factors used to gauge tree survival but also susceptibility to bark beetle attack (Hood et al. 2007, Smith and Cluck 2011). Studies on bark beetle impacts followed by prescribed fires have determined that the likelihood of bark beetle infestation significantly increases with burning alone (Fettig et al. 2008, Fettig and McKelvey 2010). Therefore, it is important to recognize potential subsequent effects following a burn when drought events or underlying resource stress (such as high tree densities) are also present.

Affected Environment

Current forest conditions are considered outside of the natural range of variation and prone to insect and pathogen outbreaks beyond background levels. Recent and ongoing, widespread, high levels of insect-related tree mortality reflect these conditions, magnified by drought (Asner et al. 2015) and temperature increases (van Mantgem et al. 2009). Past management activities have changed forest structure, leading to changes in tree species diversity, age classes, and density.

Bark Beetles

Currently, there are extensive areas of very high drought and insect-related mortality occurring on the lower slopes of the Sierra and Sequoia National Forests (see Figure 8 and Figure 9). These levels are greater than what has occurred in the last 50 years but there have been other outbreaks of note as well. Over the past four decades, California has experienced significant drought events that have triggered unprecedented levels of bark beetle-associated tree mortality. From 1992 to 1994, more than 1,430,000 acres (primarily true firs) were killed statewide; in 2002 to 2005, over 6,688,400 acres of pines were killed, primarily in southern California forests; and recently since 2006, upper montane whitebark pine forests have lost over 50 percent of overstory trees, with new patches of dead trees developing annually.

Figure 8. Photo of dead and dying ponderosa pines in the foothill zone of the Sierra National Forest, fall 2015

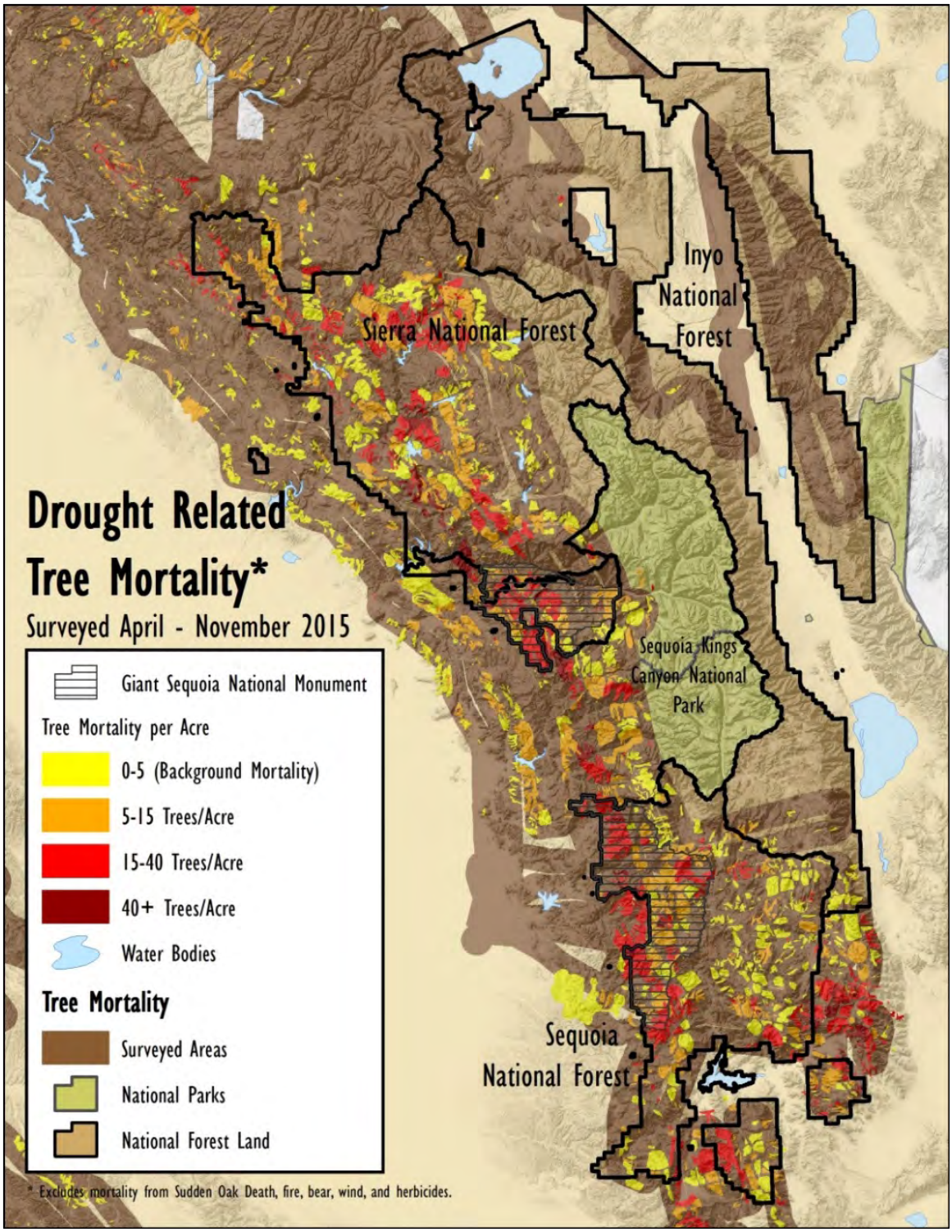

Figure 9. Drought and insect-related mortality in the southern Sierra Nevada based on aerial surveys by the Pest Management Program (from late fall 2015)

These levels are greater than what has occurred in the last 50 years but there have been other outbreaks as well. Over the past four decades, California has experienced significant drought events that have triggered unprecedented levels of bark beetle-associated tree mortality. From 1992 to 1994, more than 1,430,000 acres (primarily true firs) were killed statewide; in 2002 to 2005, over 6,688,400 acres of pines were killed, primarily in southern California forests; and recently since 2006, upper montane whitebark pine forests have lost over 50 percent of overstory trees, with new patches of dead trees developing annually.

On the Inyo National Forest, the greatest concern is loss of pinyon and keystone high elevation species, such as whitebark pines. Since 2006, more than 61,000 acres of whitebark pine, an estimated 425,000 trees, have been affected by mountain pine beetle in California. Eighty to 88 percent of the basal area has been lost in some areas of the Inyo National Forest (Meyer et al. 2014). Pinyon *Ips*, often in association with black stain root disease, is building in scattered locations of the Inyo National Forest, most recently in the Inyo and White Mountains.

Defoliators

Other insects that cause noticeable and significant damage have been defoliators, insects that eat the needles or leaves of trees and can kill the trees when attacks are severe. The native Douglas-fir tussock moth cycles in population boom and bust every 7 to 10 years. White firs are its primary host, but other neighboring species can be affected if populations are high. From 1996 to 1999, 44,000 acres in Sequoia-Kings National Park and Sequoia National Forest were defoliated; about 5,800 acres were severe (USDA FS 2015). Pandora moth is infrequent, but outbreaks can cause severe localized damage. Both insects become public safety hazards: Douglas-fir tussock moth larvae have urticating hairs that cause severe respiratory problems in sensitive individuals; Pandora moth larvae can become so numerous on roads or other public settings to create treacherous conditions. Pandora moth, however, is also a valued resource collected by tribal members.

Dwarf Mistletoes and Root Diseases

Dwarf mistletoes and root diseases can have profound long-term effects on forest structure and composition. Forest pathogens work slower than insects in killing individual tree hosts by extracting water and photosynthates, crippling and deteriorating tree metabolism and vigor. Infected hosts are thereby more susceptible to structure failure or attack by secondary pests that eventually kill the tree. Dwarf mistletoes are highly evolved parasitic plants that persist on individual trees for decades causing dieback or severely reducing growth and development. *Heterobasidion* spp. is the most common root disease found in the southern Sierra Nevada forests. True firs are highly susceptible to *Heterobasidion* infection. *Ips confuses* beetle attacks are commonly associated with prior infections of black stain root disease in pinyon pines. Black stain root disease is more prevalent in eastern Sierra Nevada pinyons.

Non-native Insects and Diseases

The most damaging conifer pathogen in California, white pine blister rust was introduced to the west coast of North America in 1910 on infected imported plant seedlings. White pines are all susceptible to white pine blister rust in laboratory studies, but only sugar pine and western white pine have been confirmed with infections so far. Recent surveys of white pine blister rust have found very low incidence in the southern Sierra Nevada national forests (Maloney 2011). However, preliminary research from Sequoia and Kings Canyon National Parks found a doubling to 45 percent white pine blister rust infection levels in western white pines since the initial survey conducted in the early 1990s (M. Cahill, University of Vermont, personal communication, 2013).

The pathogen has not yet been found on eastside forests, but is continually expanding its range as observed in northwestern forests and Rocky Mountains. It continues to be a serious threat to white pines as climate conditions change and pathogens are easily transported through other pathways.

Expected Trends

Forest Health Monitoring risk maps (USDA FS 2012b) show substantial risk of increased tree mortality (greater than 25 percent basal area lost) in the next 15 years due to bark beetles and other pest complexes (see maps in the Insect and Pathogen supplemental report). Data from these maps are summarized in Table 22.

Droughts may become frequent and prolonged, and it can be expected that mortality will be proportional (Smith 2007). Warming and drying climate are expected to greatly increase the likelihood and risk of widespread and elevated insect and pathogen outbreaks (Fettig 2012).

Table 22. Summary of percent area at risk by basal area loss categories for the Inyo, Sequoia, and Sierra National Forests

Percent Basal Area Loss (%)	Percent Area at Risk Inyo National Forest	Percent Area at Risk Sequoia National Forest	Percent Area at Risk Sierra National Forest
1-4	10%	8%	7%
5-14	23%	27%	24%
15-24	14%	20%	20%
>25	53%	45%	49%

Environmental Consequences to Insects and Pathogens

Consequences Common to all Alternatives

All forested lands are affected by native insects and diseases. With the exception of a few introduced insects and pathogens, forests in the Sierra Nevada have the same insect and disease associates they had 100 to 150 years ago. Every tree species has its complement of pest hosts that cause natural mortality and generate small-scale ecosystem disturbances. As opportunists when favorable conditions arise, bark beetle-associated activity can be expected to increase if current forest conditions remain unchanged or limited. If bark beetle attack potential is not mitigated, stands categorized as high risk may experience undesirable levels of dead and dying trees during times of drought or other conditions that are conducive for insect population growth and expansion. Climate change, urbanization, large wildfires, and chronic elevated ozone pollution levels all influence forest resilience to insects and pathogens in addition to the proposed restoration treatments.

All alternatives have measures to limit the spread and infection of non-native invasive insects and pathogens. This includes white pine blister rust.

Consequences Specific to Alternative A

Alternative A would have limited areas of restoration (Table 6 through Table 8, chapter 2), including thinning from mechanical treatment or moderate intensity prescribed fire that would reduce the risk of bark beetle outbreaks. There would continue to be large areas at high risk of bark beetle-caused tree mortality beyond desired condition levels. Trees in dense stands, outside of the natural range of variation, would continue to experience high tree-to-tree competition for

water. Water stress from dense, competing trees as well as potential drought, compounded with pathogens such as root disease or dwarf mistletoes would combine to further weaken trees, inciting secondary insect attacks (beetles). Current elevated levels of tree mortality would be likely to continue now or develop again in the near future with drought and temperature increases.

Consequences Specific to Alternative B

In alternative B, more forested acres are proposed to be treated whether with mechanical thinning, prescribed fires, and wildfires managed to meet resource objectives (TERR-FW-OBJ-01 to 04; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OGJ-01). This reduction of overall tree density across the landscape should reduce the likelihood of bark beetle infestations growing to epidemic levels within treated areas. This is because increased restoration treatment rates under alternative B would reduce stand densities, increase heterogeneity, and restore tree composition to conditions aligned with the natural range of variation (TERR-POND-DC-01 to 05; TERR-DMC-DC-01 to 06; TERR-MMC-DC-01 to 06; TERR-RFIR-DC-01 to 07; TERR-UMJF-DC-01 to 07; TERR-MCHP-DC-01 to 02; TERR-PINY-DC-01 to 05; TERR-MJF-DC-01 to 07). Reducing density would reduce moisture stress to individual trees (trees have greater capacity to resist insect attack via pitching response) and reduce the likelihood that stands would support pathogen spread and insect eruptions. Greater heterogeneity in the forests, species diversity, and variations in spacing and structure may limit pathogen spread through root-to-root contact or canopy-aided dispersal. In alternative B, increased mechanical treatments in the focus landscapes and along ridges and roads would be particularly effective at enhancing the resilience of forest ecosystems to undesirable impacts by insects or pathogens, especially in low- to moderate-elevation forests such as mixed conifer, ponderosa pine, and Jeffrey pine forests (see management approaches discussed in “Fire Trends” section).

Consequences Specific to Alternative C

Alternative C would have lower levels of mechanical thinning than alternative A with more emphasis on prescribed burning and wildfire managed to meet resource objectives (Table 6 through Table 8, chapter 2). As a result there would continue to be high levels of risk to bark beetle-associated mortality unless the burned areas are extensive and moderate intensity with substantial reduction in tree densities. If the focus of mechanical treatments is removing smaller diameter trees, limited changes to current forest conditions may serve to perpetuate the risk of insect and pathogen outbreaks in many areas. The exception includes the wildland-urban intermix defense zone, where mechanical treatment rates under alternative C would be similar to alternatives A and some reduction in stand density would occur nearest to communities. There may be increased levels of bark-beetle infection in areas treated with burning alone, particularly when it occurs in dense stands where the trees are already stressed (Fettig et al. 2008, Fettig and McKelvey 2010).

Consequences Specific to Alternative D

Alternative D would have similar consequences as alternative B but over substantially more area. Increased levels of thinning, prescribed fire and wildfire managed to meet resource objectives proposed in alternative D (Table 6 through Table 8, chapter 2) would result in decreased levels of bark beetle activity in forest ecosystems. Alternative D would increase the pace and scale of forest restoration toward desired conditions and greatly improve forest resilience over larger spatial and longer temporal scales. Insect and pathogen outbreaks under this alternative would be more limited to localized, endemic levels that closer resemble historic conditions (Savage 1994). Trees in restored stands would have improved access to water and resources and lower competition for water. This would allow trees in restored stands to more rapidly recover after

drought or wildfire, and gradually adjust if climate conditions continue upward trends (North 2012, Fettig et al. 2007).

Cumulative Effects

There can be cumulative effects resulting from management of nearby lands under different ownerships. Insects and pathogens can increase on adjacent lands and spread to national forest lands. Similarly, insect and pathogen outbreaks can spread from national forest lands to adjacent lands.

There are three different types of land ownership adjacent to national forest lands, each with varied capacities and likely forest management approaches that affect insect and pathogens. First, there are other Federal lands including Sequoia and Kings Canyon and Yosemite National Parks. Second there are urbanized or developed areas. Third, there are larger private land owners that actively manage the forests including private timberlands and utility companies.

There an emphasis on prescribed and managed fires and little mechanical thinning in national parks. This could result in different elevated mortality levels and potential spread to national forest lands, but to date mortality levels have been similar or less (see Figure 9). It could be that elevated mortality on national forest lands has resulted in elevated mortality levels on national park lands.

Forests on small private lands are often very dense, because trees are retained as natural screening or shading. There is a higher likelihood of root damage near structures and roads that can increase susceptibility to pathogens. This can increase the likelihood of insect and pathogen attack and may increase the spread to national forest lands but the amount of area in this condition is small. On the other hand, the recent bark beetle outbreaks within and surrounding Sequoia and Sierra National Forests may result in spread and elevated insect and pathogen levels in forests on those private lands. This spread may also occur to forests managed by larger private land owners.

Analytical Conclusions

Common consequences for all alternatives are such that (native and invasive) insect and disease activity would continue to persist, and effects to trees would occur regardless of treatments under all alternatives. The differences lie in the levels of intensity and severity of outbreaks; in particular, levels of tree mortality. Eastside and westside forests of the Sierras will experience varying degrees of mortality as insects and pathogens continue to target stands of highest risk (stands with highest stand densities and greatest moisture stress).

While alternative B allows for restoration treatments on the landscape, including the use of mechanical thinning, wildfire and prescribed fires, climate change predictions that forecast warmer, potentially drier temperatures in the next few decades may occur before much of that restoration is completed. With the greater rate and amount of restoration, alternative D may more rapidly prepare for these conditions. The trend of large-scale wildfires on an annual basis in California has increased urgency for developing resiliency and resistance to elevated forest pest levels and in current forest structures.

Management direction of alternatives A and C would not sufficiently reduce stand density, structure, or microsite conditions that are conducive to bark beetle-associated tree mortality, especially during periods of drought (Smith 2007). Ponderosa pine stands in California need lower stocking thresholds to prevent losses beyond background levels (Oliver 1995). The level of treatments proposed for alternative D followed by alternative B would be most effective to

prevent bark beetles, such as western pine beetle, from reaching regional and bio-regional scales as is currently happening in the southern Sierra Nevada.

Combined Effects of Climate, Fire, Insects, and Pathogens

Terrestrial Ecosystems

Climate, fire, insects and pathogens all influence each other. Various aspects of how they influence each other are discussed in the individual subsections above. It is important to also consider them as a whole, since they all affect vegetation and are affected by vegetation condition. For the forest plans, the primary means of altering ecosystems is management of vegetation condition. In this subsection, the cumulative effects and analytical conclusions for climate, fire and insects and pathogens on vegetation condition and management are considered. More detail on the combined effects of climate, fire, insects and pathogens is described in the Vegetation Resilience supplemental report.

Cumulative Effects

The conceptual diagram below (Figure 10) shows how each of these agents of change influence each other and vegetation condition. In the diagram, the direction and weight of arrows show how each agent of change and vegetation relate to each other. Although the way fire is managed may vary, fire will occur regardless at some point in time because the plan areas are dry and fire prone, with regular ignition sources (lightning and human-caused).

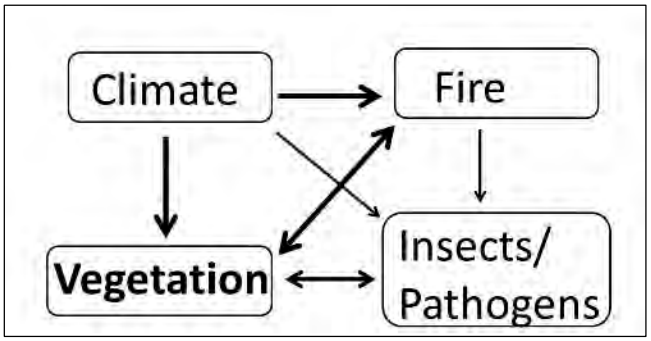

Figure 10. Conceptual diagram of the interaction between climate, fire, insects/pathogens and vegetation

Starting with vegetation and moving clockwise around the diagram:

- Vegetation is in bold, because this is the only aspect of ecosystems that can be directly influenced by forest plan direction.
- Climate influences vegetation, fire, and insects and pathogens directly through temperature and moisture changes.
- Fire influences vegetation, and vegetation influences fire. The arrow between fire and vegetation is bold because there is a strong influence of vegetation on fire and vice versa.
- The arrow that goes from fire to insects and pathogens is thinner because most of the influence of insects and pathogens is through the changes it causes in vegetation.
- The changes insects and pathogens have on vegetation change fuels, which then influences fire.

These interrelationships mean that cumulative effects are interrelated. As described above in the previous subsections, there has been and will continue to be a trend of warming climate, increased fire, and increased insect, pathogen, and disease levels and vegetation-related mortality. Effects on vegetation are magnified where vegetation structure and composition are outside the

natural range of variation. There is a large proportion of the middle and lower-elevation landscapes that are outside the natural range of variation and are highly departed from the vegetation desired conditions (see the "Terrestrial Ecosystems" section). Denser vegetation has a lower resilience to climate change, fire, insects, and pathogens. Composition that has shifted toward dominance of less drought- and fire-tolerant species has decreased resilience. Non-native plant species may increase with climate change and changing fire, especially in eastside sagebrush, pinyon-juniper, and desert ecosystems. This is beginning to cause a negative feedback with increased non-native plant invasions causing more fire, which causes more invasions.

Analytical Conclusions

Three factors most important in changing ongoing and reasonably foreseeable future effects of climate, fire, insects, and pathogens on vegetation condition include the pace, scale, and intensity of restoration to change vegetation conditions toward desired conditions. The alternatives vary in the pace, scale, and intensity of restoration, particularly in the low and mid-elevation areas including ponderosa pine, mixed conifer, Jeffrey pine, pinyon-juniper and sagebrush vegetation types.

Alternative D has the greatest amount of restoration treatment (pace), across the largest area (scale), with the greatest certainty of moving vegetation toward or achieving desired conditions (intensity) in treated areas. This would be through extensive thinning, prescribed fire and more opportunities for wildfires managed to meet resource objectives. There would be twice as many focus landscapes where limiting wildlife plan direction is waived or reduced, allowing more intensive treatments and high likelihood of fully achieving the vegetation desired conditions. Up to half of the landscapes most departed from desired conditions would be restored within the next 10 years in alternative D and be resilient to fire, climate, drought, insects and pathogens.

Alternative B would have the second most amount of restoration, but it would be concentrated in a less extensive portion of the national forests, in 15 to 25 percent of the lower and mid-elevation forested or sagebrush and pinyon-juniper areas. Outside of focus landscapes, there would be limitations on the intensity of restoration from canopy cover retention requirements for California spotted owl and Pacific fisher. In these areas, only part of the desired conditions would be achieved. There is a moderate level of uncertainty that only some of the prescribed fire objectives in alternative B would be achieved because of more limitations on prescribed fire in riparian and old forest wildlife habitat. Most of the landscape would continue to have low resilience to climate change, fire and insects and pathogens.

Alternatives A and C would likely have the lowest pace, scale, and intensity of restoration because they have the least amount of active mechanical and potentially prescribed fire treatments. Although there is more planned prescribed fire in alternative C (except for the Sequoia National Forest), there are more limitations on restoration because of canopy cover retention requirements for the California spotted owl and Pacific fisher that make prescribed fire more costly and difficult. There would be less mechanical treatment and less resulting restoration of ridges and roads that could be used to "anchor" off of for large prescribed fires.

Overall, only alternative D would have a substantial change in vegetation across enough area to limit the negative impacts of climate change, large high-intensity fire and elevated insect and pathogen levels. Alternative B would have some landscapes where the negative impacts would be moderated, but most of the landscape would be vulnerable.

Revision Topic 1: Fire Management

Introduction

Wildfire has and will continue to affect vegetation and ultimately be a primary driver of change to ecosystems in the Inyo, Sequoia, and Sierra National Forests. Wildfire has been a vital part of the Sierra Nevada range for centuries. Many of the ecosystems that make up the three national forests have been shaped by the way fire moved across the landscape in the past as well as by the lack of fire in recent history. The historic role of fire in reducing fuels was nearly eliminated with 100 years of effectively suppressing fires. Fire management has gone through several changes over the last few decades; transitioning from a more suppression-focused approach to moving toward a more managed approach.

Decades of fires suppression, buildup of vegetation and forest debris, and more recently, drought and climate change have caused wildfires to grow larger and become more destructive (see the "Climate Change" and "Fire Trends" sections). Limited funding for prevention programs and many challenges to implement fuel reduction projects have resulted in limited progress toward reducing the compounding effects of decades of suppression and an increase in the frequency of large, high-intensity wildfires. The number and extent of wildfires in the western United States each season is driven by natural factors such as fuel availability, temperature, precipitation, wind, humidity, and the location of lightning strikes, as well as human factors. It is well known that climate fluctuations significantly affect these natural factors, and thus the severity of the western wildfire season, at a variety of temporal and spatial scales (Westerling et al. 2003). Unwanted wildfires are those that have the potential to damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and destroy homes and communities in the wildland-urban intermix. Other wildfires burning under more desirable conditions provide an opportunity to be managed to meet resource objectives.

The increase in wildfires in western U.S. forests is related to warmer spring and summer temperatures, reduced precipitation associated with warmer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons in some middle upper elevation forests. These conditions can be attributed to climate change (Westerling and Bryant 2008). As the climate becomes warmer and drier, vegetation becomes drier, stressed, and more susceptible to insects and disease, and is more likely to be consumed by fire. Traditionally, fire season in California was from May to September. Recently, fires have occurred throughout the year more regularly, resulting in an almost year-round fire season. Not only are fires occurring more frequently outside of the traditional fire season, they are much more intense causing more severe and long-lasting damage to the vegetation and soils. Large-scale and long-duration droughts may occur and will increase the potential for fires to burn larger and with higher intensity than desired. The result of this type of changing climate is likely to be larger, more damaging wildfires with fewer opportunities to manage wildfires to meet resource objectives or to conduct prescribed burns.

Increased amounts and duration of smoke produced from large wildfires is likely to continue to impact population centers, including those long distances from the fire. Increases in wildfire smoke emissions may have detrimental impacts on air quality and, combined with a growing population, may result in increased population exposure to unhealthy air pollutants (Hurteau et al. 2014). Wildfires may occur during times of unfavorable atmospheric conditions resulting in a

compounded impact. However, substantially increasing the amount of fire restored to the landscape will require societal trade-offs, such as accepting more smoke from prescribed fires and managed wildfires versus continuing to live with high wildfire risk. When evaluating these tradeoffs, the costs to society, such as short-term versus long-term air quality impacts, must be considered in the context of doing nothing (Hurteau et al. 2014). Emissions from prescribed fires are typically lower than those from wildfires burning the same area (Wiedinmyer and Hurteau 2010). Prescribed fires are planned with careful consideration of smoke to limit human health impacts, impacts to transportation corridors, and smoke-sensitive populations. Atmospheric dispersion (how pollutants disperse throughout the atmosphere) influences smoke behavior. By limiting the amount of fuels available to wildfires, impacts to air quality from future wildfires will likely be reduced. Since wildfires that are managed to meet resource objectives burn over many days, they may burn during unfavorable conditions such as during high ozone days; however, long-term benefits exist as fuels available for future wildfires will be diminished. See the "Air Resources" section for more information.

Wildfire suppression costs have increased significantly over the last decade (Association for Fire Ecology et al. 2015). This fact, coupled with decreasing or static budgets for fuels management, presents serious challenges to fire managers and increases the risk of continued large and high-intensity wildfires. A way to address these issues is to use a risk-based approach to guide the future management of wildfire. The concept of managing for fire risk can be thought of as similar to the concept of the financial risk of investing. If you had a wide range of financial investment options and no risk information to manage the uncertainty of each option, would you invest at all? Not likely; you would want information up front on dealing with the uncertainty of the investment, such as what is the likelihood you would increase your investment and what is the likelihood you would lose your investment. In both financial investing and investing to change wildfire outcomes, timely upfront information on risk is essential to making informed decisions.

Fire Management

Background

Fire management includes the strategies and actions used both before and during wildfires. Management of wildland fire (wildfire and prescribed fire) influences whether fire effects are beneficial or cause negative impacts to values such as water quality, air quality, habitat, recreation areas, or communities. Wildfire management includes a spectrum of responses from full suppression to managing a fire to meet resource objectives. Suppression is a management action used to extinguish or confine an unwanted wildfire at its discovery. The term used for naturally ignited wildfires that are managed to reduce fuels and improve ecosystem health is "manage wildfires to meet resource objectives." This term is used throughout the document. These fires tend to have effects that are similar to or trend toward those that would have occurred historically. Managing wildfires to meet resource objectives is a strategic choice to use unplanned wildfire ignitions to achieve resource management objectives and ecological purposes under specific environmental conditions. The benefits of managing wildfires to meet resource objectives include reducing fuels so that future fires burn in that area with lower intensity, lower impacts, and reduced smoke, are more manageable, and pose less threat to communities. Managing wildfires to meet resource objectives allows fire to resume its natural role in the ecosystem under pre-identified objectives and conditions. By allowing this to occur, the results are a healthier ecosystem. Fire can create a diversity of habitats, cycle nutrients back into the soil, and reduce dense areas of vegetation, which improves vegetation health.

Fuel reduction treatments include prescribed fire and mechanical treatments which are designed to change the amount, configuration, and spacing of live and dead vegetation. Prescribed fires are fires intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives. Mechanical treatments are changes made to vegetation composition and structure (by cutting, thinning, or pruning) and changes made to forest fuels to reduce fire hazard. Mechanical treatments are often followed up with prescribed burning. The costs, environmental impacts, and effectiveness of different fuel treatment types vary. The desired outcomes of fuel reduction treatments are less intense fire behavior and reduced severity during wildfires, moving the area toward the natural range of variation, less tree mortality post fire, and reduced amounts of smoke. Strategically located fuel reduction treatments also provide more opportunities to proactively manage the size and costs of future wildfires.

Managing wildfires can be difficult because of smoke impacts, proximity to human communities, and liability and cost constraints (Quinn-Davidson and Varner 2012). In addition, policy and management requirements also factor into how wildfires are managed. For example, Forest Service fire policy (Forest Service Manual 2320) states that in wilderness, fire should be allowed to play its natural role as nearly as possible but this presents challenges if the fire has the potential to burn outside of wilderness areas and threaten communities or other resource values. Mechanical treatments have their own set of legal, operational, and administrative constraints, limiting the location and extent of treatment (North et al. 2015), including exclusion in wilderness. Forest and wildland fire managers in the southern Sierra Nevada currently have the ability to more holistically manage wildfire by incorporating the management of wildfires to meet resource objective within the forest plans (Meyer et al. 2015).

Holistic wildland fire management can be thought of as an approach that simultaneously considers the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs. There are multiple factors that make it difficult for forest managers to incorporate a more holistic approach into fire management. Some of these factors are risk aversion, sociopolitical pressures, and a resulting propensity to choose the status quo fire response of suppression. These factors do not improve resource conditions and create a positive feedback loop; this is known as the "fire paradox," in which aggressive suppression today leads to accumulation of fuels and worse fires in the future (Arno and Brown 1991). This in turn leads to continued excessive suppression expenditures (Thompson et al. 2013). Society's expectation that fires are aggressively suppressed is well ingrained, regardless if the fires might meet the objectives of current policy.

National Cohesive Wildland Fire Management Strategy

Increasingly, wildfire management is being viewed as a form of risk management, with a corresponding increase in analytical rigor and alignment with risk management principles (Calkin et al. 2001). Through planning, risk analysis, and collaboration between stakeholders, a broad coalition led by the Western Governors' Association and Federal land management agencies (USDA Forest Service and Department of Interior agencies) developed the "National Cohesive Wildland Fire Management Strategy" to establish a national vision for fire management (referred to hereafter as the Cohesive Strategy). This strategy defines goals, describes wildfire challenges, identifies opportunities to reduce wildfire risk, and is the basis for the fire management strategies in the alternatives considered for revising the forest plans.

There are three primary goals to the Cohesive Strategy: (1) restore and maintain landscapes, (2) create fire-adapted communities, and (3) respond to wildfires safely and effectively. A risk-management approach serves as the foundation for all fire management activities. To restore and

maintain resilient landscapes, risks and uncertainties relating to fire management must be understood, analyzed, communicated, and managed as they relate to the cost of doing or not doing an activity. To create fire-adapted communities, it is imperative to work with partners and use a risk management approach to identifying communities at risk and help protect these communities. A safe and effective response to wildfire requires moving beyond an emphasis on suppression and considering a more holistic way to meet resource objectives.

Funding is limited and there are not enough resources to reduce fuels with mechanical or prescribed fire treatments alone to change fire dynamics on a landscape scale. Managing wildfire to meet resource objectives is the most effective and efficient way to reduce fuels, effectively reduce the risk to communities and resources (such as water sources or habitat), and restore and maintain landscapes. Areas where fires were historically frequent can derive ecological benefits from fires; vegetation health is improved, habitat is improved, and species benefit.

Wildfire Risk Management

Wildfire risk management is the process whereby management decisions are made and actions taken concerning control of risk and acceptance of remaining risk. It involves identifying, assessing, and prioritizing risks followed by the coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events (Calkin et al. 2011). Wildfire risk management is often supported by a scientific assessment that can be used to determine where individual wildfires are likely to have negative or positive outcomes. It is based upon a detailed quantitative analysis of the location of values at risk (such as water sources, communities, or recreation sites) and the likelihood of fire starts (often called "ignitions"), fire spread, and fire intensity. For the forest plans and alternatives analyzed in this draft environmental impact statement, we conducted a wildfire risk analysis to evaluate the alternatives and develop science-based management areas for strategic fire management zones. The strategic fire management zones for the alternatives are described briefly in chapter 2 and in more detail on page 96. In the next section, a brief description of the underlying analysis for the wildfire risk assessment is described. This includes what values at risk were included and the relative ranking of each.

Fire Management Considerations

A strategy to address the need to change fire management includes recognizing constraints, acknowledging the ecological role of fire, aligning procedures with policy, and managing risk to the extent possible.

Recognize Constraints to Fire Management

Recognize that in general there are a very large number of burnable acres of National Forest System lands that cannot be actively managed by mechanical means, and an even larger number that cannot be economically treated with prescribed fire. Appropriately managing wildfire in places with an opportunity to obtain resource benefits and a low risk of potential damages may be the only way in many areas to increase the pace and scale of ecosystem restoration activities. Continued risk-informed management of wildfire would also need to include a method to maintain areas once restoration has occurred.

Acknowledge the Ecological Role of Fire

Acknowledge the ecological role of fire but also be cognizant of the fact that many fire regimes in the southern Sierra Nevada are currently highly altered and will stay altered because many sociopolitical concerns affect how wildfires are managed and how fuels are treated. Accepting

that fire regimes are altered is not a defeat; it is an acceptance of the world we live in today. We need better wildfire outcomes; some outcomes that are not desired but are less impactful than the worst wildfires may be more acceptable as long as they ultimately enhance and maintain what we value. The goal of ecological restoration is not to return the landscape to its historical fire regime (because such an outcome is not realistic with the extent of human influence), but instead to have forests that are sustainable and resilient to expected changes over time.

Align with Policy

The 2009 "Guidance for Implementation of Federal Wildland Fire Management Policy" directs Federal agencies to manage wildfires to accomplish protection and resource objectives. A wildfire may be concurrently managed for one or more objectives and these can change as fire spreads across the landscape. Objectives for wildfires are affected by changes in fuels, weather, and topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives. This guidance requires land managers to address the location and conditions under which resource benefits and protection objectives can be met in forest plans.

The "wildfire management continuum" was created to visually depict how wildfires may be managed for one or more objectives (Thompson et al. 2016). Using risk management results according to the dimension allow for the landscape to be zoned according to broad categories. The strategic fire management zones highlights where the objectives can be met under a wide range of fire season conditions. The basics of the wildfire management continuum can be described according to four dimensions (see Figure 11).

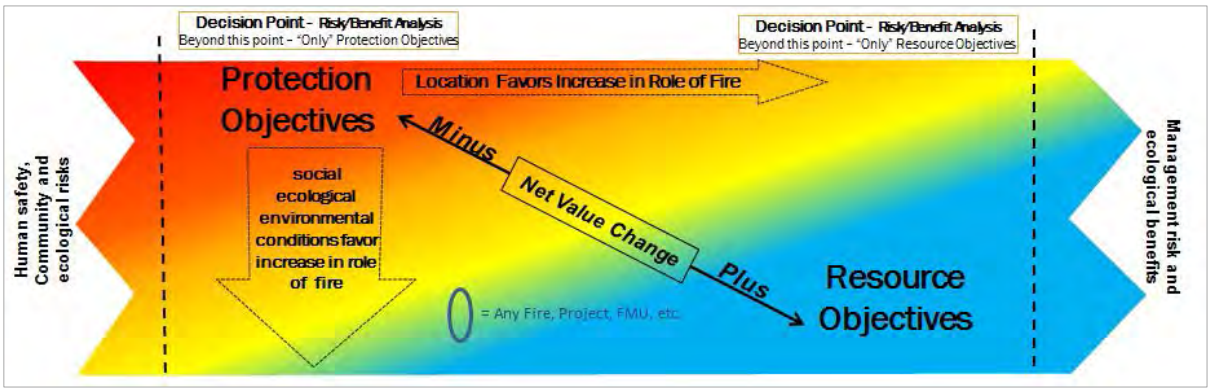

Figure 11. The wildfire management continuum

- The length (side to side) of the continuum shows the spatial component, or the location on the landscape. The location also affects the mix of objectives: on the left, it favors protection objectives, whereas on the right it favors resource objectives.
- The width (up and down) of the continuum illustrates the different social, ecological or environmental conditions affecting the mix of objectives. On the top, protection objectives prevail, whereas on the bottom resources objectives are easier to obtain.
- The colors depict the range of objectives, taking in the combination of both location and conditions. Red (upper left) represents how the combination of conditions and landscape location can experience higher risks to communities or ecological resources, which result in protection as the predominate objective. Blue (lower right) has the combination of low-risk conditions and landscape location that make managing for resources the primary objective.

The colors also represent the net value change to natural resources and community assets; red indicates a negative change (damage) while blue indicates a positive change (benefit). The fire management response is to protect from potential damage and to obtain benefit. As risk is lowered on the landscape, more positive net value change opportunities exist over more locations and conditions, therefore increasing the ratio of blue to red.

- The teeth on each end of the continuum indicate that it wraps around to form a cylinder. A wildfire on the far left could be near an area with high risk and management of that portion of the fire would be to meet protection objectives. Whereas, a fire on the right side being managed primarily for resource objectives may change to a fire managed for protection objectives due to environmental changes that caused it to grow and threaten resources and assets.

Manage Risk

Effective management of wildfire addresses the nature of wildfire and its contributing factors, recognizes the positive and negative consequences of fire, addresses uncertainty, and develops plans that reduce the chances of catastrophic losses (USDA and USDI 2014). Forest and fire managers manage risk, both in the short and long terms. If the potential positive and negative consequences of fire are recognized, and management actions to obtain positive outcomes are matched, then in the long term the risk to communities and assets will be reduced; fire will be restored as an ecosystem function to the landscape; and smoke impacts to communities will be reduced. Also, risks and uncertainties relating to fire management activities must be understood, analyzed and communicated.

Synopsis

All wildfires are managed on a continuum between meeting protection objectives and resource objectives, and the mix of these objectives are based both on the location of a wildfire (or a portion of a wildfire) and the conditions under which it is burning. These resource objectives come from the forest plan mainly in the form of desired conditions.

Forest Service policy dictates that every wildfire has some aspect of a protection objective in a fire management response (2015 “Interagency Standards for Fire and Fire Aviation Operations”). This response can vary from monitoring the fire under conditions that are likely to achieve resource benefits to an aggressive suppression effort to protect communities and natural resources from potential damages.

During any wildfire, fire managers must consider firefighter and public safety, risk to property, fire management resource availability, national and regional priorities, costs, and potential resource benefits in all wildfire management decisions.

Analysis and Methods

We conducted a wildfire risk assessment using the methods outlined in the publication “A Wildfire Risk Assessment Framework for Land and Resource Management” (Scott et al. 2015), across all three national forests. The wildfire risk assessment identified areas of risk, which helped in the development of designating the strategic fire management zones. The spatial data used in the assessment analyzes where resource objectives and protection objectives can be met.

For this analysis, FSim, a computer program for large-fire simulation, was used to quantify wildfire hazard across the landscape. FSim is a comprehensive fire occurrence, growth, behavior,

and suppression simulation system that uses locally relevant fuel, weather, topography, and historical fire occurrence information to estimate the contemporary likelihood and intensity of wildfire across the landscape (Finney et al. 2011). A geographic information systems model combined the FSim outputs and highly valued resources and assets (HVRAs) to identify the strategic fire management zones for the alternatives. We evaluated and refined the zones using local knowledge from fire managers, fuels specialists, and other forest managers.

A major part of a wildfire risk assessment is to have a good indication of where potential damages and benefits can occur. This is more than just locating the highly valued resources and assets, it is locating where they have the potential to be positively or negatively affected considering the likelihood of a wildfire occurring and the intensity at which it would likely burn. The two main indicators are location (where the potential damages and benefits to highly valued resources and assets are located) and source (where the wildfire ignitions of these potential damages and benefits start). The technical measure of the potential damages and benefits for location and source is determined by the net value change and is documented in the Southern Sierra Nevada Wildfire Risk Assessment report in the project record.

Highly valued resources and assets are a combination of natural resources and community assets whose value could potentially be affected either positively or negatively by fire. A requirement for highly valued resources and assets is that they must be able to be mapped. Once we identified and mapped the highly valued resources and assets categorically, resource specialists identified what the potential response to fire would be for each category. Next, the responsible officials for the Inyo, Sequoia, and Sierra National Forests determined the relative importance between the highly valued resources and assets (Table 23).

Table 23. Example highly valued resources and assets (HVRAs) and their relative importance values

Highly Valued Resources and Assets (HVRA)	Relative Importance (max. 100)
Human habitation – (classified into 3 sub-HVRAs) High-density human habitation, moderate-density human habitation, and low-density human habitation	97
Major infrastructure – (classified into 4 sub-HVRAs) Electrical power transmission lines, non-hydroelectric power plants, communication sites, hydroelectric power plants	83
Watershed resources – (classified into sub-HVRAs) based on number of people served (Forest to Faucets*), vegetation, slope and erosion potential	80
Critical terrestrial habitat (classified into sub-HVRAs) based on 4 habitat types: California spotted owl, Pacific fisher, northern goshawk, and greater sage-grouse, and different species type and size of trees	78
Timber resources – 3 groups of tree species and size (classified into 6 sub-HVRAs) based on access (terrain steepness and access from road)	74
Inholdings – include State forests and private timber lands	67
Recreation and administrative infrastructure – (classified into 2 sub-HVRAs); Low and high developed sites	65
Visual resources - scenic byways	60
Vegetation condition class – (classified into 15 sub-HVRAs) based on biophysical settings, succession class, and relative abundance	50

Forests to Faucets is a reference for how the number of people served by watershed was determined (see http://www.fs.fed.us/ecosystemservices/FS_Efforts/forests2faucets.shtml)

Relative importance values were developed by first ranking the highly valued resources and assets then assigning a relative importance value to each. The most important highly valued resources and assets were assigned a relative importance value of 100. Each remaining highly valued resource and asset was then assigned a relative importance value indicating its importance relative to the most-important highly valued resource and asset.

As previously stated, the Cohesive Strategy goals formed the basis for developing the fire management strategies in the alternatives. Using the wildfire risk assessment as a tool, the three goals from the Cohesive Strategy are evaluated as indicators for each alternative:

- **Restore and maintain landscapes through the use of wildfire.** Landscapes are resilient to fire-related disturbances in accordance with management objectives and the risk of undesired effects to landscapes is diminished. Managing wildfire to meet resource objectives is vital to meeting this goal, especially in areas where active management is limited.
- **Support fire-adapted communities.** Human populations and infrastructure within and adjacent to the national forest can withstand a wildfire without loss of life and property. Risk of wildfire impacts to communities is diminished. Assess the level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- **Improve safe and effective fire response.** All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions. Assessing wildfire risk upfront is essential to safe and effective response. Risk exposure to firefighters is based on a balanced consideration of values protected and the probability of success. Injuries and loss of life to the public and firefighters are diminished.

Two measures rate how well each alternative addresses the indicators:

- **Managing Uncertainty:** Managing uncertainty aids in making more holistic wildland fire management decisions by giving decisionmakers needed information on potential decision outcomes and their associated risks in advance of the time when these decisions become urgent. Uncertainty is measured by how well each strategic fire management zone in each alternative categorizes the potential damages and benefits to highly valued resources and assets from simulated wildfires. A zone that captures mostly benefits would have low uncertainty while a zone with a high mix of both damages and benefits would have high uncertainty.
- **Facilitating Wildland Fire Management:** This measures the ability of each alternative to identify and enhance strategic fire management features on the landscape and provide a greater ability to enhance these features through fuel reduction and vegetation treatments.

Affected Environment

Historical Wildfires and Wildfires Managed to Meet Resource Objectives

Wildfires on all three national forests historically burned about 509,541 acres, averaging 23,000 acres a year from 1992 to 2013. The amounts fluctuate from year to year depending on conditions and the number of fire ignitions. Fire ignitions are either from lightning or human-caused sources. Over the 22 year analysis period, 2,404 lightning-caused fires burned approximately 157,187 acres whereas 1,729 human-caused fires burned approximately 352,355 acres (Figure 12).

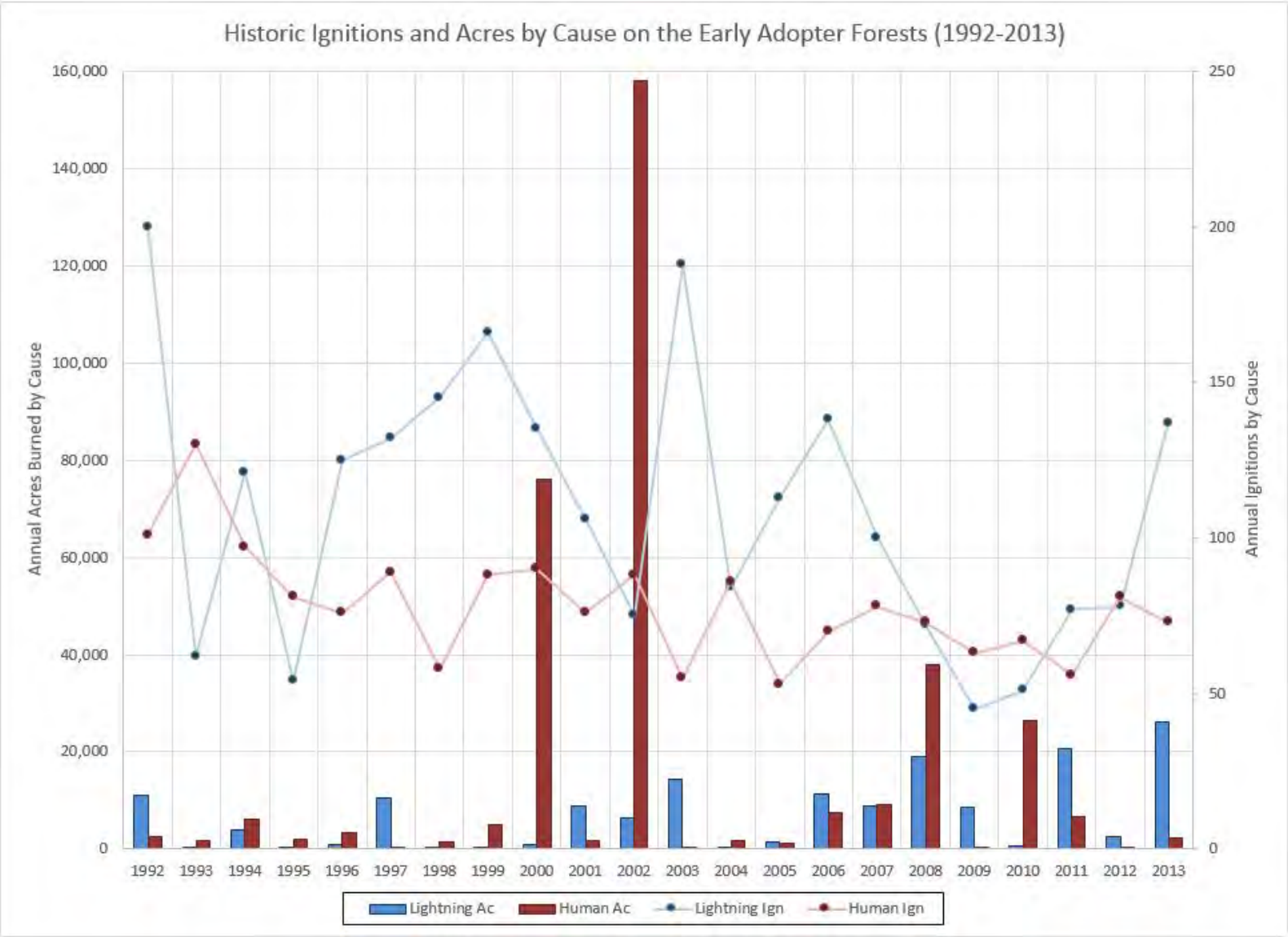

Figure 12. Historic ignitions (Ign) and acres (Ac) burned by cause, 1992-2013, Inyo, Sequoia, and Sierra National Forests

Currently, only lightning-caused wildfires are managed to meet resource objectives on all three national forests. Wildfires managed to meet resource objectives, on average totaled approximately 4,625 acres a year (20-year average) across the three national forests. While fire managers on each national forest have had the option to manage wildfires to meet resource objectives, it has been rarely used, except on the Sequoia National Forests where it has been used primarily on the Kern Plateau. Wildfires on the Kern Plateau have been managed in conjunction with the National Park Service to meet resource and agency objectives in Sequoia and Kings Canyon National Parks and adjacent National Forest System lands. Fewer wildfires have been managed to meet resource objectives on the other national forests, with a few notable fires being the 2003 Summit Fire and 2008 Honey Bee Fire on the Inyo National Forest and the 2008 Tehipite Fire on the Sierra National Forest.

Fuel Reduction Treatments

Mechanical treatments average approximately 10,000 acres annually (10-year average) across the three national forests. Most mechanical treatments are a combination of mechanical thinning of understory trees and mastication or piling and burning of small trees and activity-generated fuels. Most treatments are designed to reduce surface fuels so that future fires will burn with lower flames. Treatments are intended to raise the height of tree branches so flames are less likely to burn into the crowns of trees and spread rapidly. Project design criteria often include requirements to retain more canopy cover for wildlife and to retain patches of shrubs and small trees for wildlife cover and to provide more natural scenery. This results in heterogeneity in fuels and higher fuel levels that influence the behavior of future fires within treated areas, increasing fire intensity and fire spread. However, overall amounts of treatments have not been extensive enough at landscape scales to substantially affect large wildfires.

Prescribed fire treatments across the national forests, on average, range from 4,800 to 5,100 acres annually (10-year average). Currently, the amount of prescribed burning is not occurring at a sufficient scale to reduce fuels to the extent that would influence large wildfires that burn at high intensity or at a pace to restore the desired fire return frequency that would restore resilience to the landscape. Most prescribed burning occurs within areas either previously mechanically treated to reduce fuels or areas that have previously been prescribed burned. Prior to a prescribed burn a burn plan is developed that determines the burn objectives and resource requirements (such as limited operating periods for wildlife and protection measures for cultural resources). Then fire managers determine if the weather and fuel conditions are optimal and fire management resources are sufficient to ensure the burn objectives can be safely met. Because prescribed burning is dependent upon weather and fuel conditions, seasonal timing, availability of resources, and acceptable conditions for managing smoke, many areas, especially on the Sierra and Sequoia National Forests, have been mechanically treated but have not yet been burned due to suboptimal conditions.

Fire Management Coordination

The Forest Service coordinates with local fire districts and State fire agencies, interagency partners (especially the National Park Service and Bureau of Land Management), and tribal liaisons during wildfire incidents and to develop prevention programs in high wildfire risk areas. Fire managers work with local communities to decide where and how to apply fuel reduction projects on Federal lands through a community wildfire protection plan. Under all alternatives, this communication and coordination would continue and propagate as fuel reduction treatments are planned on all three national forests.

Environmental Consequences of Fire Management

Strategic Fire Management Zones

The wildfire risk assessment covers a 4,323,416-acre area encompassing the Inyo, Sequoia, and Sierra National Forests characterized by vegetation conditions ranging from valley-bottom grasslands in the Central Valley to alpine forests and rock at the highest elevations, and to arid sagebrush shrubland on the east side of the Sierra crest.

The zones used in alternative A consist of the two zones within the wildland-urban intermix: the defense zone and the threat zone; and the general forest, which consists of the area outside the urban-wildland intermix. These are derived from the current forest plans. The wildfire risk assessment was the basis for the creation of strategic fire management zones in alternatives B and D and, in part, the zones in alternative C. The zones identified from the modeling outputs are described below for comparison. The consequences are described separately by alternative in the analysis that follows.

Overview of the Proposed Strategic Fire Management Zones

Fire Management Zones in Alternative A

The zones in alternative A shown in Figure 13 were created for the existing three forest plans during the 2004 Sierra Nevada Forest Plan Amendment (USDA FS 2004) and were not created using a wildfire risk assessment.

Wildland-urban Intermix Defense Zone: This zone identifies areas with a one-quarter-mile buffer from structures. Fire management direction within this zone focuses on hazardous fuel reduction treatment as the highest priority. Fuel reduction treatments (mostly mechanical) in this zone are the most intense to create defensible space to prevent the loss of life and property. Lightning-caused wildfires may be managed to meet resource objectives when conditions allow, and it can be done in a safe manner as identified within the current forest plans.

Wildland-urban Intermix Threat Zone: This zone identifies areas with a buffer of 1.25 miles beyond the one-quarter-mile buffer from the wildland-urban intermix defense zone. Fire management direction within this zone focuses on hazardous fuel reduction treatment as the highest priority. Fuel reduction treatments in this zone are strategically located to interrupt wildfire spread and reduce fire intensity. Fuel reduction treatments are more cautiously applied, particularly in California spotted owl protected activity centers and home range core areas, within the southern Sierra fisher conservation area, in old forest emphasis areas, and in stands consisting of large-diameter trees. Prescribed fire is emphasized in California spotted owl protected activity centers and home range core areas and in old forest emphasis areas. Lightning-caused wildfires may be managed to meet resource objectives when conditions allow and it can be done in a safe manner, as identified within the current forest plans.

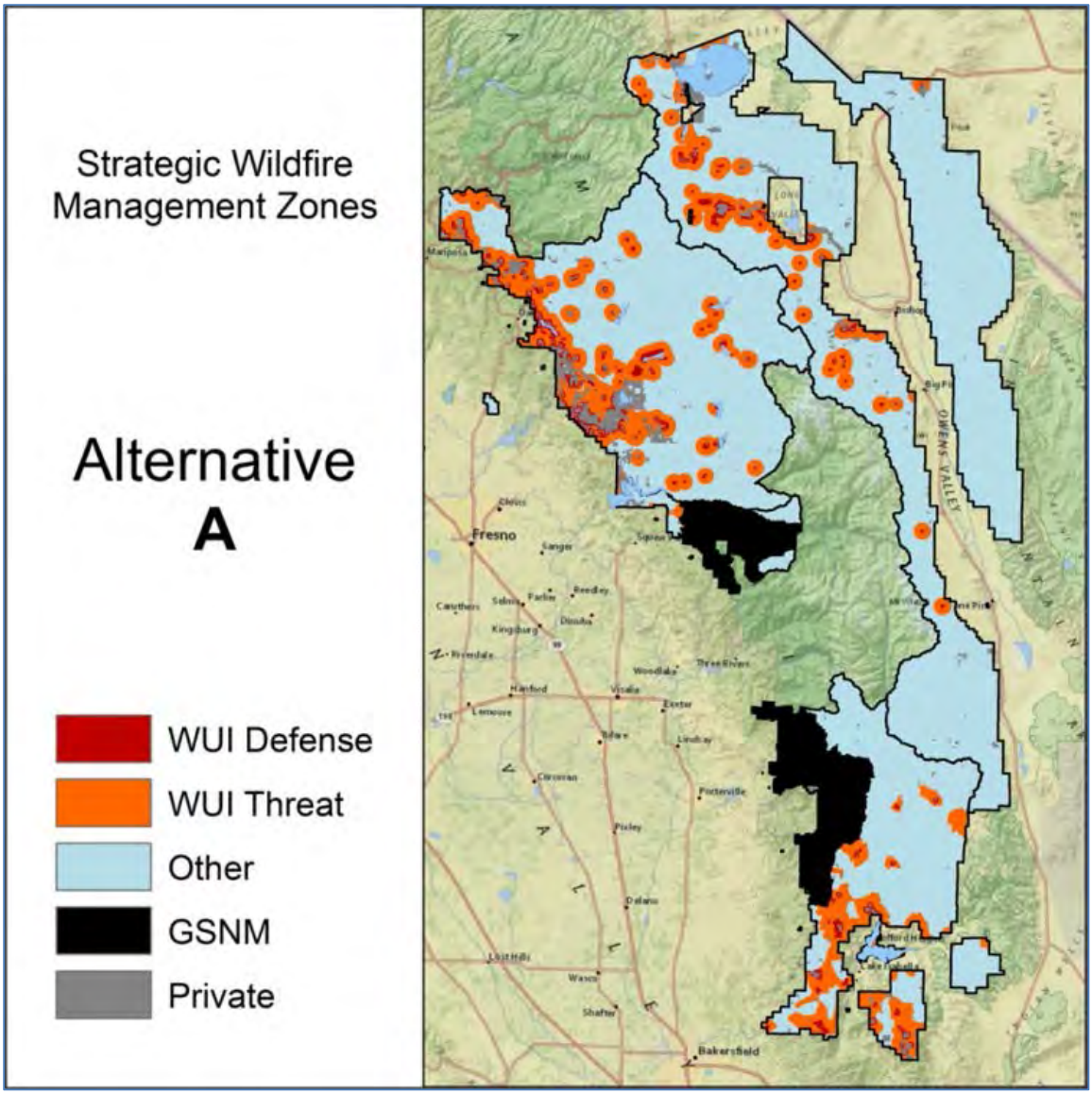

Figure 13. Map showing the location of the fire management zones for alternative A
(WUI = wildland-urban intermix; GSNM = Giant Sequoia National Monument)

Other: This zone identifies areas in the rest of the forest outside the wildland-urban intermix defense and threat zones. This area encompasses other land allocations, but home range core areas, old forest emphasis areas, general forest, and wilderness allocations predominate. Fuel treatments in the general forest are designed to support treatments in the wildland-urban intermix threat zone, to protect sensitive habitats, and reintroduce fire into fire-dependent ecosystems. Fuel treatments are more cautiously applied, particularly in California spotted owl protected activity centers and home range core areas, in the southern Sierra fisher conservation area, in old forest emphasis areas, and in stands consisting of large-diameter trees. Prescribed fire is the only treatment allowed in California spotted owl protected activity centers and is emphasized in old forest emphasis areas and California spotted owl home range core areas. Wilderness is managed to maintain predominantly natural and natural-appearing environments and mechanical vegetation treatments are not allowed. Prescribed fire can be used to reduce the risk and

consequences of wildfire burning within wilderness, or prevent wildfire escaping from wilderness to an acceptable level. Lightning-caused wildfires may be managed to meet resource objectives when conditions allow and it can be done in a safe manner, as identified within the current forest plans.

Strategic Fire Management Zones in Alternatives B and D

The zones for alternatives B and D are management areas created from modeled outputs produced by the wildfire risk assessment. The proportion of area in each zone is shown in Figure 17 along with a map in Figure 14.

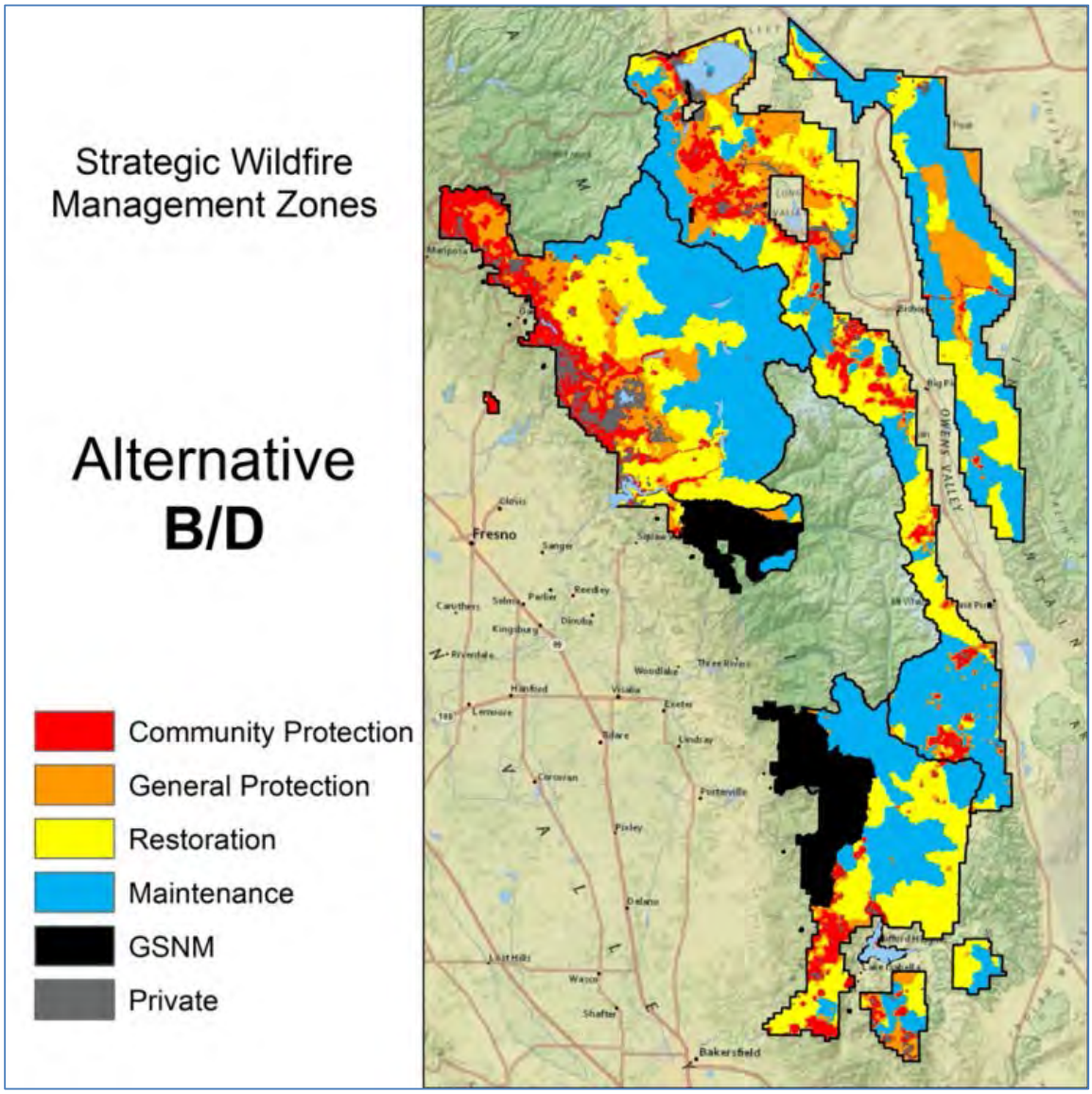

Figure 14. Map showing the location of the strategic fire management zones for alternatives B and D

(GSNM = Giant Sequoia National Monument)

1. **Community Wildfire Protection Zone:** This zone identifies the areas with the highest risk to communities and community assets. This zone assists with preparedness decisions, communication and outreach to high-risk communities, and prioritization of fuel treatments within and near communities.
2. **General Wildfire Protection Zone:** This zone identifies areas with a moderate to high risk to communities and assets as well as natural resources. This zone assists in prioritizing fuel treatments and fire management activities where targeted ecological restoration and hazardous fuel reduction will be needed to contribute to the protection of communities.
3. **Wildfire Restoration Zone:** This zone identifies the areas with a low to moderate risk, mostly to natural resources and some risk to assets. This zone assists with prioritization of fuel reduction treatments to create more opportunities under a wider range of conditions to manage wildfires to meet resource objectives and achieve forest plan desired conditions.
4. **Wildfire Maintenance Zone:** This zone identifies the areas with very low risk, mostly to natural resources and some risk to assets. Wildfires that occur in this zone will likely maintain or help achieve forest plan desired conditions. The management of wildfires to meet resource objective is encouraged when conditions allow and when it can be done in a safe manner.

Strategic Fire Management Zones in Alternative C

Figure 15 shows that the zones created for alternative C are management areas based on a combination of existing management areas and modeled outputs from the wildfire risk analysis.

1. **Wildland-urban Intermix Defense Zone:** This zone identifies areas created with a one-quarter-mile buffer from structures. This zone is the same as the wildland-urban intermix defense zone in alternative A.
2. **Wildfire Maintenance Zone:** This zone identifies areas with very low risk, mostly to natural resources and some risk to assets. Wildfires occurring in this zone will likely maintain or help achieve forest plan desired conditions. This zone was created with the same concept as the wildfire maintenance zone in alternatives B and D; however, the proportion of the forest area that it covers is slightly higher due to the way the zones were divided. Management of wildfires to meet resource objectives and applying prescribed fire treatments is encouraged in this zone when conditions allow and when it can be done in a safe manner.
3. **General Wildfire Zone:** This zone identifies the remaining areas within the forest boundary. This is a broad area, including the wildfire restoration zone, general wildfire protection zone, and portions of the community wildfire protection zone from alternatives B and D. An increased emphasis on managing wildfire to meet resource objectives and increased use of prescribed fire in fire adapted ecosystems would occur in this zone.

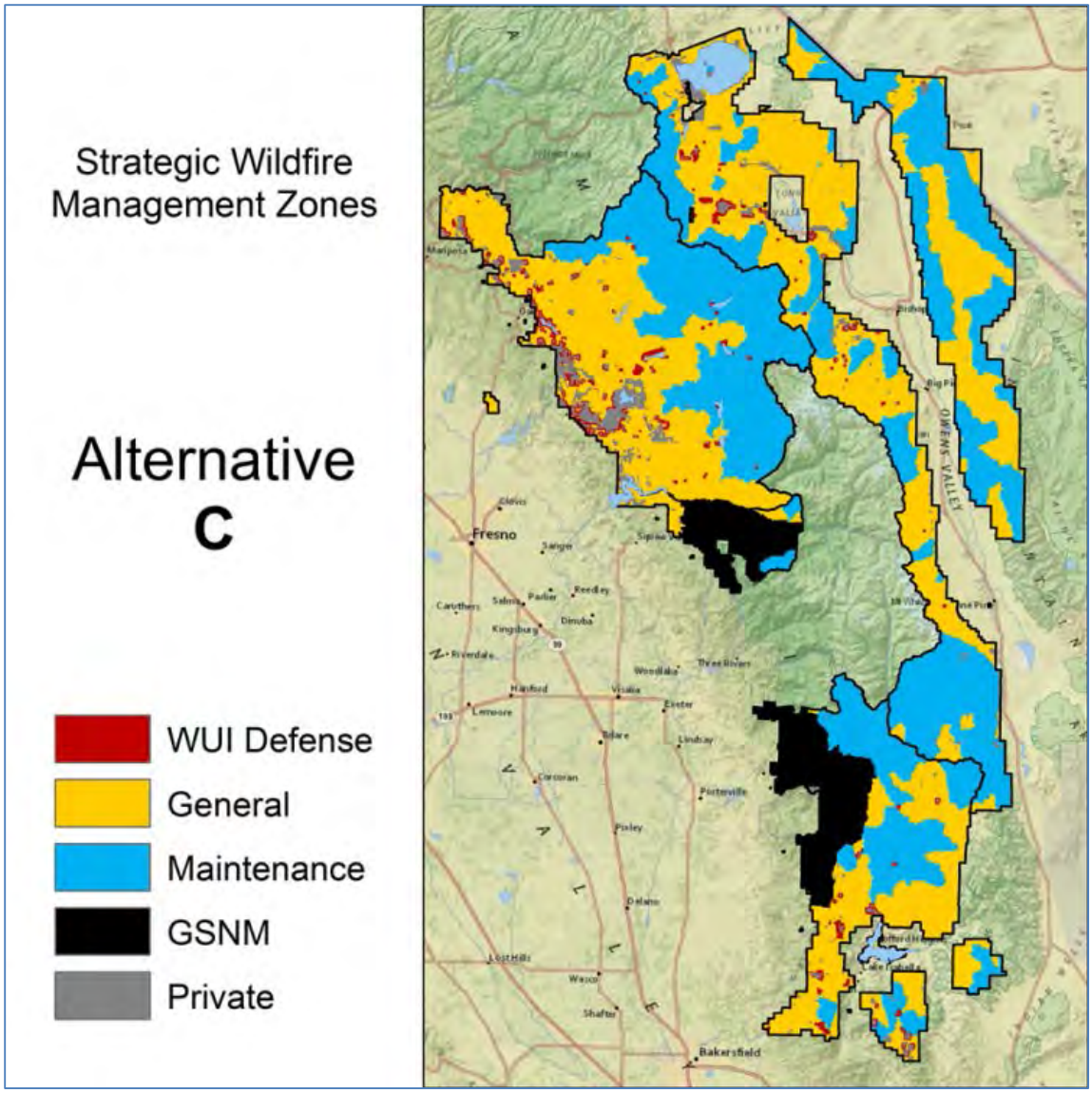

Figure 15. Map showing the location of the strategic fire management zones for alternative C
(WUI = wildland-urban intermix; GSNM = Giant Sequoia National Monument)

Consequences Specific to Alternative A

Under this alternative there are two fire management oriented zones and the rest of the forest area which we are calling "other" (see Figure 13 on page 97). The proportion of the total area of the Sierra, Sequoia, and Inyo National Forests within each zone are 2 percent in the wildland-urban intermix defense zone, 16 percent in the wildland-urban intermix threat zone and 82 percent in "other" as shown in Figure 16. These two wildland-urban intermix zones used proximity to communities as a proxy for fire risk, with the highest risk immediately adjacent to communities but recognizing fires that start more than 1.5 miles away from communities and outside of the wildland-urban intermix can still be a threat. These wildland-urban intermix zones are used primarily to prioritize fuel treatments on each national forest.

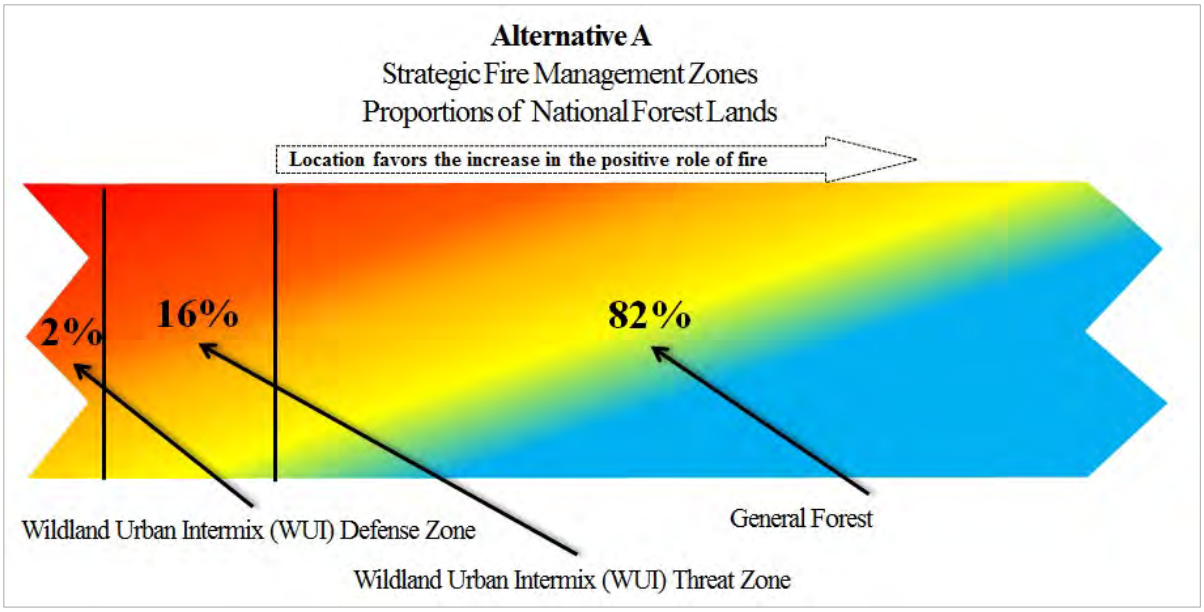

Figure 16. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in alternative A

The focus of fire management in this alternative is to use mechanical treatments and prescribed fire to slow fire spread in the forest overall and provide defendable space in the wildland-urban intermix. The overall strategy outside of the wildland-urban intermix is reliance on strategically placed land area treatments (also known as SPLATs) to slow fire spread and aid in the management of fires. For these strategically placed treatments to be effective, the pattern of treatments and percent of area treated on the landscape is important (USDA FS 2004). Due to various treatment constraints, treatment effectiveness is rarely obtained. Other strategically located treatments were not identified in relation to the risks and benefits they would provide to fire decisionmaking and are not a priority for treatment. Treating along key roads and ridges provides fire managers with opportunities to develop operational plans to conduct larger prescribed burns or to manage wildfires to meet resource objectives. Outside of wilderness and remote areas, without an emphasis on treating along these strategic locations, there are few opportunities to manage wildfires. The primary response to wildfire ignitions is to continue suppressing most lightning fires, which will continue to move areas away from the natural range of variation related to fire as an ecosystem function.

Under alternative A, the amount of fuel reduction treatments (prescribed burning and mechanical treatment) would remain the same as under current direction.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Alternative A was developed with an emphasis on reducing fire threats to communities based upon a concept of two distance-based zones in the wildland-urban intermix where fuel reductions are concentrated. Alternative A does not assess the potential benefits or damages to resources that would be expected from wildfires. The wildfire risk assessment validates that the existing wildland-urban intermix defense and threat zones reasonably capture where potential damages might occur in relation to where people live as shown by the amount of red and orange areas in Figure 16 in those zones. However, the two wildland-urban intermix zones do not capture potential damages to infrastructure outside these areas or to natural resources as shown in the amount of red and orange in the “other” portion of the forests. In

addition, benefits to natural resources from wildfires shown in the blue areas in Figure 16 are not captured, so areas where wildfires could contribute to ecosystem restoration and maintenance of ecosystem functions are not identified.

In alternative A it is more difficult for forest and fire managers to know where the potential damages and benefits are located when deciding on a fire management strategy when a fire ignition occurs. Under this alternative these decisions are typically supported by analysis and information about potential wildfire risks and benefits gathered on-the-fly after the wildfire starts. This can be challenging when there are multiple fires occurring in the area, across states, or across the nation. In these situations, fire resources are scarce and precautionary decisions to suppress fires are often made by default. With current fire management strategies that lack upfront identification of potential risks and benefits and associated plan components that identify resource objectives, there would be a continued emphasis on suppressing wildfires.

Facilitating Wildland Fire Management: The primary emphasis in alternative A is to reduce the threat of wildfire to communities in the wildland-urban intermix. The strategies and priorities were designed to reduce fuels near communities and employ fuel reduction treatments in a pattern of strategically placed treatments in other areas of the forest so fires would burn into them and slow down and lessen their intensity to aid in suppression. The most flexibility to design effective fuel reduction treatments occurs in the wildland-urban intermix defense zone, closest to communities. Outside of the wildland-urban intermix defense zone, additional standards and guidelines apply to minimize or mitigate concerns for the effects of fuel reduction treatments on wildlife habitat. Some of those standards and guidelines are reduced or waived in the wildland-urban intermix threat zone to recognize the need for more effective treatments to reduce the potential for fires to burn from the threat zone into the defense zone and threaten communities. However, designing implementable and effective fuel reduction projects that comply with the standards and guidelines has been difficult in some areas, resulting in small, disconnected treatment units, or treated areas with residual fuels and vegetation that are not very effective at slowing fires down or that make prescribed burning more complex.

Most fuel reduction treatments are designed as mechanical thinning or mechanical manipulation of fuels followed by prescribed burning of treated units or burning of piles of fuels. In many cases, thinning has occurred but restoring fire through prescribed burning has yet to occur resulting in a backlog of areas ready for prescribed burning. The opportunity to apply prescribed burning over large landscapes is limited given the pattern of heavy fuels and interspersed areas where fuel reduction treatments have occurred.

The ability to manage wildfires to meet resource objectives is allowed, but it is rarely done. On the Sequoia National Forest this approach has been successfully used because forest and fire managers have a high level of experience in this type of wildfire management. There is a risk that because plan direction allows but does not encourage this option, this practice may not continue when existing personnel leave. Plan direction does not emphasize additional fuel reduction treatments in key locations such as along ridges and key roads that can serve as anchor points for larger landscape prescribed burning or serve as tactical locations to manage wildfires to meet resource objectives. The current pattern of small and disconnected fuel reduction treatments under alternative A would remain at the same low pace and scale of treatment due to constraints for other resources; this is reducing the potential to restore and maintain landscapes to a level where they are sustainable, resilient, and can recover from disturbance.

Support Fire-adapted Communities

Managing Uncertainty: Under alternative A, the wildfire risk to communities and values are defined by the distance-based wildland-urban intermix defense and wildland-urban intermix threat zones, which were not created using a risk assessment. Although management activities in these zones are focused on protecting life and property, without a risk assessment management decisions in the general forest are likely to be less effective because managers don't fully understand how risks are distributed across the landscape spatially and which highly valued resources and assets face the greatest loss or benefit. Important factors such as the type and distribution of fuels, terrain, winds, historic fire ignition locations, and the combinations of these factors are recognized as contributing to fire risk in the wildland-urban intermix, but they were not modeled to evaluate potential risk to communities in the wildland-urban intermix zones. Continued coordination with local partners and communities for protection and prevention in high wildfire risk areas exists to enhance the effectiveness of initial fire response.

Facilitating Wildland Fire Management: Although fuel reduction treatments are limited in alternative A, fire managers would continue to work with communities to be more fire adapted through collaborative efforts, supporting community wildfire protection plans, and conducting fuel reduction treatments in the wildland-urban intermix defense and threat zones. A priority is placed on fuel reduction in the two wildland-urban intermix zones. Alternative A does not account for the likelihood of fires to spread from adjacent areas in the "other" portions of the forests that contribute to the risk to communities or infrastructure. Managing wildfires to meet resource objectives is a decision option, although it is rarely used near fire-adapted communities due to public concerns and the challenge of managing risks.

Improve Safe and Effective Fire Response

Managing Uncertainty: Under alternative A, risks have not been spatially identified outside the wildland-urban intermix defense and wildland-urban intermix threat zones. Without assessing risk upfront, pre-planning actions such as fuel reduction treatments and fire prevention actions would not be focused or prioritized on high risk locations. Wildfire response would continue to favor the current response of actively suppressing most fires. This would continue to make it difficult for fire managers to make on-the-fly decisions that consider the safety of fire responders and costs of the fire commensurate with values at risk because these risks to values are not evaluated upfront.

Facilitating Wildland Fire Management: The two wildland-urban intermix zones in alternative A do not provide the support for improving wildfire response to large, unwanted wildfires that could threaten communities, or identify where the potential damages and benefits are located to enhance wildfire response. The limited fuel reduction treatments are focused on slowing fire spread and reducing fuels in more easily treatable areas near roads and on flatter ground. The original intent to treat in a more geometric pattern so that wildfires would run into these areas like speedbumps has proven difficult to implement on the ground due to prescriptive and restrictive standards and guidelines that limit the type of treatment and the effectiveness of reducing fuels. Communities would continue to experience the risk of high-intensity fires that threaten structures and homes from fires that burn on national forest and move toward communities. Although the choice to manage wildfires to meet resource objectives exists, it is not the current management choice in most situations.

Consequences Specific to Alternative B

Under this alternative there are four risk-based strategic fire management zones that cover all national forest lands. The proportion of the total area of the Sierra, Sequoia, and Inyo National Forests within each zone are 11 percent in the community wildfire protection zone, 15 percent in the general wildfire protection zone, 30 percent in the wildfire restoration zone and 44 percent in the wildfire maintenance zone (Figure 17).

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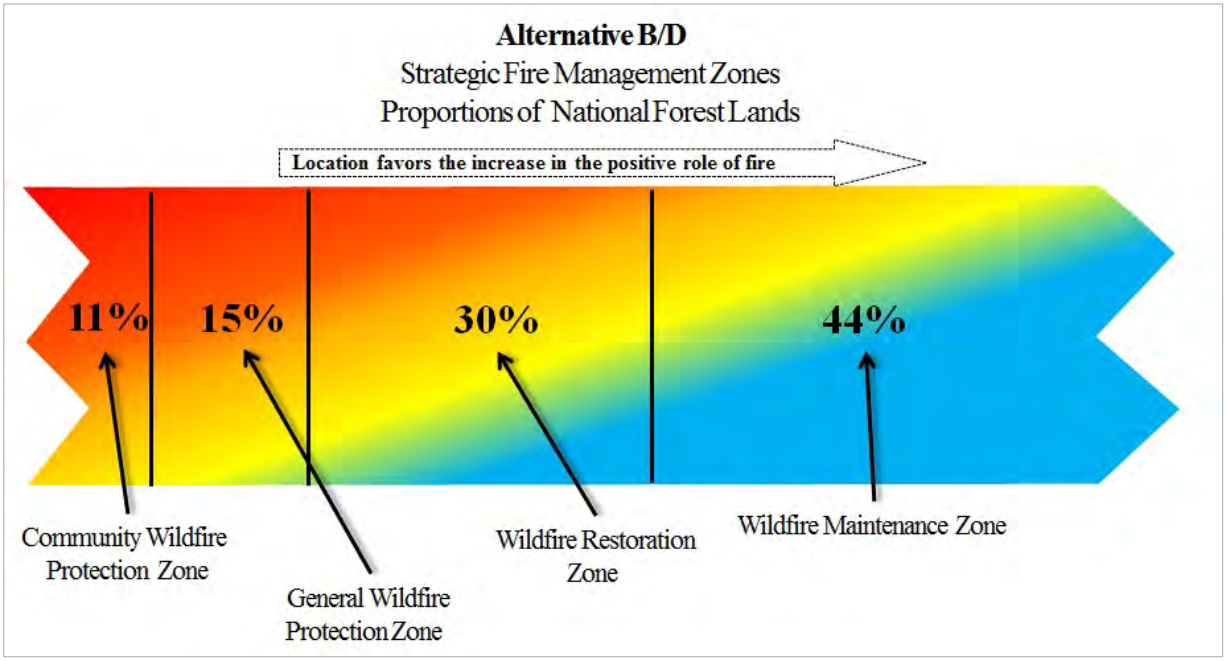

Figure 17. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in alternatives B and D

In alternative B, fuel reduction treatments are more extensive than alternative A to improve vegetation desired conditions and to make more areas suitable for managing fires to meet resource objectives. Managing wildfire to meet resource objectives is highly encouraged in the maintenance and restoration zones and somewhat limited in the protection and general zones.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Under alternative B, fire management responses ranging from managing the fire to meet resource objectives to suppression is available across all the zones. Allowing the natural role of fire to occur under conditions that are conducive to meeting resource objectives when it can be done in a safe manner would provide for ecological restoration and improved resilience within any of the zones. Having the flexibility to manage wildfire along the full range of the continuum can be useful if decisionmakers have the needed information to decide to use that flexibility. Knowing up front the potential outcomes of a fire before it happens aids in reducing uncertainty to fire management decisionmakers; in this alternative, the strategic fire management zone were designed with that in mind. The zones categorize the locations of where the values of highly valued resources and assets change positively or negatively for both assets and natural resources. These zones capture where benefits and damages are likely to happen under a wide range of fire conditions because the zones were developed using a modeled risk assessment. Important strategic locations are identified in relation to potential damages and

benefits, most of which are along zone boundaries. The condition a fire burns under ultimately dictates the outcome of the fire but these zones aid in defining the location of likely outcomes. Alternative B and D have the same zones, which address uncertainty the best of any other alternatives. Managing uncertainty should result in more wildfire being managed in a way that restores and maintains landscapes; however, it is expected that this would occur the most often in the wildfire restoration and wildfire maintenance zones because these zones identify the areas with the lowest risk to highly valued resources and assets.

Facilitating Wildland Fire Management: Wildfire management under alternative B provides an increased opportunity to manage larger wildfires due to the increased amounts of treatments that reduce fuel loading in strategic locations. In alternative B, there would be more opportunity for fuel reduction projects and wildfires managed to meet resource objectives. Treatments would be prioritized in strategic locations (roads, ridgetops, and other natural and manmade features) and in focus landscapes designed to treat primarily the dry forest patches to restore fuels toward the natural range of variation. These treatments would serve as anchor points for larger prescribed burns and they create areas of low fuel that can be used to manage future wildfires. All of these restoration activities would reduce potential smoke emissions from large, undesirable wildfires.

Support Fire-adapted Communities

Managing Uncertainty: The community and general wildfire protection zones capture a substantial portion of the high fire risk to communities and assets as shown by the large portion of red and orange in Figure 17 on page 104. Increased fuel reduction treatments in alternative B would assist in creating more fire-adapted communities with improved certainty of resource and asset locations in the community and general wildfire protection zones. The identification of fire risk would aid in coordination with State and local fire agencies.

Facilitating Wildland Fire Management: More fuel reduction treatments occur in alternative B than in alternative A. Fire managers would continue to work with communities to help them become more fire adapted through collaborative efforts, such as supporting community wildfire protection plans and prioritizing fuel reduction treatments in the community and general wildfire protection zones. Managers would continue to coordinate with local partners and communities for protection and prevention in the high wildfire risk areas to enhance the effectiveness of initial response to fires. Although the use of wildfire to meet resource objectives would likely be limited initially in the wildfire protection zones, more fuel reductions treatment would lower the risk over time and increase the potential to reduce fire suppression costs by managing at least portions of wildfires to meet resource objectives.

Improve Safe and Effective Fire Response

Managing Uncertainty: In alternative B, risks are better identified than in alternative A by the creation of the four strategic fire management zones based upon with wildfire risk assessment. The zones reduce uncertainty by categorizing risk and allow for fires to be managed on a continuum between meeting protection objectives and resource objectives within these zones, while using risk-based responses. Categorizing the potential benefits along with the residual risks to resources reduces uncertainty in the wildfire restoration and maintenance zone as shown by the gradation of red to blue in those two zones as shown in Figure 17 on page 104.

Facilitating Wildland Fire Management: In this alternative, more treatments would occur within larger focus landscapes to have a greater likelihood of interrupting the spread of wildfire and reduce the intensity of fires as they burn into treated areas. Additionally, treatments would be designed along strategic roads, ridgetops, and other natural and manmade features that would

create more opportunities to conduct larger prescribed burns and provide tactical locations to manage future wildfires. This alternative allows for wildfires to be managed to meet resource objectives as areas on the landscape (zones) shift toward the wildfire maintenance zones. The additional recommended wilderness areas in the community and protection zones could limit use of mechanized equipment during wildfire response and limit fuel reduction treatments, but use of prescribed fire could occur under some circumstances when it is for restoring fire toward the natural range of variation and to meet wilderness desired conditions. In the community wildfire protection zone, community buffers are identified in close proximity to structures where fuel conditions and snags are treated to allow for safer conditions for firefighters.

Consequences Specific to Alternative C

Mechanical fuel reduction treatments are focused around structures and limited in other areas in alternative C. Managing wildfire to meet resource objectives is limited in the wildland-urban intermix defense zone (2 percent) and highly encouraged in the general wildfire and wildfire maintenance zones (52 percent and 46 percent, respectively; Figure 18).

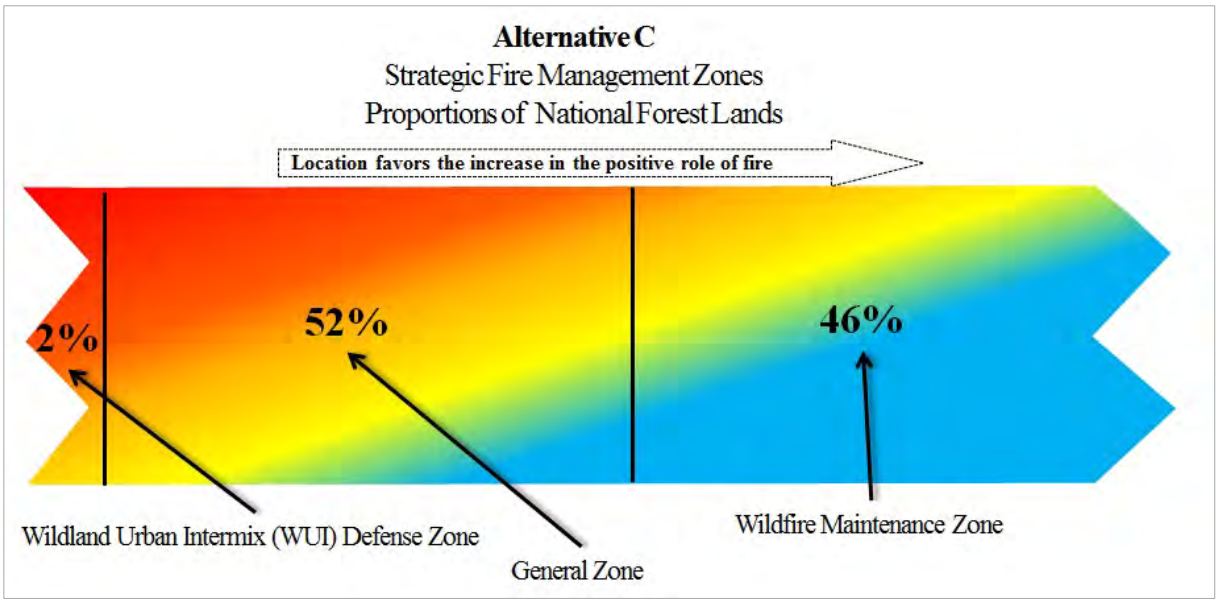

Figure 18. Proportion of the Sierra, Sequoia, and Inyo National Forests within each zone in Alternative C

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Under alternative C, fire management responses ranging from managing the fire to meeting resource objectives to conducting full suppression exists across all the zones. Similar to alternative A, fires would be managed to meet resource objectives when conditions allow and it is safe to do so; however, with much uncertainty in the general wildfire zone. The wildfire maintenance zone was created using the risk assessment and generally occurs in the higher elevations and wilderness areas. The wildland-urban intermix defense zone was defined by proximity to communities and is primarily at the lower elevations along the national forest boundary, but it also surrounds smaller communities and developments within the national forests. This leaves a large area between these two zones, which became the general wildfire zone with a wide range of highly valued resources and assets potentially changing value from high damage shown in the red and orange in the upper left, to low benefit shown in blue and green in

the bottom right. This wide range in risk in the general wildfire zone provides decisionmakers little information to aid in choosing an appropriate management strategy for a wildfire.

Facilitating Wildland Fire Management: Mechanical fuel reduction treatments in this alternative would be more restricted than in alternative A, but strategically placed as in alternative B. Mechanical treatments would be limited primarily to only removing small-diameter material within large portions of the landscape where spotted owl or fisher habitat exists. The costs of removing only small material would limit the amount of area that can be accomplished due to the need to use appropriated funding where projects cannot offset costs with timber harvest and stewardship funding. This would leave more fuels to be removed by prescribed burning, which may require multiple prescribed burns over time to effectively reduce fuels. Prescribed burning would be encouraged and would likely initially focus on burning areas previously treated mechanically and expanding treated and burned areas to larger landscapes. Prescribed burns may be more complex compared to if fuels were reduced mechanically; this would require additional fire resources to complete the burn and more careful planning for weather and fuel conditions to safely meet burn objectives. When conditions allow and it is safe to do so, wildfires would be managed to meet resource objectives under this alternative, but this is mostly limited to the wildlife maintenance zone due to the more limited areas of effective fuel reduction treatment in the other zones.

Support Fire-adapted Communities

Managing Uncertainty: The wildland-urban intermix defense zone captures much of the risk closest to communities but does not account for the likelihood of fires to spread from high risk areas in the adjacent general wildfire zone to the wildland-urban intermix defense zone, which would threaten communities or infrastructure (as shown by the large area of red and orange in the general wildfire zone in Figure 18). In this alternative, fuel reduction and preparedness in the communities are relied upon more to manage risk on the lands closest to the structures.

Facilitating Wildland Fire Management: In alternative C, continued coordination with local partners and communities for protection and prevention in high wildfire risk areas would enhance the effectiveness of initial response. Mechanical fuel reduction treatments would be more limited in alternative C than in alternatives B and D as limitations on mechanical treatments to provide for habitat for the California spotted owl and Pacific fisher apply even within the wildland-urban intermix defense zone. However, fire managers would continue to assist communities in being more fire adapted through collaborative efforts such as community wildfire protection plans and an increased focus on fuel reduction treatments where possible in the wildland-urban intermix defense zone. There is the least amount of mechanical treatment and it is limited to primarily small-diameter tree removal. This would make it more costly and take longer to conduct some prescribed burns where fuels are heavier and multiple prescribed burns may be needed to achieve effective fuel reduction. Prescribed burning is encouraged in lieu of mechanically removing medium and larger trees but where the costs of prescribed burning is higher due to heavier fuels and where it takes multiple prescribed burns to reduce fuels, there would be fewer acres with effective fuel reduction compared to the other alternatives. There is more uncertainty in completing prescribed burning as the primary method to reduce fuels because of the increased complexity to plan and implement prescribed burns in areas with high fuels. The management opportunity to manage wildfires to meet resource objectives exists under this alternative in all zones but is not likely to be used in the wildland-urban intermix defense zone or general wildfire zone.

Improve Safe and Effective Fire Response

Managing Uncertainty: Under alternative C, risks have been identified outside of the wildland-urban intermix defense zone. Similar to alternatives B and D, the wildfire maintenance zone reduces the uncertainties of where potential resource benefits can be obtained by managing wildfire to meet resource objectives in the higher elevation areas. However, similar to alternative A, there is a large portion of the forest with little improvement in reducing the uncertainty for potential risks and benefits to highly valued resources and assets as shown by the large area with red and orange in the general wildfire zone shown in Figure 18. This large uncertainty in the general wildfire zone makes it difficult to make fire management decisions that consider safety to firefighters and the public in relation to risks to highly valued resources and assets.

Facilitating Wildland Fire Management: In this alternative, there would be the fewest areas where fuels are reduced mechanically prior to prescribed burning of all alternatives. Fuel reduction treatments would primarily be with mechanical removal of small-diameter trees, mostly in the wildland-urban intermix defense zone and generally avoiding habitats for California spotted owl and Pacific fisher elsewhere. Some strategic treatments along key roads and ridges may occur, but treatments would be more limited to reduce the short-term impacts to wildlife habitat. This may facilitate some large prescribed burning but with heavier initial fuels, it may make it more difficult to conduct prescribed burns due to an increased complexity of the burns and more limited timing when weather and fuels conditions would allow prescribed burns to be safely conducted and meet burn objectives. In areas where prescribed burning has occurred, there would be greater opportunities to manage future wildfires. Where fuels are heavier or fuel reduction treatments are less effective, the primary response to wildfire ignitions would likely continue to favor suppression. The opportunity to manage wildfires to meet resource objectives exists under this alternative in all strategic fire management zones; however, with the uncertainty of risks to structures and assets, the possibility of this management response may be limited except in the wildfire maintenance zone.

Consequences Specific to Alternative D

Alternative D uses the same strategic fire management zones as described for alternative B above (see Figure 17 on page 104).

In alternative D, fuel reduction treatments would be applied more widely. Fuel reduction treatments would be more effective within focus landscapes and more strategic areas would be treated. Fuel reduction treatments would be applied in all strategic fire management zones dependent on vegetation conditions, with fewer funding and resource limitations than any other alternative. Like alternative B, managing wildfire to meet resource objectives is highly encouraged in the wildfire maintenance and restoration zones and somewhat limited in the community wildfire protection and general wildfire protection zones.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: In alternative D, the management uncertainty would be the same as described previously for alternative B.

Facilitating Wildland Fire Management: This alternative allows for an increase in the amount of strategic treatments along ridgetops, roads, and other natural and manmade features to support large landscape prescribed burns or as an opportunity to manage wildfires to meet resource objectives. As with alternative B, important strategic locations are identified in relation to potential damages or benefits, most of which are along the boundaries between zones. The

increase in fuel reduction treatments would result in larger areas of reduced fuels and restoring vegetation toward its natural fire regime, which has the greatest benefit for restoring fire in the wildfire restoration and maintenance zones. Under alternative D, there would be more opportunity than alternative B for fuel reduction projects, which increases the potential for wildfires managed to meet resource objectives in all zones. There would be more potential to manage wildfires to meet resource objectives if there are more areas with fuel reduction and more strategic areas that can be used to control or contain fires. All of these restoration activities would reduce fuels and potential smoke emissions compared to large, undesirable wildfires.

Support Fire-adapted Communities

Managing Uncertainty: In alternative D, there would be more opportunity for coordination with local partners and communities for fire protection and prevention in high wildfire risk areas, which would enhance the effectiveness of initial fire response to the extent there is more collaborative fuel reduction projects in the community and general protection zones.

Facilitating Wildland Fire Management: There would be more fuel reduction treatment opportunities in alternative D than in the other alternatives. Fire managers would continue to assist communities to become more fire adapted through continued collaborative efforts such as community wildfire protection plans and fuel reduction treatments. An increase in the amount of fuel reduction under this alternative includes more mechanical treatment and prescribed burning within the two wildfire protection zones. Fuel reduction in the wildfire restoration zone would further reduce the risk of large high-intensity wildfires starting further away on the national forests that may threaten communities.

Improve Safe and Effective Fire Response

Managing Uncertainty: In alternative D, risks are better identified than in alternatives A and C by the creation of the four strategic fire management zones. Fires are managed on a continuum between meeting protection objectives and resource objectives within these zones, while using risk-based responses. This alternative would reduce fuels on more of the landscape, which would reduce risks over time and should tend to shift areas toward less risk in future risk assessments.

Facilitating Wildland Fire Management: Alternative D has the least treatment restrictions and the highest possibility of generating revenue from treatments with timber harvest that can be invested in reducing fuels on more areas. These two factors would allow for more strategic treatments, mostly along roads, ridgetops, and other natural and manmade features and treatments in larger focus landscapes to support large landscape prescribed burns or as an opportunity to manage wildfires to meet resource objectives. These applications would allow areas on the landscape to shift toward the wildfire restoration and wildfire maintenance zones as more areas with vegetation density move toward the natural range of variation, allowing fire to burn at lower intensity overall and with more variable patches of low, moderate, and high severity. This would give fire managers more options to provide for the safety of firefighters and the public while managing costs of fire suppression and risks and benefits to highly valued resources and assets.

Cumulative Effects

Under all alternatives, fire management is coordinated with neighboring units (National Park Service, Bureau of Land Management, and the State fire agencies) on whether the decision is to suppress or manage the fire to meet resource objectives. All agencies work together across jurisdictions and boundaries to manage the fire to meet resource objectives in the wildfire maintenance zones in alternatives B, C, and D or in some cases in the rest of the forest area in alternative A. Suppression efforts to protect life and property in coordination with the State or other Federal agencies would continue under all alternatives. The community protection and general wildfire protection zones in alternatives B, C, and D align with State objectives to protect life and property.

Analytical Conclusions

Alternative A does not proactively analyze risk with a spatial risk assessment, which highly limits the restoration and maintenance of landscapes through managing wildfire to meet resource objectives, and the safe and effective fire responses due to the uncertainty of the location of assets and resource at risk. The lack of risk-informed fuel reduction treatments also limits the restoration and maintenance of landscapes through the use of wildfire, both with strategically located prescribed burning and wildfires managed to meet resource objectives. Alternative A relies heavily on ignition risk assessments after the fire has started and local fire manager knowledge to manage wildfire to meet resource objectives, but is not as reliable since it is more reactionary and depends primarily on experienced fire managers knowledgeable of the local conditions.

The strategic management zones created by the wildfire risk analysis for alternatives B and D identify areas of risk more accurately than the wildland-urban intermix defense and threat zones in alternative A. By using the spatial wildfire risk assessment, alternatives B and D allow identifying areas on the landscape where strategic fuels and vegetation treatment might be cost-effective in managing wildfire. These alternatives also identify where fire may play a beneficial role and can be managed to meet resource objectives rather than taking suppression actions.

Alternatives A and C do not account for the likelihood of fires to spread from adjacent areas, which could potentially contribute to the risk to communities or infrastructure. Outside of the wildland-urban intermix defense and threat zones in alternative A, there is little specific direction that encompasses a risk management-based approach to wildfires. In alternative C, a risk management-based approach is applied in the wildfire maintenance zone, but there are fewer fuel reduction treatments planned along strategic fire management features (such as along ridgetops, roads, or other natural or man-made features) that facilitate safely conducting more cost-effective, larger prescribed fires or that provide more opportunities to manage wildfires to meet resource objectives. Forest and fire managers would continue to work with communities and stakeholders to support fire-adapted communities under all alternatives, having the most restrictions under alternatives A and C.

In alternatives B, C, and D, the risk assessment provides information that reduces uncertainties and allows forest and fire managers to have more latitude to proactively plan and restore the landscape by managing wildfire to meet resource objectives and using prescribed fire, partially due to the awareness of where the assets are located, thereby reducing risk. Alternative C emphasizes the use of prescribed fire and limits mechanical treatment to small-diameter trees. Alternatives B and D apply risk management the most explicitly and have the greatest amount of restoration that reduces risk and provides resource benefits. The zones in alternatives B and D provide the most efficient and effective way to prioritize fuel reduction treatments around

communities and other values at risk, prioritize ecological restoration to increase the potential to safely manage wildfires to reduce landscape fuels and benefit resources. The greater amount of ecological restoration projects and the enhancement of strategic fire management features would provide the greatest likelihood of implementing large prescribed fires or managing wildfires to meet resource objectives. This provides a safer work environment for firefighters, lowers the likelihood for fire that escapes control, and allows a greater window of opportunity to manage wildfire.

The graphs below are a comparison of the results for location and source from the risk assessment for all the alternatives. The location identifies where on the landscape fire ignitions result in negative versus positive outcomes. The source identifies where the fire was ignited to identify spatial patterns on the landscape.

Figure 19 on page 112 shows the amount of potential damage and benefits to assets and resources at the location of where these potential changes occur based on modeled outputs. The pie charts on the left represent the percentage of the forests that reside in the different strategic fire management zones. The bar charts on the right show the percentage of benefit or damage to highly valued resources and assets.

A graph with higher values on the damage side leads to managing for protection objectives while those with higher values on the benefit side would result in managing primarily for resource value objectives. It is also important to know what is possibly going to be affected; zones that have a large proportion of either resource or assets helps in the wildfire management decisions. Alternatives B and D categorize risk location and can aid in managing uncertainty. For these reasons, alternatives B and D are more effective, because the protection zones have a higher damage-to-benefit ratio while the maintenance zones have a higher benefit-to-damage ratio, leading to less uncertainty in management decisions.

The amount of potential damage and benefits to assets and resources at the source (where wildfires start) that cause these changes based on modeled outputs are shown in Figure 20 on page 113. As before, the risk location of any strategic fire management zone with nearly equal potential for damage and benefits has a high level of uncertainty and adds little information for forest and fire managers in their wildfire management decisions. Also graphs that have a large proportion on one side or the other help manage uncertainty and aid in management decisions. A graph that has a larger proportion on the damage side leads to managing for protection objectives while those that have a larger proportion on the benefit side leads to primarily managing wildfire for resource value objectives. It is important to know what value is possibly going to be affected. Since these graphs capture changes from the source, most zones show both resource and assets affected because wildfires start in those zones and move into adjacent zones where resource and assets exist. However, alternatives B and D are more effective in categorizing risk and can aid in managing uncertainty because the majority of the asset damage is in the protection zones.

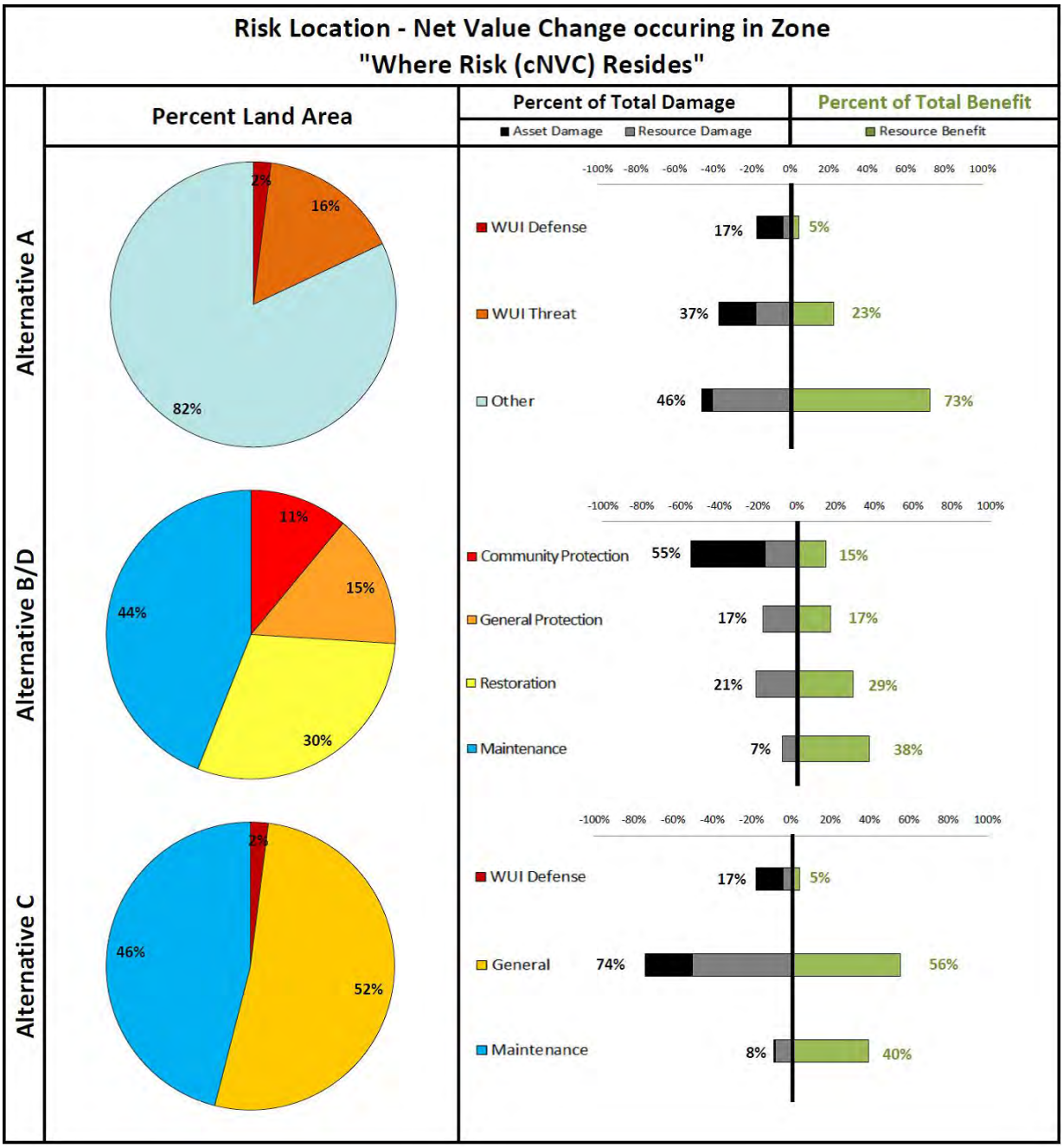

Figure 19. Risk location by alternative or comparison of the magnitude of net value change by strategic fire management zone

WUI = wildland-urban intermix

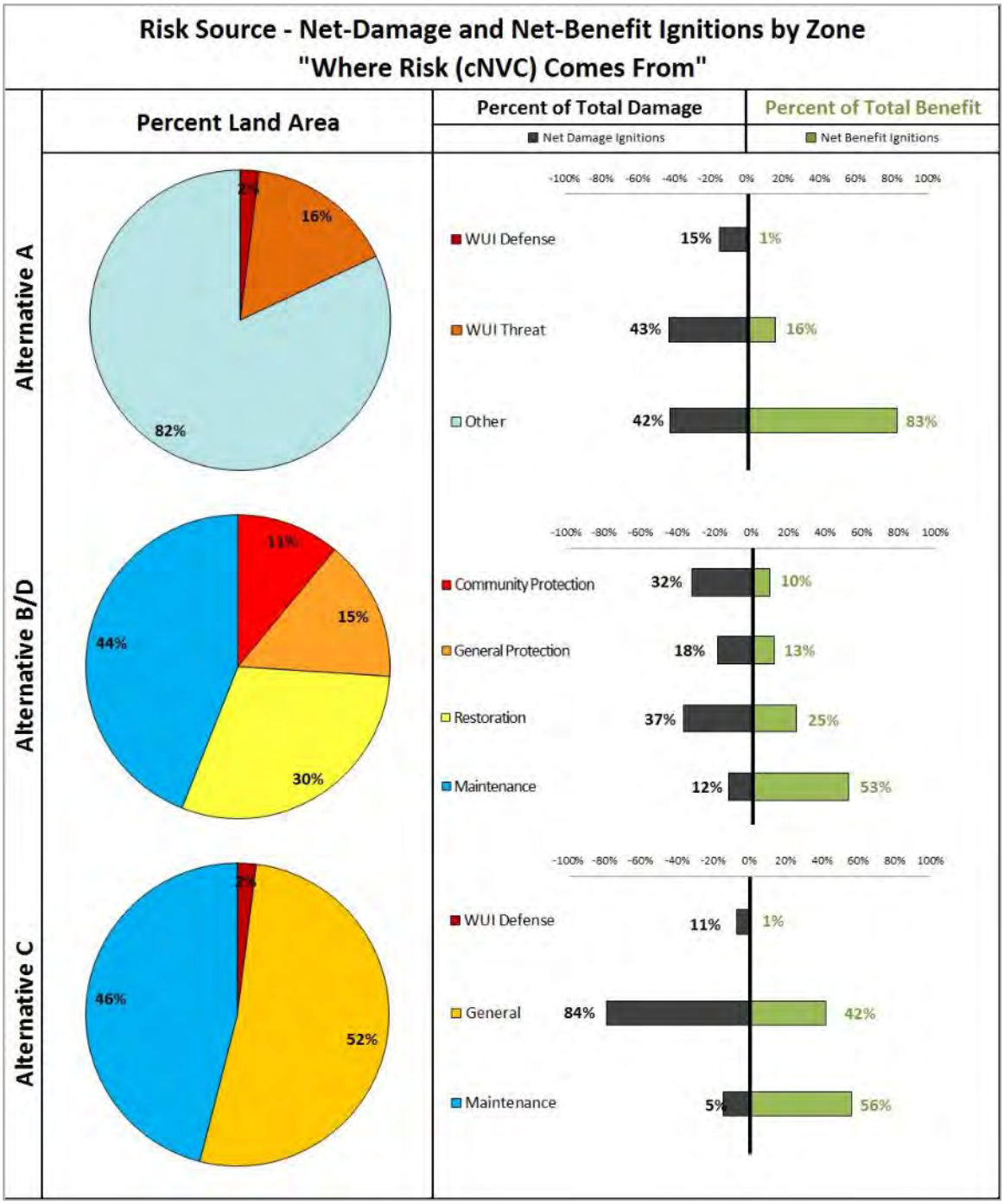

Figure 20. Risk source by alternative or comparison of the magnitude of net value change by strategic fire management zone

WUI = wildland-urban intermix

The four alternatives are ranked by the measures (managing uncertainty and facilitating fire management) for each indicator (Table 24). All indicators were measured to rate how well each alternative addresses them. These measures were given a numerical rating based on how well they managed uncertainty and how well they addressed facilitating wildfire management. Note that the lower the number, the better the alternative in regard to meeting the fire management indicator. In this ranking indicators were equally weighted.

Table 24. Comparative ranking of alternatives by fire management indicators and measures

Alternative	Indicator	Managing uncertainty	Facilitating fire management	Total
A	Restore and maintain landscapes	4	3	7
A	Fire-adapted communities	3	3	6
A	Wildfire response	3	3	6
B	Restore and maintain landscapes	1	2	3
B	Fire-adapted communities	1	2	3
B	Wildfire response	1	2	3
C	Restore and maintain landscapes	3	4	7
C	Fire-adapted communities	4	4	8
C	Wildfire response	4	4	8
D	Restore and maintain landscapes	1	1	2
D	Fire-adapted communities	1	1	2
D	Wildfire response	1	1	2

Wildfire Risk Management

The individual indicators shown in Table 24 can be summarized as an overall assessment of risk management for each alternative.

Consequences Specific to Alternative A

Managing Uncertainty: Fire management decisions in alternative A are not guided by risk-based strategic fire management zones. The two zones: wildland-urban intermix defense and wildland-urban intermix threat zones, and the general forest (which contains the areas outside of the other land allocations on the national forest) were generated for the forest plan as shown in Figure 13 on page 97. Although these areas were not created using a wildfire risk assessment, due to the proximity to assets, potential damages to highly valued resources and assets in the wildland-urban intermix defense and threat zones are moderately captured. These two zones do not account for potential damages to infrastructure such as powerlines outside communities or the negative wildfire impacts to community ecosystem services such as water supplies. In regard to categorizing risk to aid management decisions, these two zones are not adequate, leaving the general forest with a wide range of risk ranging from a high potential for damage to a moderate potential for benefits. There are many uncertainties for location and source of risk under this alternative. Risk management is difficult when values at risk are not pre-identified.

Facilitating Wildland Fire Management: Implementing effective strategic fire management by managing wildfire to meet resource objectives and accomplishing fuel reduction treatments that improve safety during fire management practices would be limited to the current plan constraints. The level of safe and effective fire management to facilitate the appropriate management response to wildfire would remain the same. This would continue to allow the accumulation of fuels that

contribute to large, unwanted wildfires that damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and threaten homes and communities in the wildland-urban intermix.

Consequences Specific to Alternative B

Managing Uncertainty: Alternative B is composed of four zones: community wildfire protection, general wildfire protection, wildfire restoration and wildfire maintenance as shown in Figure 14 on page 98. These four zones were designed to categorize risk and reduce many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets. They facilitate fire management decisions by reducing the uncertainty of where and under what conditions wildfires are more likely to have positive outcomes and be suitable to consider for managing to meet resource objectives.

Facilitating wildland fire management: An increase in implementing effective strategic fire management through fuel reduction treatments and managing wildfire to meet resource objectives would be more attainable. The risk-based strategic fire management zones would help prioritize fuel reduction in areas based upon the location and source of potential damages and benefits to highly valued resources and assets.

Consequences Specific to Alternative C

Managing Uncertainty: Alternative C has three zones: the wildland-urban intermix defense zone, general wildfire zone, and wildfire maintenance zone as shown in Figure 15 on page 100, making it more difficult to manage fire compared to the other alternatives. This is due to the higher uncertainty of where risk resides combined with less fuel reduction treatments that primarily rely on prescribed fire and much less mechanical thinning of fuels. The wildland-urban intermix defense zone is to the same as alternative A and does not account for potential damages to infrastructure and assets. The wildfire maintenance zone is the same as alternative B and the risk is low in this zone. The general wildfire zone does not categorize risk well because it consists of the remaining area and the risk ranges from a high potential of damages and moderate potential for benefits, thus resource objectives assigned to this zone cannot be safely used to make fire management decisions due to the wide range of uncertainty of risk.

Facilitating Wildland Fire Management: Managing wildfire to meet resource objectives in alternative C would be similar to the decision to manage wildfire for resource benefit in the wildland-urban intermix defense zone in alternative A; somewhat limited in the general wildfire zone; and highly encouraged in the wildfire maintenance zone. Prioritizing fuel reduction treatments would be similar to alternative A, based upon project planning due to the uncertainty of the risk to values and resources conveyed by the general wildfire zone. This will continue to allow the accumulation of fuels that contribute to large, unwanted wildfires that damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and threaten homes and communities in the wildland-urban intermix.

Consequences Specific to Alternative D

Managing Uncertainty: Alternative D is composed of the same four zones as alternative B: community wildfire protection, general wildfire protection, wildfire restoration and wildfire maintenance as shown in Figure 14 on page 98. These four zones were designed to categorize risk and remove many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets.

Facilitating Wildland Fire Management: Fire management practices in alternative D would provide firefighter safety in all zones while providing asset protection (structures, powerlines, etc.) in the Community Wildfire Protection and General Wildfire Protection Zones.

Summary

The four alternatives are ranked by the measures (managing uncertainty and facilitating fire management) for how they overall address risk management (Table 25). As with Table 24 on page 114, these measures were given a numerical rating based on how well they managed uncertainty and how well they addressed facilitating wildfire management. Note that the lower the number, the better the alternative in regard to addressing risk management.

Table 25. Summary of approach to wildfire risk management by alternative, all three national forests

Alternative	Indicator	Managing Uncertainty	Facilitating Fire Management	Total
A	Risk Management	3	3	6
B	Risk Management	1	2	3
C	Risk Management	4	4	8
D	Risk Management	1	1	2

Alternative D has the highest rank (lowest total) because it uses a set of strategic fire management zones that help inform fire management decisions across the fire continuum. There is more certainty about managing fire for protection objectives in the community and general wildfire protection zones and more certainty about managing fires for resource objectives in the wildfire maintenance zone. Alternative D includes direction to strategically treat areas in the wildfire restoration zone to encourage restoring fire as an ecosystem process and lower fire risk over time. Alternative B has the same fire management zone and the same classification of fire risk as alternative D, but it reduces fuels and restores fire on fewer acres so fire risk remains higher in more areas. Alternative A classifies fire risk in the wildland-urban intermix defense zone and threat zone but doesn't encourage or prepare the landscape for greater management of wildfires to meet resource objectives so the fire risk would remain high on many areas. Alternative C has the lowest rank (highest total) because it classifies fire risk in only the smaller wildland-urban intermix defense zone and in the wildfire maintenance zone but poorly classifies risk in the larger general wildfire zone. Combined with fewer strategic fuel reduction treatments due to plan components for other resource, the fire risk would remain high across most of the national forests in the general wildfire zone but might be reduced similar to alternatives D and B in the wildfire maintenance zone.

Air Quality

Background

Air quality is important to human health, forest visitor experience, vegetation health, soil quality, water quality and visibility. The planning area air quality is influenced by external and internal sources of air pollution that can be affected by the management direction in the forest plans. Some air pollutants (external) are generated primarily in urban areas and are transported to national forests. Ozone and nitrogen oxides are examples of pollutants that are generally transported from urban areas and are significant agents of change in the southern Sierra. Some air pollutants are generated by national forest management activities and may influence local and

distant air quality. Smoke from prescribed burning or managing wildfires to meet resource objectives is an example of a source of air pollution emitted as a result of national forest management.

The emphasis in this section is on smoke from prescribed burning and wildfire managed to meet resource objectives since these management actions contribute to air pollution on National Forest System lands but can also influence short- and long-term smoke emissions from unplanned wildfires. The overwhelming source of other air pollutants is from lands adjacent to the national forests, especially in the San Joaquin Valley and wind-blown dust from Mono Lake and the Owens Valley. For more details on other air pollutants see the Science Synthesis (Bytnerowitz et al. 2014) and the assessments (USDA FS 2013a, 2013b, 2013c, and 2013d).

Air quality is regulated at three levels: Federal, State, and local air pollution control districts. Federal agencies, such as the Forest Service, must meet all regulations put forth at each level. The three national forests fall within four different air pollution control districts: San Joaquin Valley Unified, Great Basin Unified, Eastern Kern, and Mariposa County Air Pollution Control Districts (Figure 21).

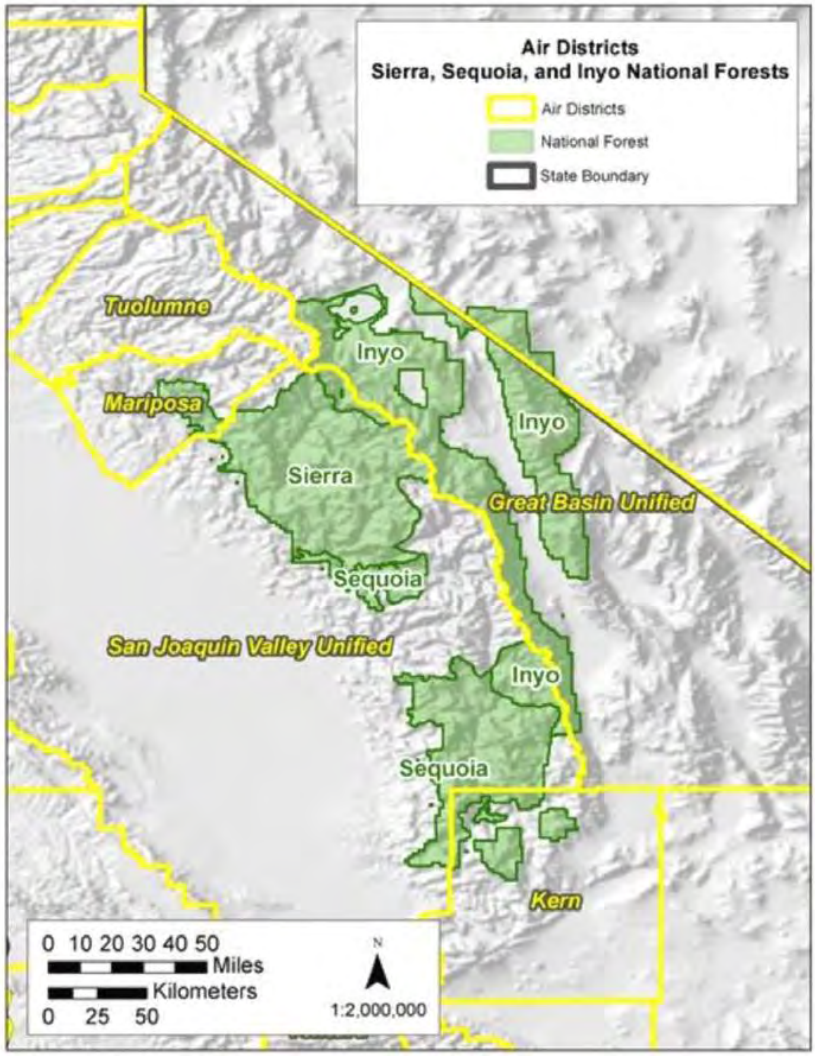

Figure 21. Map of air management districts in California

Air quality standards are based upon the Clean Air Act. The standards include regulating emissions such as ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. Smoke is one of the sources of particulate matter. Dust is also a type of particulate matter. Although most of these air pollutants originate outside of the national forests, some of them (in particular, ozone) can have a negative impact on forest health. Trees and other plants can become less healthy and even die from high ozone exposure. Management on national forests cannot control ozone levels but management of forests, in particular reducing forest density, can make forests more resilient to ozone damage (Byternowitz et al. 2014). See the "Terrestrial Ecosystems" section for more information on forest responses to ozone.

Air quality on National Forest System lands are regulated in a few ways. All lands are designated as in "attainment" or "non-attainment" based upon whether they meet the standards or not. If there is insufficient data, areas can be designated as "nonclassified." When an area's air quality exceeds the regulatory guidelines it is designated as "nonattainment." These statuses are designated at the Federal level by the Environmental Protection Agency and additional requirements are designated at the state level by the California Air Resources Board. The status of each area is reevaluated periodically, and the current status is described under the "Affected Environment" section below. The Forest Service is also required by the Regional Haze Rule of 1999 to monitor air quality in class I airsheds (wilderness areas). The goal of this law is to return haze levels to natural background conditions by the year 2064.

Analysis and Methods

This analysis examines the potential air quality impacts from implementation of the proposed forest plan and the alternatives. The proposed action is programmatic covering the broad pattern of potential projects and wildfires that can influence air quality. Specific air quality impacts from individual projects would be analyzed prior to implementation in project-based analysis.

The assessment of air quality impacts is both quantitative and qualitative. The primary approach compares the tradeoffs between potential smoke emissions from the restoration treatments that reduce the potential wildfire emissions and the wildfire emissions that would occur without the restoration. For more detail on the emissions analysis see the Fire-climate supplemental report and the Smoke and Air Quality supplemental report. Forest carbon storage and effects are discussed in the Carbon Stability supplemental report. This section focuses on regulated air pollutants.

Assumptions

There are many uncertainties about when or where wildfires occur and what potential other sources of smoke may be and how great the emissions. We made several assumptions for this analysis, mostly to address these uncertainties.

- It is unknown exactly, when, where or how much wildfire will occur but the trend of increasing large wildfires and associated high smoke emissions is expected to continue (Hurteau et al. 2014).
- The amount of emissions released by combustion of vegetation will vary depending on the amount of vegetation present and the completeness of combustion. For example, combustion of a stand of Douglas-fir produces more emissions than a sparsely vegetated acre of pinyon-juniper with identical combustion efficiency. Thus, vegetation type is an important factor in quantifying emissions. See the Smoke and Air Quality supplemental

report for assumptions of vegetation types under each alternative and corresponding emissions factors.

- Restoration actions that follow the proposed plan and alternatives would result in reduced emissions from wildfires that burn across those areas (Hurteau and North 2009, North 2010, Tarnay and Lutz 2011, Vaillant et al. 2013). Restoration treatments would "offset" future large wildfire emissions. The amount of the reduction depends upon the type and intensity of treatments. See below for a summary of the research on the amount of emissions reductions with forest thinning, biomass removal, mastication, and prescribed fire.
- Smoke management would be practiced actively with all prescribed fire and wildfires managed to meet resource objectives. This would include smoke prediction modeling, smoke monitoring, and close coordination with the local air districts.

Mechanical Thinning, Biomass Removal, and Mastication

Mechanical treatments include thinning trees, removing biomass (smaller trees, shrubs or larger tree branches), and mastication (where small trees and shrubs are shredded or crushed). Thinning can result in substantially lower emissions during large wildfires (Hurteau and North 2009) and local examples indicate by as much as 90 percent or more (Hurteau et al. 2008). During large wildfires woody biomass burns resulting in a release of carbon and smoke. Thinning can reduce these emissions by removing some woody biomass from the forest and we assumed it would occur in each alternative where it is allowed. Machinery use would generate emissions; however, these would be minimal at the planning area level. Emissions from machinery use would be analyzed at the project level.

Smoke from Prescribed Fires and Wildfires Managed to Meet Resource Objectives

All fires produce smoke emissions. The amount of smoke emitted and the area it impacts varies with the size of the fire, type of fire, vegetation density, and location. Smoke management is a key aspect of prescribed fires and wildfires managed to meet resource objectives. Prescribed fire activities generally occur under favorable atmospheric conditions for smoke dispersion to limit human health impacts. Wildfires managed to meet resource objectives offer long-term benefits by reducing future wildfire emissions. Research indicates that prescribed burning results in an 18 to 25 percent reduction in wildfire emissions, with examples as high as 60 percent (Wiedinmyer and Hurteau 2010). Long-term reductions in emissions from implementation of these activities were modeled by Hurteau et al. 2014. The degree to which emissions are reduced depends on the amount of restoration that occurs.

Smoke from Wildfires

In general, large wildfires produce 100 to 1,000 tons of fine particles in smoke per day, moderately sized fires 10 to 100 tons, and small fires less than 10 tons per day (Tarnay and Lutz 2011). Emissions from wildfires are generally much larger than prescribed fire (Vaillant et al. 2013). Larger fires have regional impacts, whereas smaller fires have local impacts. Restoration treatments such as mechanical thinning, prescribed fire, and wildfires managed to meet resource objectives can reduce long-term wildfire emissions. Research indicates that smoke emissions from large fires will double during the next half century due to trends in vegetation conditions, climate, and fire ignitions (Hurteau et al. 2014). Increasing smoke emissions identified by Hurteau et al. is a baseline in this analysis.

Indicators and Measures

Three indicators describe the indirect and cumulative effects of each alternative to air quality. A short-term (present to 10 years) or long-term (10 years to mid-century) category describes the timeline of effects to each indicator. The selected indicators consist of smoke effects from alternative implementation on: air quality, recreation, and visibility. The following section presents each indicator and measure used in further detail.

Smoke Effects on Air Quality

The potential effects of smoke on air quality indicators was measured quantitatively. Emissions produced by alternative A serves as a baseline to compare emissions produced by actions under alternatives B, C, and D. The pollutants analyzed are the criteria pollutants of total organic gases (TOG), reactive organic gases (ROG), carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM), particulate matter less than 10 micrometers (PM_{10}), and particulate matter less than 2.5 micrometers ($PM_{2.5}$). Long-term, indirect, and cumulative effects from implementation is analyzed using modeled future emissions from Hurteau et al. (2014). This indicator is comprised of two categories of emissions: wildfires and restoration treatments. Restoration treatments include the following activities: mechanical treatments, prescribed fire, and managing wildfire to meet resource objectives.

Smoke Effects to Recreation

This indicator will be measured qualitatively. Smoke obscures visibility and impacts recreation through visitor avoidance of smoke impacted areas. Long-term, indirect, and cumulative effects from implementation is analyzed using modeling information from Hurteau et al. (2014).

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

The Forest Service, along with other agencies, monitors class I wilderness areas through the Interagency Monitoring of Protected Visual Environments (IMPROVE) network. There are three sites within the southern Sierra Nevada in the Kaiser Wilderness, Hoover Wilderness, and Dome Lands Wilderness. This monitoring network measures pollutant concentration as well as visibility, a measurement of how clearly distant objects can be seen. Indirect and cumulative effects are qualitatively assessed. Current trends are compared to long-term modeled impacts from Hurteau et al. (2014).

Affected Environment

The Central Valley of California with the surrounding mountain ranges acts as a basin trapping pollution in the valley. The Sierra and Sequoia National Forests form part of the eastern boundary of the Central Valley bowl and overall have moderate to poor air quality (Bytnerowicz et al. 2014). The air quality on the eastern side of the Sierra Nevada, including the Inyo National Forest, is good except when wildfire smoke is present. At this time, the eastern side of the national forests are in attainment of State and Federal standards. Although the eastern Sierra meets air quality standards, smoke is frequently present. On the west side, the Sierra and Sequoia National Forests exceed State and Federal ozone standards, and are therefore in nonattainment status. Ecosystem impacts from air pollution have been identified as a threat to ecological integrity in the analysis area. Examples of impacts include: ozone damage, excessive nutrient nitrogen, and pesticide drift. High concentrations of ozone harm forest health, making trees more susceptible to drought, insects and pathogens. See the Bio-Regional Assessment (USDA FS

2013a), forest assessments (USDA FS 2013b, 2013c, 2013d), and Science Synthesis (Long et al. 2014) for more information.

Overall air quality within the region is largely outside of the control of the Forest Service except for smoke management for activities on National Forest System lands. Smoke management opportunities are limited during large wildfires. There has been a trend in increased large wildfires and associated heavy smoke emissions. The level of smoke emissions from large wildfires is expected to double over the next 50 years, given current vegetation conditions and trends in climate and fire ignitions (Hurteau et al. 2014). There have been a limited number of prescribed fires in the last decade (see "Fire Management" section). Multiple wildfires managed to meet resource objectives have occurred in the eastern portion of the Sequoia National Forest in the Kern River drainage.

Environmental Consequences to Air Quality

Consequences Common to all Alternatives

The alternatives each vary in the amount of treatments analyzed. Current conditions under alternative A are used as a baseline to analyze impacts to the indicators and measures of: air quality, recreation, and visibility. In addition, information gathered during the forest plan assessment phase is used in the analysis.

In the fire-climate study conducted for the southern Sierra Nevada, reductions in projected wildfire emissions from different levels of restoration were analyzed (see the "Fire Trends" section on page 58). Figure 22 shows the reductions in projected wildfire smoke emissions with four different restoration scenarios. This graph was based upon a climate projection called the GFDL (Geophysical Fluid Dynamics Laboratory) A2 climate scenario and it assumed that the fires burn with high severity and high emissions. Figure 22 shows that with climate projections, smoke emissions are predicted to double from the model's point of reference level from 1961 to 1990. The first bar represents the current trend and is labeled "Baseline." The second bar represents current management activities projected to the mid-century, resulting in large increases in emissions from wildfires. The remaining bars indicate future wildfire emission reduction comparing total particulate emissions measured in kilograms per hectare (kg/ha) from different treatment levels. The same relationships were applied to the indirect and cumulative effects of each alternative.

In general, alternative A is represented by the historic scenario, with restoration rates remaining the same at 5 to 10 percent of the landscape. Alternative B is represented by the range of conditions between the 15 and 30 percent restoration scenarios. Alternative C is represented by the range of conditions between the historic and 15 percent restoration scenarios. Alternative D is represented by the range of conditions between the 30 and 60 percent scenarios.

Based on the fire-climate simulations, wildfire emissions would continue to increase and double from current conditions by mid-century with some limited exceptions (Hurteau et al. 2014). All alternatives would have beneficial reductions in potential wildfire smoke emissions where restoration treatments occur; however, the degree of long-term improvement depends on the level of restoration (Figure 22). Uncertainty of analysis exists when considering when, where, and how much of a large wildfire will overlap with restoration treatments. Potential long-term reduction in emissions from restoration was analyzed. For additional information see the "Analysis and Methods" section.

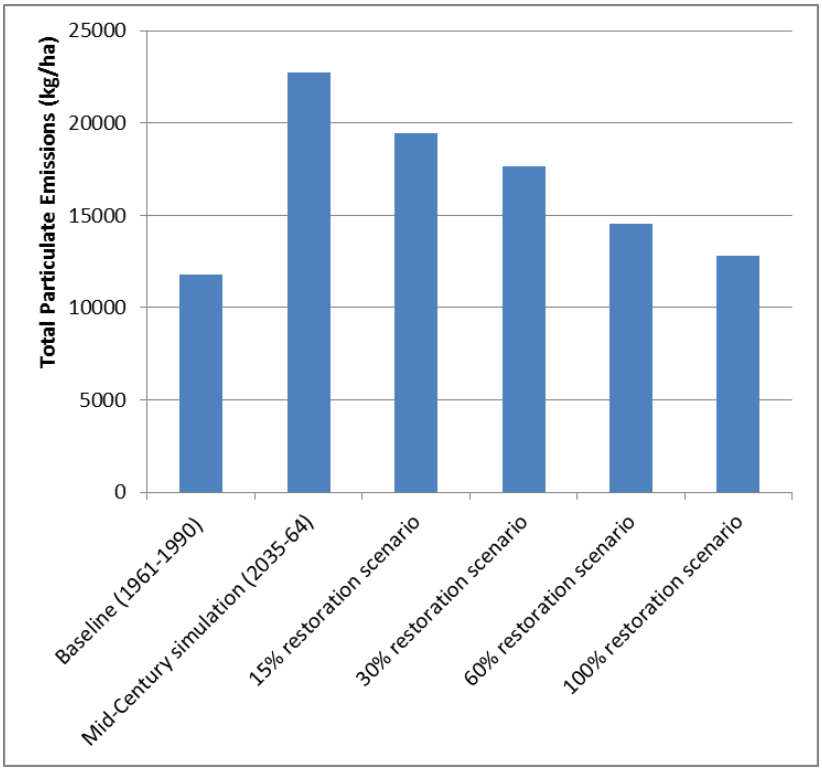

Figure 22. Graph displaying modeling results of particulate matter emissions from wildfires
(Data was modeled by Hurteau et al. 2014)

Consequences Specific to Alternative A

Under alternative A, there would continue to be limited restoration treatments (such as prescribed burning and mechanical treatments) that would reduce fuels and potentially reduce emissions during large wildfires. This alternative represents current management and resulting emissions. The primary impact from alternative A would be a continuation of current trends in large wildfires that produce large smoke emissions. The exception may be in the Kern River drainage on the Sequoia National Forest due to prior management actions that have restored fire to much of that area and where some wildfires are managed to meet resource objectives.

Smoke Effects on Air Quality

In alternative A, there would be a continuation of current trends in large uncharacteristic wildfires that contribute to reduced sustainability of air quality as modeled by Hurteau et al. (2014). Because emissions from wildfires are largely uncontrollable and can be large in scale, they result in large air quality impacts. In addition, wildfires may occur during times of unfavorable atmospheric conditions resulting in a compounded air quality effect. Smoke from wildfires tends to be of higher intensity than prescribed fires and managers have little control to limit emissions. For example, typically high ozone concentrations are present during summer months and air quality effects would be compounded by the smoke from wildfire. Consequences include adverse effects on human health, particularly for residents of communities in that path of smoke events.

Alternative A would not contribute to altering current trends or improve the sustainability of air quality benefits to people. While alternative A is considered “no action,” emissions would be generated by continuing current management and indirectly through wildfires. See Table 26 for an estimate of annual emissions from alternative A. Under this alternative, emissions would be

generated by continuing current management activities such as prescribed fire and limited wildfires managed to meet resource objectives. Alternative A shows emissions in tons per year and modeled mid-century emissions with no change in management from today. The annualized increase in emissions is primarily due to increased amounts of wildfire in this alternative at mid-century. This alternative serves as a baseline for comparison of each alternative. Emissions figures represent the most recent reported annual emissions (2013) from the Great Basin and San Joaquin Air Basin (CARB 2013). These two basins cover the vast majority of the emissions within the analysis area. Table 26 shows no data for most of the pollutants at mid-century because Hurteau et al. (2014) only modeled particulate matter and not other pollutants.

There would be a moderate to substantial intensity of the associated short- and long-term effects to air quality across a large geographic area from alternative A. Air quality would continue to be impacted through increased wildfire emissions in the long term (mid-century). In the short term, treatments would cause a sporadic reduction (as treatments occur) of impacts to air quality from wildfires but would have pulses of impact associated with prescribed burning.

Table 26. Table displaying baseline annual emissions in tons per year under alternative A compared to the modeled mid-century emissions with no change in management

Reference Period	Total Organic Gases	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Baseline annual emission (Combined San Joaquin and Great Basin Air Basins) and current forest management	650,669	380,140	120,587	4,231	222,504	124,490	33,456
Annualized increase in emissions at mid-century	No data	No data	No data	No data	45,283	No data	No data

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 or 2.5 micrometers in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Smoke Effects to Recreation

There would be no change in the current trends of those forest conditions that result in smoke due to wildfire effects, which reduce recreational visitation on the national forests. Such smoke events have potential adverse short- and long-term effects on local communities. There is also additional loss of benefits to the recreational users who must find other settings for their recreational activities. The substitute recreation site may offer less opportunities or lower quality of the experience. In addition, substitute sites may be located farther away than the preferred site, thus increasing costs of recreating.

There is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Rural communities located along access routes to the national forests have a strong tie to the economic contributions that recreational visitors provide. This includes the spending that supports jobs and also contributions to local tax revenues through the sales tax and lodging tax collected. These local tax revenues support important public services that improve the quality of life in these communities. The connection between recreation visitation and local economies is especially true for the Inyo National Forest and the context of recreational based service-oriented businesses within Inyo and Mono Counties. Alternative A does not contribute to altering current

trends or improve the sustainability of these recreational benefits to people. Alternative A could result in increased wildfire and reduced recreational facility availability.

There would be a moderate to substantial intensity of smoke that would affect recreation across a large geographic area from the associated short- and long-term effects of implementing alternative A.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

In general, data from the three IMPROVE sites show that visibility is currently increasing within the planning area (see Assessment). However, modeling indicates that wildfire emissions will significantly increase by mid-century (Hurteau et al. 2014). Increasing emissions is expected to reduce visibility throughout the planning area.

Visibility in class I airsheds is regulated under the Regional Haze Rule and the Forest Service is responsible for meeting goals set-forth by the Environmental Protection Agency. Implementation of alternative A would make attaining these goals unlikely as wildfires increase.

Impacts to visibility is expected to be low to moderate in the short term and would increase to high in the long term.

Consequences Specific to Alternative B

Alternative B would result in restoration treatments in up to 30 percent or more of many landscapes in the foothill, montane, and sagebrush/pinyon-juniper areas. In the fire-climate scenario, there would continue to be an increase in large fires and heavy smoke emissions but a little more than half of what could potentially occur without any restoration. There would be more prescribed fire, mechanical thinning, and in some areas wildfires managed to meet resource objectives. All of these restoration activities would reduce potential emissions from large, undesirable wildfires. There would be increased smoke emissions from prescribed fires but levels of smoke would be substantially lower (45 percent less) than during wildfires and result in immediate post-fire reductions in potential wildfire smoke emissions (Vaillant et al. 2013).

Smoke Effects on Air Quality

Alternative B would contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. The prescribed burning in this alternative would have a potential short-term adverse effect on air quality but these activities tend to be conducted under favorable atmospheric conditions and thus these effects can be mitigated to some extent. Wildfires managed to meet resource objectives similarly consider the impacts of smoke as management actions are taken, although there is less control than for prescribed fires. The mechanical thinning proposed in the alternative would reduce the quantity of smoke that would occur during prescribed fire activities and for wildfires managed to meet resource objectives by reducing the amount of fuels available to burn.

Air pollution resulting from agricultural and industrial activities is a concern for the national forests adjacent to California's Central Valley. The Forest Service does not have direct control over this pollution but can contribute to air quality enhancement by limiting the smoke from wildfires that add to this pollution. In the long term, implementation of alternative B would indirectly improve air quality compared to alternative A by reducing the potential for large wildfires, and therefore reducing emissions. Alternative B contributes to altering current trends and improving the sustainability of air quality benefits to people. Under alternative B, emissions

would be generated by increasing current prescribed fire and wildfires managed to meet resource objectives. Indirect emissions would occur from wildfires. Emissions estimates were conservatively modeled and report the highest amount of emissions possible. During actual implementation, emissions would be reduced from the reported amounts by pre-thinning vegetation. See Table 27 for a conservative estimate of emissions. Actual emissions and smoke impacts depend on additional factors such as: seasonality of implementation, meteorology, and combustion efficiency. In the short term, alternative B would directly increase emissions. By mid-century, alternative B is projected to decrease emissions.

Table 27. Emissions from treatments under alternative B in tons per year compared to the baseline established in alternative A

Reference Period	Total Organic Gases	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Baseline emissions from alternative A	650,669	380,140	120,587	4,231	222,504	124,490	33,456
Annualized increase in emissions at mid-century under alternative B	32,687	695,647	6,326	4,256	123,745	66,530	56,411
Annualized percent of increased emissions under alternative B	5	65	5	50	36	35	63

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 or 2.5 micrometers in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

There would be a moderate intensity of the associated short- and long-term effects to air quality across a large geographic area. Air quality would improve through wildfire emissions reduction in the long term (mid-century). In the short term, treatments would cause a sporadic reduction (as treatments occur) of impacts to air quality from wildfires but would have pulses of impact associated with prescribed burning and wildfires managed to meet resource objectives.

Smoke Effects to Recreation

Alternative B would contribute to reducing current trends in those forest conditions that result in smoke due to wildfire effects. Reductions in smoke events have potential beneficial short- and long-term effects on local communities due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning. However, the net-effect of air quality on recreational visitation is expected to be mitigated to some extent given the level of mechanical thinning occurring before any prescribed burning occurs. In addition, mitigation measures would control when and where prescribed burning can occur to reduce smoke events and most prescribed burning occurs in the late fall through spring, outside of the peak recreation season. There is also additional benefit to the recreational users who are able to enjoy recreational activities in the national forests when wildfires would otherwise prevent visitor use.

As described in alternative A, there is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience

that contributes to quality of life. Alternative B would contribute to a decrease of current trends of smoke to improve the sustainability of recreational benefits to people.

There would be a moderate to substantial intensity of smoke that would affect recreation across a large geographic area from the associated short- and long-term effects of implementing alternative B.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Effects to the visibility in class I airsheds under alternative B represent a trade-off. In the short term, increased emissions would directly reduce visibility in the class I airsheds within the analysis areas. In the long term, treatments under alternative B would reduce emissions and thus indirectly improve visibility in class I airsheds by mid-century. In general, data from three IMPROVE sites show that visibility is currently increasing within the planning area (see Assessment). However, modeling indicates that wildfire emissions would significantly increase by mid-century (Hurteau et al. 2014). Increasing emissions is expected to reduce visibility throughout the planning area. Restoration treatments can improve visibility through the reduction of emissions in the long term. Less smoke would be produced in the analysis area under this alternative compared to alternatives A and C due to mechanical thinning in stands outside of wilderness areas, as well as increasing restoration treatments such as wildfires managed to meet resource objectives.

Visibility in class I airsheds is regulated under the Regional Haze Rule and the Forest Service is responsible for meeting goals set-forth by the Environmental Protection Agency. Implementation of alternative B would make attaining these goals less likely in the short term due to the increase of emissions from prescribed burning and wildfires managed to meet resource objectives. This effect would decrease after implementation is complete. In the long term, a more resilient landscape would increase the likelihood of attainment in class I airsheds by the mid-century.

In the short term, moderate to substantial intensity impacts resulting in decreases in visibility would occur in class I airsheds when implementation is occurring. In the long term, moderate to substantial intensity impacts resulting in improved visibility in class I airsheds would occur through reduced wildfire emissions.

Consequences Specific to Alternative C

Alternative C increases the amount of treatment compared to alternative A. This would result in short-term smoke emissions but potentially substantial reductions in potential large wildfire smoke emissions in areas where large prescribed burns occur. The prescribed fires are conducted under controlled conditions for smoke management and dispersal allowing the effects to be mitigated as opposed to wildfires. There is uncertainty about how much of the prescribed fire and wildfires managed to meet resource objectives would be implemented because there are more limitations on mechanical treatments. There would be less treatment of strategic areas along roads and ridgetops so there is less likelihood of treatments reducing current trends in large wildfires emissions that adversely affect the long-term sustainability of air quality.

Smoke Effects on Air Quality

Alternative C would contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality to the extent that larger landscape prescribed burning occurs. The prescribed burning would have a potential short-term negative effect on air quality but these activities tend to occur under favorable atmospheric conditions and

thus effects can be mitigated to some extent. There is less mechanical thinning proposed than in alternatives B and D and therefore these prescribed fires and wildfires managed to meet resource objectives would have a greater quantity of smoke associated with restoration activities as more fuels are available to burn.

Air pollution resulting from agricultural and industrial activities is a concern for the national forests adjacent to California's Central Valley. The Forest Service does not have direct control over this pollution but can contribute to air quality by controlling the smoke from wildfires that add to this pollution. Alternative C would contribute to altering current trends and improving the sustainability of air quality benefits to people. Emissions would be generated by increasing current prescribed fire and wildfires managed to meet resource objectives. Indirect emissions would occur from wildfires. The emissions estimates were conservatively modeled and no reduction techniques, such as pre-treatment thinning of vegetation, were modeled. See Table 28 for an estimate of emissions. Actual emissions and smoke impacts depend on additional factors such as seasonality of implementation, meteorology, and combustion efficiency. In the short term, alternative C would directly increase emissions. By mid-century, alternative C is projected to limit some wildfire emissions.

There would be a moderate intensity of the associated long-term effects to air quality across a large geographic area and a moderate to substantial intensity of associated short-term effects. Air quality would improve through reduced wildfire emissions in the long term (mid-century) where prescribed burning occurs and where wildfires are managed to meet resource objectives. In the short term, treatments would cause a sporadic reduction (as treatments occur) of air quality impacts from wildfires. There would be pulses of impact associated with prescribed burning and wildfires managed to meet resource objectives that would be larger than alternatives B and D due to less fuel reduction with mechanical methods and more fuels to burn.

Table 28. Emissions from treatments under alternative C measured in tons per year and compared to the baseline established in alternative A

Reference Period	Total Organic Gases	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Baseline emissions from alternative A	650,669	380,140	120,587	4,231	222,504	124,490	33,456
Annualized increase in emissions under alternative C at mid-century	29,248	623,397	5,387	3,732	110,482	59,399	50,369
Annualized percent of increased emissions under alternative C	4	62	4	47	33	32	60

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 microns or 2.5 microns in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Smoke Effects to Recreation

Alternative C contributes to reversing current trends in those forest conditions that result in smoke due to wildfire effects. Reductions in smoke events have potential beneficial short- and long-term effects on local communities due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed

burning and wildfires managed to meet resource objectives. The net-effect on air quality is more uncertain under alterative C than under alternatives B and D given there is less mechanical thinning occurring before any prescribed burning. There would be mitigation measures used to control when and where prescribed burning can occur in order to reduce smoke exposure, and smoke impacts would be considered when managing wildfires to meet resource objectives. There is also additional benefit to the recreational users who are able to enjoy recreational activities in the national forests when wildfires would otherwise prevent visitor use.

Like alternatives A and B, there is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Alternative C would also contribute to altering current trends to improve the sustainability of recreational benefits to people.

There would be a moderate to substantial intensity of smoke that would affect recreation across a large geographic area from the associated short- and long-term effects of implementing alternative C.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Effects to the visibility in class I airsheds under alternative C represent a trade-off. In the short-term, if fully implemented increased emissions from prescribed fire and wildfires managed to meet resource objectives would reduce visibility in the class I airsheds within the analysis areas. In the long-term, treatments under alternative C would reduce emissions from wildfires and thus indirectly improve visibility in class I airsheds by mid-century. In general, data from three IMPROVE sites show that visibility is currently increasing within the planning area (see Assessment). However, modeling indicates that wildfire emissions would significantly increase by mid-century (Hurteau et al. 2014). Increasing emissions is expected to reduce visibility throughout the planning area. Restoration treatments can improve visibility through the reduction of emissions in the long term. In the short term, treatments from this alternative would result in greater quantities of visibility-reducing smoke in nearby class I airsheds as compared to alternative B because fewer acres would have reduced fuels from mechanical treatment prior to prescribed burning or wildfire managed to meet resource objectives.

Visibility in class I airsheds is regulated under the Regional Haze Rule and the Forest Service is responsible for meeting goals set-forth by the Environmental Protection Agency. Due to the limited potential amount of mechanical fuel reduction treatments, implementation of alternative C would make attaining these goals unlikely.

In the short term, moderate to substantial intensity impacts resulting in decreases in visibility would occur in class I airsheds when implementation is occurring. In the long term, moderate to substantial intensity impacts resulting in improved visibility in class I airsheds is expected.

Consequences Specific to Alternative D

Alternative D would have the greatest amount of restoration activities, including prescribed fire, mechanical thinning, and wildfire managed to meet resource objectives. Thirty to 50 percent of many montane and foothill landscapes would have restoration treatments. Based on the fire-climate scenarios (see “Fire Trends” section) this would result in a substantial reduction in potential wildfire emissions. At mid-century there would still be an increase in emissions over current levels but far less than the projected doubling of smoke emissions under alternative A.

Smoke Effects on Air Quality

Alternative D contributes to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. The prescribed burning in this alternative would have a potential short-term adverse effect on air quality, but these activities tend to be conducted under favorable atmospheric conditions and thus effects can be mitigated to some extent. The mechanical thinning proposed in the alternative would also help to reduce the quantity of smoke that would occur during these prescribed fire activities and when areas are burned in wildfires managed to meet resource objectives.

Like the other alternatives, air pollution resulting from agricultural and industrial activities is a concern for the national forests adjacent to California's Central Valley. Alternative D contributes to altering current trends and improving the sustainability of air quality benefits to people. Under alternative D emissions would be generated by increasing current prescribed fire and wildfires managed to meet resource objectives. Additional indirect emissions would occur from wildfires. The emissions were conservatively modeled, meaning the figures represent maximum emissions and may be lower when restoration activities are implemented. See Table 29 for an estimate of annual emissions.

Table 29. Emissions under alternative D in tons per year compared to the baseline established in Alternative A

Reference Period	Total Organic Gases	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Baseline emissions from alternative A	650,669	380,140	120,587	4,231	222,504	124,490	33,456
Annualized increase in emissions under alternative D at mid-century	36,657	779,723	7,214	4,809	138,880	74,667	63,311
Annualized percent of increased emissions under alternative D	5	67	6	53	38	37	65

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 microns or 2.5 microns in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Actual emissions and smoke impacts depend on additional factors such as seasonality of implementation, meteorology, and combustion efficiency. Under this alternative, emissions would be generated through continuation of current management activities. In the short term, alternative D would directly increase emissions. By mid-century, alternative D is projected to decrease emissions.

There would be a moderate to substantial intensity of the associated short- and long-term effects of alternative D to air quality across a large geographic area. Air quality would improve more than any other alternative through reduced wildfire emissions in the long term (mid-century). In the short term, treatments would cause a sporadic reduction (as treatments occur) of air quality impacts from wildfires but would have pulses of impact associated with prescribed burning and increased use of wildfires managed to meet resource objectives.

Smoke Effects to Recreation

Like alternative B, alternative D would contribute to reducing current trends in those forest conditions that result in smoke due to wildfire effects. Reductions in smoke events have potential beneficial short- and long-term effects on local communities due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning and wildfires managed to meet resource objectives. However, the net-effect of air quality on recreational visitation is expected to be mitigated to some extent given the level of mechanical thinning occurring before any burning occurs as well as the mitigation measures in place to control when and where prescribed burning can occur in order to reduce smoke events. There is also additional benefit to the recreational users who are able to enjoy recreational activities on the national forests.

As with the other alternatives, there is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Alternative D would contribute to altering current trends in air quality to improve the sustainability of recreational benefits to people.

However, there would be a moderate to substantial intensity of the associated short- and long-term effects of alternative D to air quality across a large geographic area.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Like the other alternatives, increased emissions from prescribed fire and mechanical treatments in alternative D would directly reduce visibility in the class I airsheds within the analysis areas in the short term. In the long term, treatments under alternative D would reduce wildfire emissions and thus indirectly improve visibility in class I airsheds by mid-century. Restoration treatments can improve visibility through the reduction of emissions in the long-term.

With the increased amounts of restoration and reduction in smoke from future wildfire, implementing alternative D increases the likelihood of attainment in class I airsheds by the mid-century. In the short term, moderate to substantial intensity impacts resulting in decreases in visibility to class I airsheds would occur during implementation of prescribed burning. In the long term, moderate to substantial intensity impacts resulting in improved visibility in class I airsheds is expected.

Cumulative Effects

In the short term, increased smoke production from prescribed burning and managing more wildfires to meet resource objectives in alternatives B, C, and D would result in a reduction in air quality, recreational opportunities, and visibility. In the long-term, alternatives B, C, and D would result in a cumulative reduction in air quality impacts from wildfires by mid-century compared to alternative A (Figure 22). The cumulative impacts of these alternatives by mid-century would result in increased air quality, recreational opportunities, and visibility due to a reduction in smoke from wildfires and increased ecosystem resilience. The degree of positive impact depends on the level of restoration selected for implementation. In the short term, alternative A would result in fewer cumulative impacts to air quality, recreation, and visibility than the other alternatives because there would be less prescribed burning and little wildfire managed to meet resource objectives. In the long term, cumulative effects from alternative A would result in an increase of negative impacts by mid-century due to increased wildfire emissions (Hurteau et al 2014).

The approach to increasing the amount of areas where fire is restored as a process is consistent with approaches of the National Park Service and Bureau of Land Management in wilderness and remote areas. Cumulative effects of smoke from these management actions by the different agencies are managed by ensuring close coordination. Daily cumulative smoke impacts from agricultural and forest burning throughout the state of California are addressed on a daily interagency coordination call. Frequent attendees include representatives from the Sierra, Sequoia, and Inyo National Forests, Sequoia and Kings Canyon National Parks, San Joaquin Valley Unified Air Pollution Control Districts, Great Basin Valleys Air Pollution Control District, and others. This daily call limits the amount of smoke produced within the airsheds of the planning area.

Analytical Conclusions

Effects to air resource indicators from each alternative is categorized by timeframes of short-term (present to 10 years) and long-term (10 years to mid-century). Effects to air resource indicators are categorized by emissions source-type of either wildfire or restoration treatments (prescribed fire, wildfire managed for resource benefit, and mechanical thinning) as shown in Table 30. No alternative offers both short-term and long-term improvements to air resource indicators. Models indicate wildfire emissions will increase through time and are considerably greater than restoration emissions. Restoration treatments would slow the progress of increasing wildfire emissions. The degree of slowing wildfire emissions growth through time depends on the level of treatments.

Restoration activities would increase emissions and affect air quality in the short term but the degree of increase is dependent on the amount of treatment. Alternative D has the highest short-term emissions from treatments followed by alternatives B and C. In the long term, alternative D would result in the greatest reduction in emissions from wildfires followed by alternatives C, B, and lastly, A. Short-term effects to air resource indicators from restoration activities can be moderated through smoke management best practices.

There would be potential adverse short- and long-term effects on the benefits to people that are obtained from the resulting decline in recreational visitation. Prescribed fire and managed wildfire smoke may impact recreational opportunities on the three national forests. In the short term, current trends of increasing impacts to recreation would continue in alternative A from smoke from wildfires that burn during the summer recreation season. There would be less smoke in the short-term in alternatives B and D where wildfires burn into areas where treatments occurred with less benefit in alternative C due to the lower amounts of treatment. In the long term, impacts to recreation are expected to increase with increasing wildfire emissions in alternative A, but to a lesser degree in alternative B and slightly lesser degree in alternative C. Only alternative D would decrease the long-term smoke from wildfires in the summer recreation season due to the greater amount of fuels reduced.

Increases in emissions and other cumulative effects would make long-term attainment of visibility goals unlikely under alternative A. Restoration treatments under alternatives B and D would result in a direct effect of reduced smoke emissions by mid-century. Reduction in wildfire emissions would make long-term attainment of visibility goals more likely under alternatives B and D than under alternative A (Figure 22). The prescribed burning restoration treatments under alternative C would result in reduced smoke emissions by mid-century and, to the extent that prescribed burning and wildfires managed to meet resource objectives occur, a reduction in wildfire smoke would make long-term attainment of visibility goals more likely than under alternative A but less

likely than under alternatives B and D. Short-term impacts would lessen throughout time as fuels are reduced and would increase visibility in the long term.

Table 30. Summary of air quality indicators and effects by alternative

Smoke effects indicator	Alternative A	Alternative B	Alternative C	Alternative D
Air quality	Short-term, emissions stay the same Long-term, emissions increase	Short-term, emissions increase Long-term, emissions reduced	Short-term, emissions increase Long-term, emissions reduced	Short-term, emissions increase the most Long-term, emissions reduced the most
Recreation	Short-term effects stay the same Long-term, more smoke effects	Short-term, more smoke effects Long-term, slightly less smoke effects	Short-term effects stay the same Long-term, more smoke effects	Short-term, more smoke effects Long-term, less smoke effects
Visibility in class I airsheds	Attainment unlikely	Attainment more likely	Attainment likely	Attainment most likely

Revision Topic 2: Ecological Integrity

Background

The topic of ecological integrity is very broad and spans from terrestrial to aquatic ecosystems. It includes the organisms that live in these ecosystems as well as the functions of the ecosystems themselves. To address this revision topic, the analysis is divided into three sections: terrestrial ecosystems; aquatic and riparian ecosystems; and wildlife, fish and plants. This topic also relies heavily upon the information provided in the "Agents of Change" section. The major vegetation types are discussed in the "Terrestrial Ecosystems" section and that discussion is referred to by other sections in this document.

Terrestrial Ecosystems

The terrestrial ecosystems analysis is presented in three subsections: terrestrial vegetation ecology, terrestrial ecosystem process and function, and climate vulnerabilities and adaptations.

Terrestrial Vegetation Ecology

Background

This section summarizes current terrestrial ecosystem conditions of dominant vegetation types on the Inyo, Sequoia, and Sierra National Forests, and the consequences of implementing the draft forest plans or the alternatives. It includes an analysis of the alternatives' effects on vegetation ecology including composition, structure, and resilience to fire, climate, drought, insects, and pathogens by major ecological and elevational zone and vegetation type. Building upon the "Agents of Change, Climate, Fire, Insects and Pathogens" section, there are more specifics about fire regime integrity and effects by vegetation type.

Much of the analysis is based upon the premise that the natural range of variation provides important background for evaluating ecological integrity and sustainability (Wiens et al. 2012). It was used to develop plan direction and select indicators and measures for the analysis. Also important in the analysis of ecological integrity and sustainability of vegetation was consideration of climate and associated fire trends that may be creating a combination of conditions that are outside of what occurred in the natural range of variation (Safford et al. 2012a, Millar et al. 2015).

Natural range of variation is a concept that focuses on the dynamic nature of ecosystems, recognizing they are not static (Landres 1999). It recognizes that disturbances, such as fire or insect attacks, and responses to those are part of the natural processes. This includes changes to vegetation composition, structure, and function (which influence habitat). Natural range of variation is typically characterized as the ecosystem conditions and processes that have occurred over long time periods (Morgan et al. 1994). While processes such as fire are naturally occurring and part of the ecosystem, it is recognized that human actions have changed vegetation and the type and effects of fire. Because of these changes, the natural range of variation is typically analyzed for the time period prior to European settlement. A premise is that ecosystems are more sustainable if their conditions fall within the natural range of variation (Safford et al. 2012b).

Application of natural range of variation concepts also recognize that native cultures managed and influenced ecosystem conditions and processes (Jackson and Hobbs 2009). For example, in the analysis area, Native American tribes actively used fire to manage resources (such as vegetation and game) of tribal importance (Lake and Long 2014).

Although the concept of natural range of variation and its use in sustainable ecosystem management is well developed from a theoretical standpoint, its application in resource management is not always straightforward. For example, sometimes an important measure of vegetation structure used to characterize wildlife habitat, such as canopy cover, is not directly or easily reconstructed historically. Or, quantitative information on historic conditions, such as tree densities, may only be available for a short period of time just before or at the onset of European settlement. Despite these limitations, it is still considered a useful way to evaluate the very important but complex concept of ecological sustainability. It is also increasingly recognized that human presence and needs may result in desired ecological conditions that are different than the natural range of variation (Higgs et al. 2014). Vegetation desired conditions for the proposed plan take into account not only natural range of variation, but also current societal desires for supporting recovery of endangered species and reducing fire near communities.

During the assessment phase, the terrestrial ecosystems were classified into broad ecological zones, based upon similarities in dominant vegetation types, climate, and fire patterns at a landscape scale. These broad ecological zones were used to analyze and summarize conditions and impacts of the alternatives to vegetation ecology and terrestrial function in the following subsection. The ecological zones include the westside foothill, montane, upper montane, subalpine and alpine zones, and pinyon-juniper ecological zones on the Sequoia and Sierra National Forests as shown in Figure 23 (see the maps in volume 3 to see ecological zones for each national forest by alternative). On the Inyo National Forest there are the pinyon-juniper and sagebrush, Jeffrey pine, upper montane, subalpine and alpine, and desert zones as shown in Figure 24. Two other vegetation types are described but not shown on these maps due to their small and localized distribution: red fir and mountain mahogany. The area in acres in each ecological zone by national forest is shown in Table 31.

Table 31. Area in acres by ecological zone or dominant vegetation type across each national forest, rounded to the nearest thousand acres

Ecological Zone/ Vegetation Type	Inyo National Forest (acres)	Sequoia National Forest (acres)	Sierra National Forest (acres)
Foothill	0	123,000	263,000
Montane	0	374,000	431,000
Upper Montane	163,000	204,000	369,000
Subalpine/Alpine	592,000	16,000	228,000
Jeffrey Pine	174,000	0	0
Pinyon-Juniper/Sagebrush	835,000	94,000	0
Desert	209,000	0	0

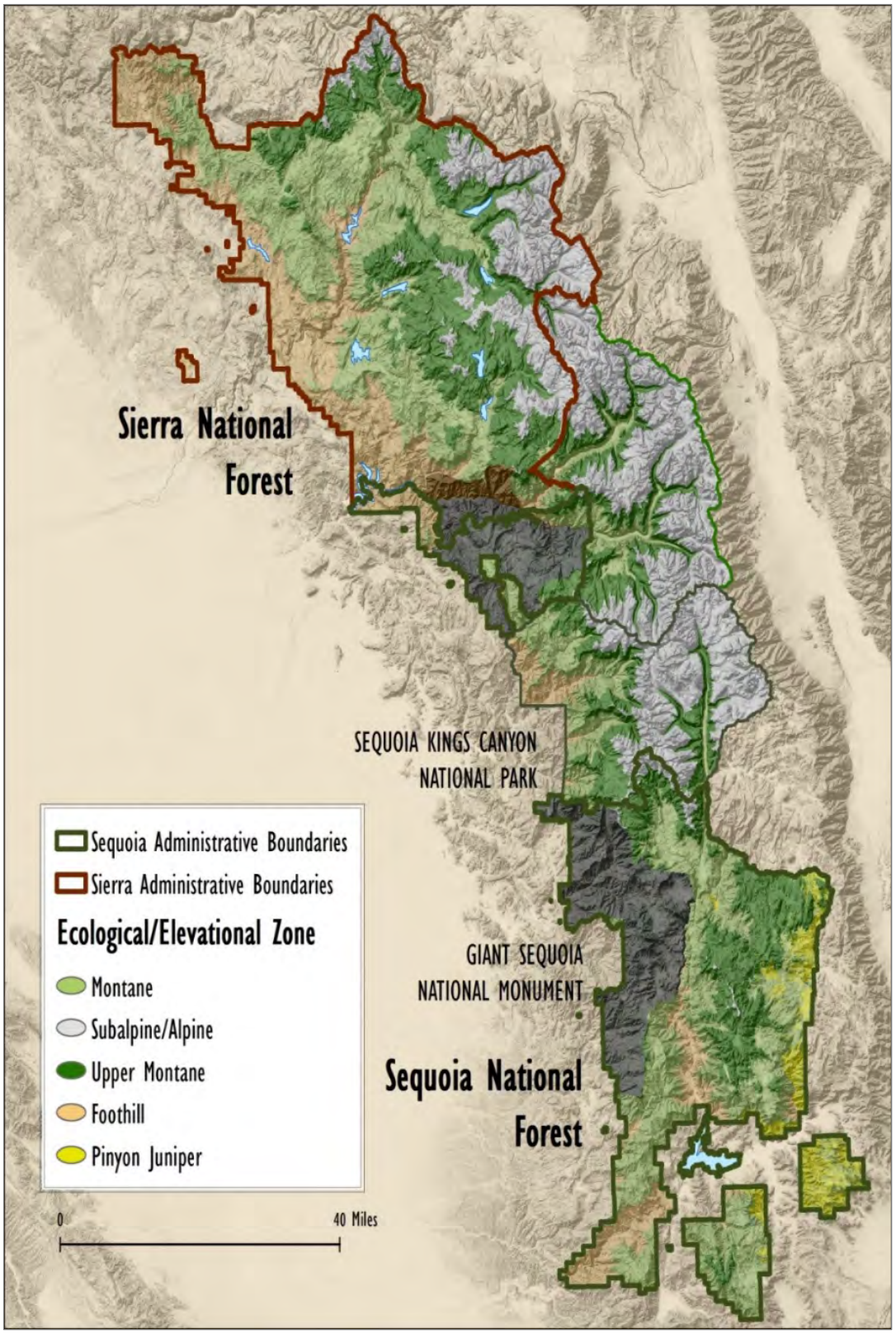

Figure 23. Ecological/elevational zones for the Sequoia and Sierra National Forests

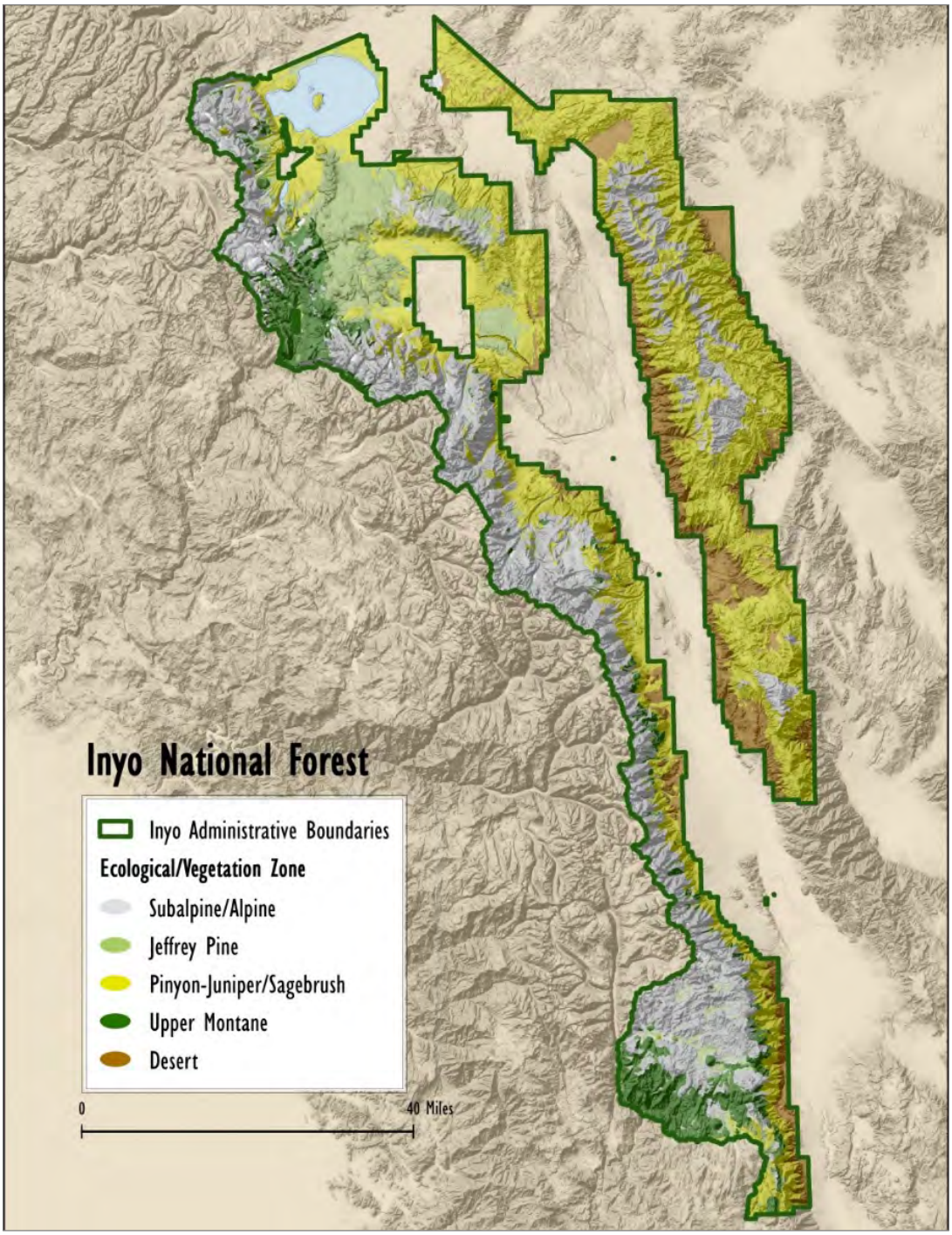

Figure 24.Ecological/vegetation zones on the Inyo National Forest

Analysis and Methods

The overarching approach we used in this analysis was to evaluate the similarity of current and estimated future conditions under each alternative to the desired conditions for each vegetation type. We used a combination of qualitative and quantitative analysis. For both types of evaluations, we identified the specific indicators, measures, thresholds for levels of similarity between desired conditions and current or future conditions, and associated assumptions. These are described in more detail in the Vegetation Ecology and Fire Ecology supplemental reports.

The desired conditions for vegetation and other terrestrial ecosystems are all directly related to the natural range of variation. For each major vegetation type, we developed desired conditions for vegetation structure, composition and function that were specific and quantitative where possible. For example, there has been extensive research on how forest density has changed over the last 100 or more years (Stephens et al. 2015, Collins et al. 2011, 2015) and other research on how forests differ between areas in national parks that have had little direct management except fire suppression and where over the past 40 years, fires have been restored (Lydersen and North 2012, Lydersen et al. 2013). This research includes information on dominant species, tree densities of different tree sizes, variation in tree spacing or heterogeneity, and evidence of high fire severity. There are some desired conditions that strive for a balance between habitat needs for at-risk species and the natural range of variation. That includes having more areas of somewhat higher canopy cover in westside montane forests than in the natural range of variation for California spotted owl and Pacific fisher and more areas of sagebrush cover for greater-sage grouse.

The choice of specific measures used in the desired conditions depends on a combination of what conditions are used to characterize suitable wildlife habitat, what is important for ecological integrity and sustainability, what is most departed from the natural range of variation, and what is most useful to apply to restoration projects. Canopy cover is an example that is important to wildlife habitat, is known to be departed from the natural range of variation and can be used to apply to restoration projects. Tree density is more difficult to relate to habitat and sustainability because it varies so widely from site to site. Basal area is a measure of forest density that incorporates aspects of tree density and tree sizes, and is available from the natural range of variation research and is very useful in restoration project design. Because of these considerations, desired conditions were developed for canopy cover at the landscape scale and within patches, and basal area was used to measure forest density.

Indicators and Measures

There are several main aspects to vegetation ecology that were used for this analysis.

Composition. Composition includes the mix of plant species. The analysis looks at predicted changes to overstory and understory composition. For the overstory, we considered the primary tree species, such as black oak mixed with ponderosa pine trees (westside) and amount of pinyon-juniper in sagebrush areas (eastside). For the understory, we considered the mix of native flowering plants, shrubs and grasses and presence and extent of non-native, invasive plants.

Structure. Structure includes the type of plants (trees or shrubs), how big individual plants or trees are, how dense they occur, and how they are arranged, such as uniformly or in a clumpy or heterogeneous pattern. Vegetation structure at the landscape scale was characterized by the amount of vegetation in the California Wildlife Habitat Relationships classes (Mayer and Laudenslayer 1988). At the patch scale, we analyzed forest density, represented by canopy cover

and basal area. We used heterogeneity (variability in tree spacing, sizes and openings) to analyze within-patch structure.

Vegetation types as described by California Wildlife Habitat Relationships classes are useful in comparing the proportion of the landscape in forested versus nonforested areas, and the amount of open versus close-canopied, or small- versus large-tree-dominated patches. While they are sometimes equated to seral stages (stages of forest development), there is not necessarily a one-to-one correspondence. For example, very open small-tree-dominated woodland at high elevations may be a very old subalpine forest. The stand size characteristic is based upon the average stand diameter. When forests consist of mixtures of tree sizes or diameters, this can make it difficult to distinguish younger from older forests. The California Wildlife Habitat Relationships classification does not reflect aspects of structure that are important to many wildlife species, such as large trees and snags (North and Manley 2012). The analysis of old forest characteristics, including the proportion of the landscape in old forest and large tree density are described in greater detail in the Old Forest supplemental report. Despite the short-comings of the California Wildlife Habitat Relationships classification, it is what has been applied for multiple decades. It is still used in part to characterize wildlife habitat suitability for some of the species of conservation concern analyzed in this plan, including the California spotted owl and Pacific fisher. Because of its continued use in wildlife models, it was analyzed here.

Resilience to Fire, Climate, Drought, Air Pollutants, Insects and Pathogens. Resilience is a measure of the elasticity of an ecosystem; that is, its ability to absorb disturbances or stressors such as severe droughts and insect outbreaks and to maintain or quickly recover its intrinsic ecological characteristics (composition, structure, and function) and ecosystem services (such as provide habitat or soil protection). For this analysis, the ability of terrestrial ecosystems, especially vegetation, to withstand drought, warmer temperatures, high-intensity fires and insect and pathogen outbreaks was analyzed. In the previous section on climate, the broader capacity of ecosystems to respond to climate change was covered. Resilience to fire was addressed in the context of the natural range of variation of fire regimes.

Two different measures were used to reflect ecological fire resilience. In forested ecosystems, we used the intensity and type of fire, such as surface or crown fire. In nonforest and woodland ecosystems, we used fire return interval departure and presence of non-native annual grasses to analyze resilience. For both of these measures, the analysis was at a landscape scale, since fires and vegetation responses can vary from site to site. The aggregate of all of those effects and resilience to fire is most important for ecological impacts.

Analysis Methods and Data Sources

We used a combination of scientific summaries, scientific research, and existing and available vegetation information for the analysis. This included Forest Inventory and Analysis plot data and remote sensing, satellite data. Most of the information included in the “Affected Environment” section was based upon the bio-regional and forest assessments (USDA FS 2013a, 2013b, 2013c, 2013d). These included information from the “Living Assessment” (USDA FS 2013e, 2013f, 2013g, 2013h), published scientific literature, the “Scientific Synthesis” (Long et al. 2014), and the “Natural Range of Variability Assessments” (Safford 2013; Estes 2013a, 2013b; Merriam 2013; Meyer 2013a, 2013b; Sawyer 2013; Slaton and Stone 2013a, 2013b. This information was used to evaluate the conditions of the indicators relative to desired conditions and analysis thresholds.

For each indicator and vegetation type or ecological zone, we evaluated potential effects on composition, structure, and resilience at the programmatic level for each alternative. This entails identifying plan direction relevant to the vegetation type for each alternative and making projections about the potential effects of future implementation of that plan direction. The specific timing and location of potential restoration projects is not known but the types of effects associated with implementation can be discussed. The evaluation of potential effects to composition, structure, and resilience associated with plan implementation is based on scientific literature (and professional experience) that has examined the effects of treatments similar to those that would be implemented under alternatives B, C, and D using fire-climate modeling (see "Fire Trends" section, Westerling et al. 2015), and ecological fire resilience modeling (USDA FS 2013a, 2013b, 2013c, 2013d).

Most of the literature on restoration of montane forests has focused on fuels treatments. More recently, there has been an increase in ecological restoration for vegetation composition, structure, and ecological function. Much of the associated research on ecological restoration for westside and yellow pine (ponderosa and Jeffrey pine) forests has been summarized in two recent technical reports, GTR 220 and 237 (North et al. 2009a, North 2012), and the recent "Science Synthesis for the Sierra Nevada Bioregion" (Long et al. 2014). Red fir restoration is also addressed in the Science Synthesis to some degree. Restoration management strategies and treatments proposed and described in those documents are the basis for management direction contained in alternative B, C, and D.

For sagebrush and pinyon-juniper ecosystems, we examined several recent comprehensive scientific literature reviews and management strategies directed at restoration of greater sage-grouse habitat (Chambers et al. 2007, Wisdom and Chambers 2009, Arkle et al. 2014, Chambers et al. 2013, Chambers et al. 2014). This includes reducing conifer density in sagebrush areas, prevention and restoration of areas with non-native, invasive annual grasses, and restoration of perennial grasses.

For some vegetation types there are multiple applicable research papers, and for readability only key ones were cited here. Additional scientific research on the effects of different restoration management activities specific to different vegetation types are summarized in the Vegetation Ecology supplemental report.

The analysis is displayed in two ways. First, there is a narrative for each indicator by major vegetation type that explains the potential consequences of implementing the different type, amount, and location of restoration activities. Second, there is an overall rating of whether the indicator has a low, moderate, or high similarity to desired conditions. This rating is based upon the degree of departure (and especially the proportion of the landscape with departure of current or expected future conditions) from the desired conditions and natural range of variation. The criteria and thresholds for the ratings were identified for each major vegetation type and indicator and are displayed in the Vegetation Ecology supplemental report. The tables for westside montane mixed conifer (Table 32) and eastside sagebrush and pinyon-juniper (Table 33) are included below because these are the primary vegetation types that would be managed.

Table 32. The indicators, measures and criteria for evaluating the current condition and consequences for westside montane ecological/elevational zone (ponderosa pine, black oak, moist and dry mixed conifer) composition

Ecological Zone Vegetation Type	Indicator	Measure	Criteria
Black oak, and Black oak-Ponderosa pine	Composition and structure	Similarity to desired conditions. Black oak cover and density, mature black oak are common with high acorn production	High – black oak is dominant or co-dominant in the overstory and understory over >60% area Moderate – same as above but 40-60% area Low –same as above but for <40% area
Black oak, and Black oak-Ponderosa pine	Composition understory	Understory – native plant composition, abundance and condition (improved with openings and fire restoration)	High – open canopy (similar to desired conditions) dominant, with restoration of fire common: >60% area Moderate – same as above but 30-60% area Low – same as above but <30% area
Ponderosa pine and dry mixed conifer	Overstory composition	Similarity of dominant overstory tree composition to desired conditions (>60% pine in mixed conifer and >90% pine in ponderosa pine, except where black oak is common)	High: meet conditions on most (>60% of area) of the landscape Moderate: meet conditions on some (40-60% of area) of the landscape Low: meet conditions on limited (<40% of the area) of the landscape
Ponderosa pine and dry mixed conifer	Understory composition	Understory – native plant composition, abundance and condition (improved with openings and fire restoration)	High – open canopy (similar to desired conditions) dominant, with restoration of fire common: >60% area Moderate – same as above but 30-60% area Low – same as above but <30% area
Moist mixed conifer	Overstory composition	Similarity of dominant overstory tree composition to desired conditions (is >60% pine on dry sites and 40-60% on moist sites. Black oak common and healthy)	High: meet conditions on most (>60% of area) of the landscape Moderate: meet conditions on some (40-60% of area) of the landscape Low: meet conditions on limited (<40% of the area) of the landscape
Moist mixed conifer	Understory composition	Similarity of understory composition and condition to desired condition (heterogeneity- see below- and amount of low and moderate intensity fire restored)	High: high heterogeneity and extensive (>60% area) low and moderate intensity fire restoration Moderate: moderate heterogeneity and moderate low and some fire restoration (40-60% area) Low: low heterogeneity and limited fire restoration (<40% area)

Table 33. The indicators, measures and criteria for evaluating the current condition and consequences for eastside ecological zones and vegetation types

Ecological Zone Vegetation Type	Indicator	Measure	Criteria
Sagebrush	Composition	Similarity of understory composition and condition to desired condition (areas of native perennial grasses and flowering plants thriving and increasing, native shrubs healthy)	High: meet conditions on many areas (>40% area); Moderate: meet conditions on some (20-40%) of the area; Low: meet conditions on limited (<20%) of the area;
Sagebrush	Composition	Presence of conifer trees (pinyon, juniper, Jeffrey pine) in historically tree free areas	High: less than 10% of sagebrush area invaded by conifers Moderate: 10 to 30% of sagebrush areas invaded by conifers Low: more than 30% of sagebrush areas invaded by conifers
Sagebrush	Structure	Similarity of seral stage mosaic to desired condition (within the natural range of variation; areas of sage grouse nesting and brooding/rearing habitat within desired conditions	High: meet conditions on most (>60% of area) of the landscape Moderate: meet conditions on some (40-60% of area) of the landscape Low: meet conditions on limited (<40% of the area) of the landscape
Sagebrush	Structure	Age structure and condition of shrubs (decadence)	High: shrub age structure diverse and within the natural range of variation on most of landscape (>60% of area) Moderate: same as above for some of area (40 to 60% area) Low: same as above for little of the area (<40% area)
Pinyon-juniper	Composition	Similarity of species composition to desired condition (limited non-native invasive grasses or plants, primarily cheatgrass)	High: few to no invasive plants Moderate: limited frequency of occurrence and slow rates of spread Low: moderate to high frequency of occurrence and rates of spread
Pinyon-juniper	Structure	Pinyon pine regeneration, mature trees and pinyon nut production	High: most (>60%) of the area within desired condition Moderate: some (40-60%) of the area within desired condition Low: limited (<40%) area within desired condition
Xeric Shrub-black brush	Composition	Native species composition; invasive species (occurrence, density and number of species); native soil crusts are intact	High: few to no invasive plants; native plants and soil crusts in good condition over most (>98% of the area) Moderate: limited frequency of occurrence and slow rates of spread of invasive plants and/or disruption of soil crusts (<5% area) Low: moderate to high frequency of occurrence and rates of spread; and disruption of soil crusts over increased area (>5% area)
Xeric Shrub-black brush	Structure and resilience	Presence of non-native plants, especially annual grasses	See above

Thresholds for evaluating condition of vegetation indicators were based upon scientific literature where available and, where not available, on general ecological theory (that is, percolation theory, Turner et al. 1989), research on landscape vegetation conditions and changes in fire patterns (Parisien et al. 2007, 10, 12; Westerling et al. 2015), and logical categories. There is limited scientific literature that specifies what proportion of a landscape needs to be in a certain condition to have ecological integrity. Landscape ecology theory provided an overall basis for setting the high and low ecological condition thresholds (Turner et al. 1989). Percolation theory distinguishes changes in landscape processes and functions when less than 40 percent of a landscape is in a different condition. This could include fragmentation of habitat, movement of wildlife, or movement of fire. Research on fire probabilities (extent, large fire size and severity) suggest that landscapes with at least 40 percent in a condition that is more consistent with the natural range of variation have a reduced likelihood of fire probability and large fire size, and areas with more than 60 to 75 percent have a substantially reduced likelihood (Parisien et al. 2007, 10, 12; Westerling et al. 2015).

We made reasonable assumptions that:

- the majority (greater than 60 to greater than 75 percent) of a landscape in condition within the natural range of variation or similar to desired conditions would have high ecological integrity;
- nearly half (greater than 40 to greater than 50 percent) of a landscape in condition within the natural range of variation or similar to desired condition would have moderate ecological integrity; and
- less than that would have low ecological integrity (less than 20 to less than 40 percent)

Affected Environment

Current conditions are first summarized overall and then later described by ecological/elevation zone and vegetation type. The distribution and area in major vegetation types by national forest are shown in Figure 25, Figure 26 and Figure 27, and Table 34 and Table 35. Note that the vegetation map for the Inyo National Forest is based upon the Terrestrial Ecological Unit Inventory while the maps for the Sequoia and Sierra National Forests use the existing vegetation data mapped by the Forest Service Remote Sensing Laboratory. For the Sequoia and Sierra National Forests, the area of wetland and riparian vegetation types are not included because they are not mapped comprehensively in this data set, only the larger, most visible areas. See the aquatic and riparian ecosystem section for more detail on the meadow, wetland, and riparian vegetation types. For the Inyo National Forest, some of the smaller patches were merged with adjacent larger patches to more closely match the maps for the other two national forests. For all three national forests, the information has not been updated for recent fires including the Aspen, French, Rough or Cabin Fires and other fires since 2009. (However, updates for vegetation changes since the large, recent fires before 2015 were made to the underlying fuels layers used to model ecological fire resilience). In addition, vegetation on the ground would show more detail and smaller patches of varying vegetation types than represented in these figures.

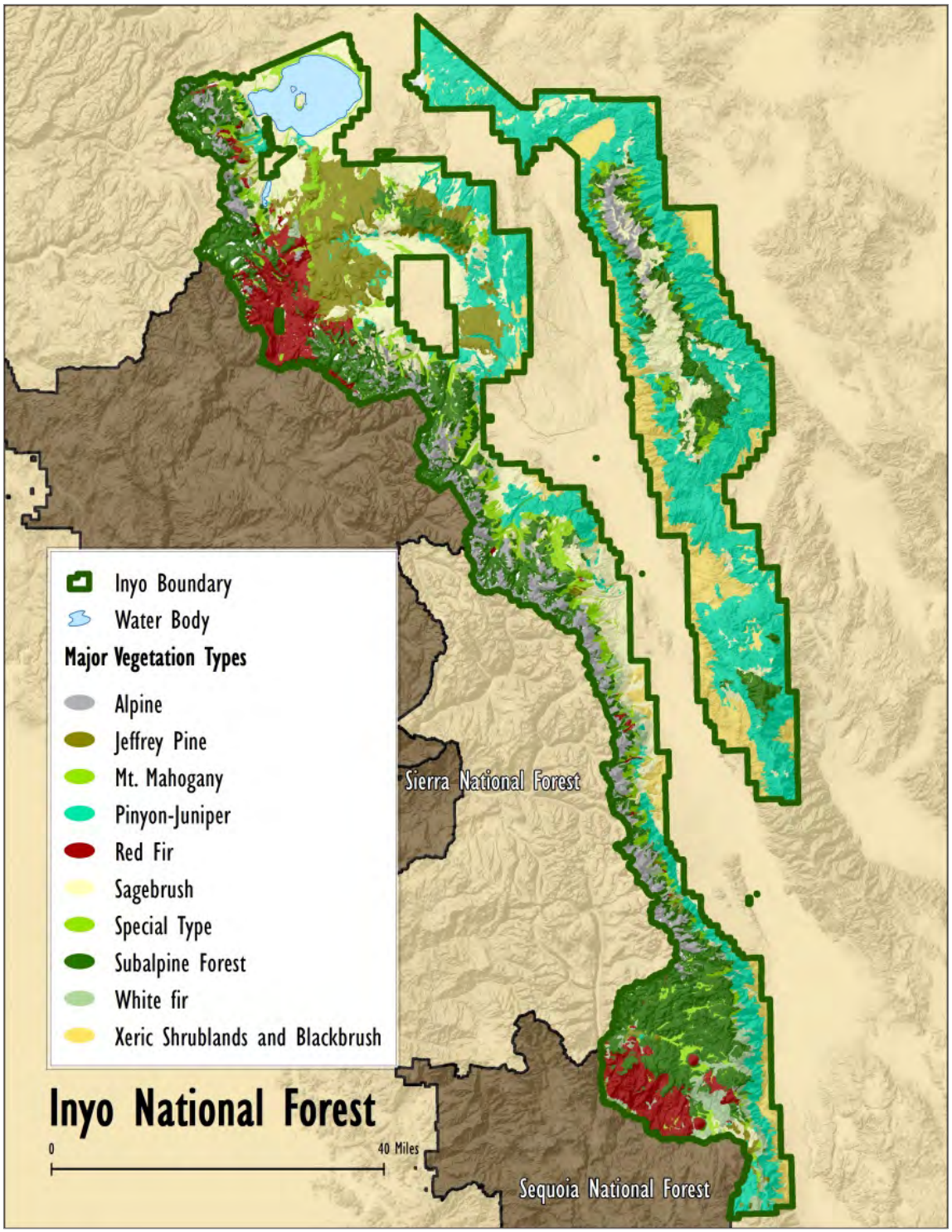

Figure 25. Major vegetation types from the Terrestrial Ecological Unit Inventory, Inyo National Forest

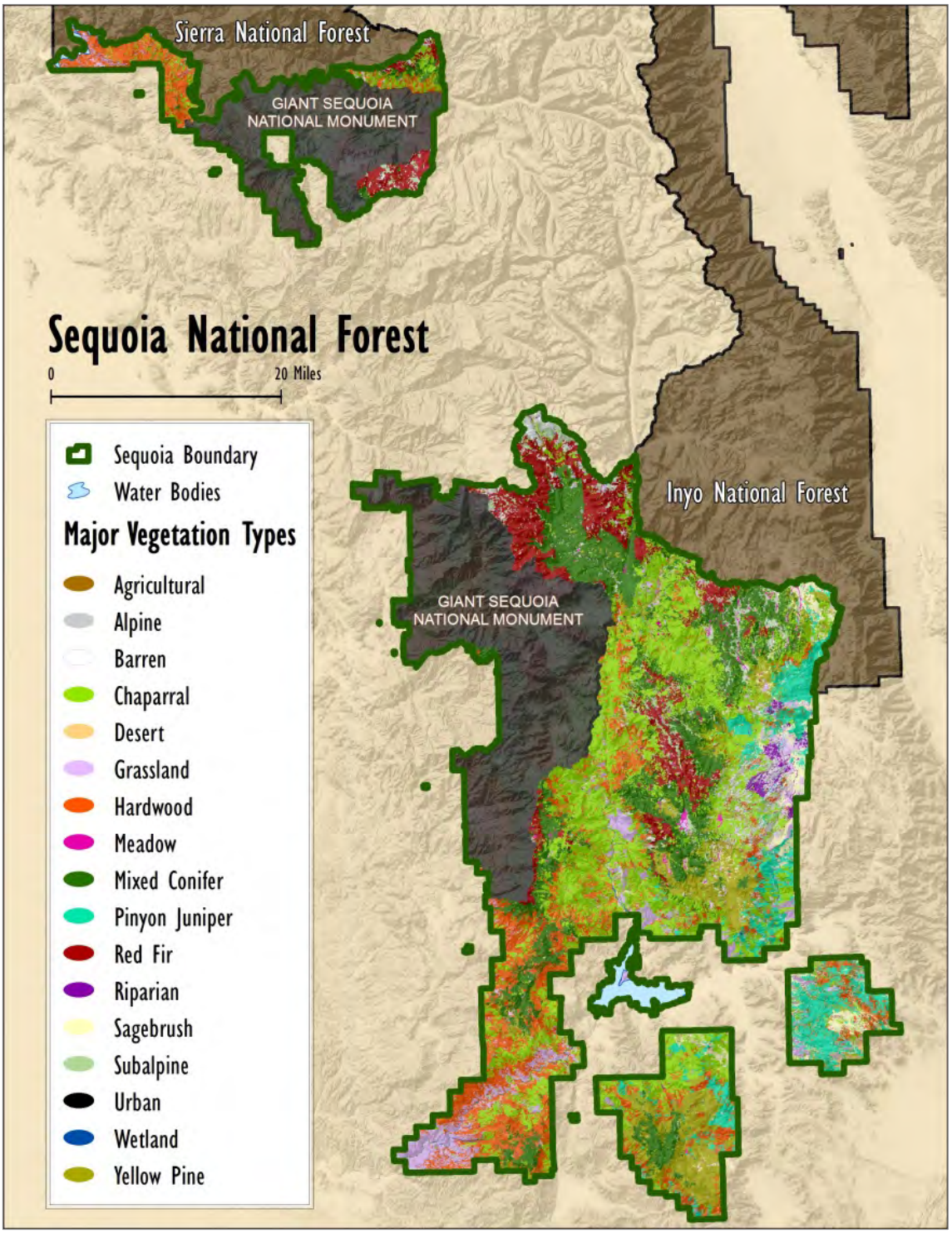

Figure 26. Major terrestrial vegetation types based on the California Wildlife Habitat Relationships classification, Sequoia National Forest

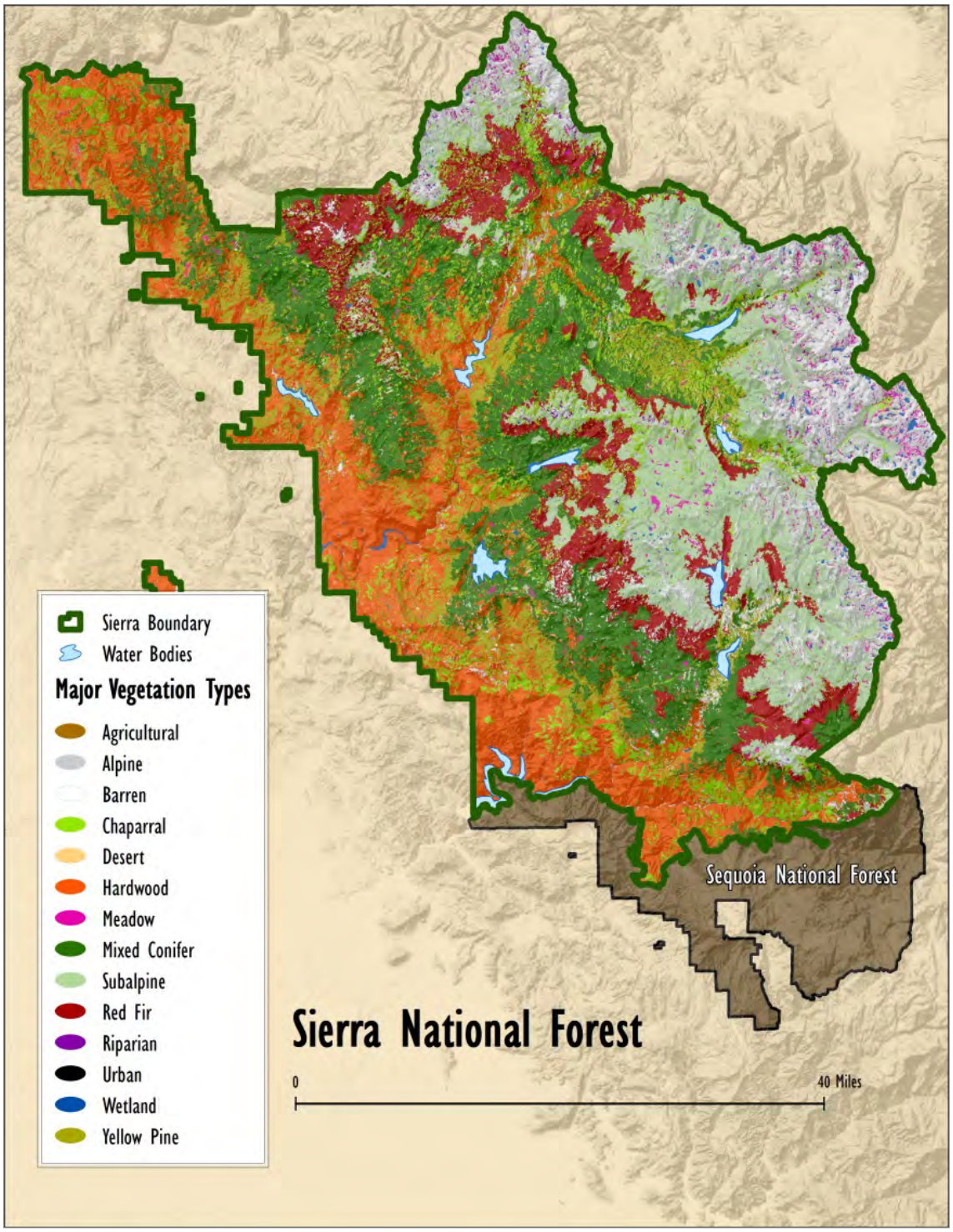

Figure 27. Major terrestrial vegetation types based on the California Wildlife Habitat Relationships classification, Sierra National Forest

Table 34. Acres of major vegetation types, Inyo National Forest[1]

Vegetation Type	Acres[2]
Pinyon-juniper	561,000
Subalpine conifer forest	383,000
Sagebrush	308,000
Xeric shrub and blackbrush	214,000
Jeffrey pine	135,000
Alpine	130,000
Red fir	118,000
Mountain mahogany	82,000
Mixed conifer	46,000

1. Vegetation types based on the California Wildlife Habitat Relationships classification and the Inyo National Forest Terrestrial Ecosystem Unit Inventory classification.
2. Rounded to the nearest thousand acres.

Table 35. Acres of major vegetation types, Sequoia and Sierra National Forests[1]

Vegetation Types	Sequoia National Forest (Acres) [2]	Sierra National Forest (Acres) [2]
Alpine	1,000	42,000
Rock, Sparse Vegetation	29,000	140,000
Chaparral	225,000	134,000
Desert	2,600	0
Grassland	52,000	0
Hardwood	118,000	263,000
Mixed Conifer	125,000	250,000
Pinyon Juniper	58,000	0
Red Fir	70,000	140,000
Sagebrush	25,000	0
Subalpine	14,000	212,000
Yellow Pine	66,000	95,000

1. Vegetation types based on the California Wildlife Habitat Relationships classification.
2. Rounded to the nearest thousand acres.

Hardwood types are important for wildlife species and some of the species of conservation concern. These were broken out by dominance of the primary species such as black oak, live oak, or blue oak. Table 36 below shows the area of vegetation dominated by different hardwood species. These types occur mostly in the foothill zone but also in the montane zones. The quaking aspen type is likely underestimated for the Sierra and especially the Sequoia National Forests in this map data.

Summary of Similarity of Current Conditions to Desired Conditions

Based on the assessments for individual major vegetation types, the current conditions show a high similarity with desired conditions for only a few types, particularly the alpine and subalpine types. For the majority of vegetation types, especially those in the montane and Great Basin ecological zones, the vegetation characteristics exhibit a low to moderate similarity with the desired conditions. A summary of the current condition compared to the desired conditions are

shown in Table 37 for westside vegetation types and ecological zones and Table 38 for eastside vegetation types and ecological zones.

Table 36. Area in acres in different hardwood vegetation types by national forest, rounded to the nearest hundred acres

Regional Dominance Type*	Inyo National Forest	Sequoia National Forest	Sierra National Forest
Interior Live Oak	0	16,000	38,000
Interior Mixed Hardwood	0	4,900	6,000
Black Oak	250	9,000	11,000
Canyon Live Oak	4,000	30,000	55,000
Blue Oak	0	12,000	21,000
Valley Oak	0	10	35
California Buckeye	0	800	230
Quaking Aspen	15,000	Not mapped completely	Not mapped completely

Defined by California Wildlife Habitat Relationships classifications

Table 37. Comparison of current conditions to desired conditions, westside vegetation types and ecological zones

Zone	Vegetation Type	Vegetation Composition Overstory	Vegetation Composition Understory	Vegetation Structure Density	Vegetation Structure Hetero-geneity	Drought, Climate, Pollution Resilience	Fire Resilience
Foothill	Chaparral	high	moderate	not applicable	not applicable	moderate	moderate
Foothill	Oak woodland	high	low	moderate	moderate	low-moderate	moderate
Montane	Black oak	high	moderate	moderate	moderate	moderate	moderate
Montane	Ponderosa pine	low	low	low	low	low	very low
Montane	Dry mixed conifer	low	low-moderate	low	low	low	very low
Montane	Moist mixed conifer	moderate	low	low	low	low	very low
Upper montane	Red fir	moderate	moderate	moderate	moderate	low	moderate-low
Upper montane	Lodgepole pine-moist	high	moderate	moderate	moderate	moderate	moderate
Upper montane	Lodgepole pine-dry	high	moderate	moderate	moderate	moderate	moderate
Upper montane	Jeffrey pine	moderate	moderate	moderate	moderate	moderate	moderate
Upper montane	Chaparral	moderate	moderate	not applicable	not applicable	moderate	moderate
Subalpine	Subalpine	high	high	high	high	low	moderate-high
Alpine	Alpine	high	high	high	high	low	moderate-high

Table 38. Comparison of current conditions to desired conditions, eastside vegetation types and ecological zones

Vegetation Type	Vegetation Composition Overstory	Vegetation Composition Understory	Vegetation Structure Density	Vegetation Structure Hetero-geneity	Drought, Climate Resilience	Fire Resilience
Sagebrush	not applicable	low	moderate	low	moderate	moderate
Pinyon-juniper	high	moderate	moderate	low-moderate	moderate	low-moderate
Mountain mahogany	not applicable	moderate	moderate	moderate	moderate	moderate
Eastside, Jeffrey Pine	moderate	low	low	low	low	low
Dry mixed conifer	low	low	low	low	low	very low
Red fir-Moist Lodgepole pine	high	moderate	low	low-moderate	low	low
Desert Shrub/Blackbrush	not applicable	moderate-high low	not applicable	not applicable	moderate	low

Vegetation in the Kern River drainage is covered separately in Table 39 because the current condition of all vegetation types that occur differs substantially from the rest of the forests. This is because of the extensive restoration of wildfire managed to meet resource objectives in this more remote area over the last 15 years (Fites-Kaufman et al. 2003, Ewell et al. 2012, Meyer 2015). This area also has a substantially different current condition and similarity to desired conditions. It spans westside to eastside vegetation, but is mostly similar to the westside conditions. It is described at the end of the westside vegetation section.

Table 39. Comparison of current conditions to desired conditions, vegetation types and ecological zones in the Kern River drainage

Vegetation Type	Vegetation Composition Overstory	Vegetation Composition Understory	Vegetation Structure Density	Vegetation Structure Hetero-geneity	Drought, Climate Resilience	Fire Resilience
Montane	moderate to high	moderate to high	moderate to high	moderate to high	moderate to high	moderate to high
Upper Montane	high	high	moderate to high	moderate to high	moderate to high	moderate to high
Subalpine/Alpine	high	moderate-high	moderate to high	moderate to high	moderate	moderate to high

Westside Vegetation Types

Westside Foothill Vegetation: Blue Oak Woodlands, Chaparral/Live Oak

The foothill ecological zone occurs at the lowest elevations on the western slopes of the Sierra Nevada, bordered by the San Joaquin Valley on the lower edges. A mosaic of chaparral, blue oak savannahs, live oak woodlands and forests, narrow riparian stringers along rivers and streams, seeps, and scattered gray pine occur at the lower elevations. At the higher reaches of the foothill zone, patches of ponderosa pine and black oak occur and gradually transition into the mixed conifer forests in the montane zone above.

Blue Oak Woodland

Overall, the vegetation and fire patterns in the blue oak woodlands are somewhat outside of the natural range of variation and resilience is low to moderate (Merriam 2013, and Sawyer 2013). Understory vegetation is dominated by non-native grasses and annuals that arrived with early European settlement. There are low levels of oak seedlings, saplings, and small trees necessary to perpetuate the oak woodlands. The frequency and intensity of fires are outside their natural range of variation and changed fire regimes may cause a permanent change (type change) in vegetation type from oak woodlands to grasslands (Rodriquez-Buritica and Suding 2013). The low levels of seedlings, saplings, and small trees make this vegetation type vulnerable to climate change and drought, which is expected to be severe in these low elevation areas. The blue oak woodlands in the foothill zone is among the most altered and fragmented vegetation type from urbanization and agriculture, and lies mostly below the western boundaries of national forests (Franklin and Fites-Kaufman 1996, USDA FS 2001). Because of the combination of these factors, the small amount of this vegetation type under public land management is disproportionately important for ecological integrity. Blue oak woodlands in the western Sierra Nevada display considerable fragmentation, increasing vulnerability to climate change because there is limited area for blue oak to migrate.

Overall, the blue oak woodlands are moderately similar to desired conditions. Although it is desirable to increase the proportion of native understory plants and area dominated by them, restoration of large areas to native plant dominance is not realistic with current forest budgets and climate warming that increases non-native plant invasion and dominance. There is less blue oak regeneration and recruitment than desired (Merriam 2013).

Chaparral/Live Oak

Evergreen shrubs and live oaks dominate the steep, lower slopes on the westside foothills of the western Sierra Nevada Mountains on the Sierra and Sequoia National Forests, and Piute Mountains of the Sequoia National Forest. Evergreen chamise, California lilac, manzanita and interior live oak dominate the vegetation but there are numerous other less common species including the uncommon yellow-flowering flannelbush and knobcone pine. Most of the trees and shrubs are highly adapted to fire. Most shrubs and oaks sprout after top-kill in fires. Other shrubs and many annual flowering plants have seeds that are stimulated to sprout after heat or smoke, creating carpets of flowers. Knobcone pines have serotinous cones that open when exposed to high heat.

Overall, chaparral is similar to desired conditions but is at the high end of the natural range in some aspects, with some areas never having burned in over a century (Estes 2013a, Keeley and Davis 2007). Where fire has been frequent, and near developed areas, non-native, grasses have invaded small areas, hindering native plant regrowth. Several recent fires have burned large areas in chaparral within the analysis area and vicinity. The Aspen Fire burned large areas of chaparral in the San Joaquin River drainage and more recently, the Rough Fire has burned extensive areas of chaparral in the Kings River Canyon. These fires burned under hot and dry conditions, following drought. The chaparral burned at very high and high intensity, with little variation in severity. This is within the natural range of variation for fire in chaparral (Keeley et al. 2005, Estes 2013a).

Black Oak/Ponderosa Pine

At the upper elevations of the foothill zone, patches of black oak, sometimes with scattered or clumped ponderosa pine occur. These patches transition broadly into mixed conifer that occurs at higher elevations. Black oak and ponderosa pine vegetation types are covered in the next section.

Westside Montane Forests: Ponderosa Pine/Black Oak, Mixed-conifer Forests

The montane zone has large areas of forests dominated by varied mixtures of ponderosa pine or Jeffrey pine, sugar pine, incense cedar, white fir, and at higher elevations some red fir (Safford 2013, Fites-Kaufman et al. 2007). These are the most productive areas, where a combination of climate and soils provide ideal growing conditions. On the Kern Plateau, Jeffrey pine replaces ponderosa pine and conditions are drier. The southern reaches of the Sequoia National Forest are also drier, with white fir replacing red fir at higher elevations and Jeffrey pine replacing ponderosa pine. Historically, these productive forests had the most frequent fire, averaging 5 to 20 years (Safford 2013, van Wagtendonk and Fites-Kaufman 2006). Frequent fires swept through the understory, keeping understory tree densities and surface fuels low. There was thought to be a high level of structural variation, with varied tree sizes, densities, spacing, and arrangements, collectively called “heterogeneity” (North 2009).

Current vegetation composition, structure and resilience are highly dissimilar to desired conditions, except in the Kern Plateau and Kern River drainage. Conditions have changed considerably since before European settlement (van Wagtendonk and Fites-Kaufman 2006, Fites-Kaufman et al. 2007, Van de Water and Safford 2011, Collins et al. 2011, Lydersen and North 2012, Safford and Van de Water 2014, Collins et al. 2015, Stephens et al. 2015), and are largely outside the natural range of variation in most of the montane zone (Safford 2013, Merriam 2013).

Composition of the overstory and understory has changed substantially. Pines and oaks have decreased substantially and shade-tolerant species, such as cedar and fir, have increased (North 2009). Large black oaks are being shaded out by conifers in many areas, causing unhealthy crowns, reduced acorn production, and reduced oak regeneration and recruitment (Merriam 2013). Increases in tree density, and decreases in frequent, low- and moderate-intensity fires have impacted understory shrubs, grasses and flowering plants (van Wagtendonk and Fites-Kaufman 2006, Fites-Kaufman et al. 2007, Wayman and North 2007, Webster and Halpern 2010). These plants have evolved with fire and some of them have adaptations, such as the ability to sprout from bulbs or roots, or fire-stimulated seed germination that enables them to thrive with fire. Other plants, such as ponderosa pine, need bare soil to germinate and survive. As a result, in the absence of frequent fire, the understory flora of shrubs, flowering plants, and grasses, is less diverse and in poor condition.

Forest structure has changed in several ways. Forest density is higher, canopy cover of trees more uniformly higher, small and medium tree density is higher, and large tree density is lower (Collins et al. 2011, Collins et al. 2015, Stephens et al. 2015). Within-stand variation in tree size and density has decreased substantially (Lydersen et al. 2013). Large tree densities and distribution across the landscape is substantially lower in most places than historically (USDA FS 2001, Franklin and Fites-Kaufman 2006, Fites-Kaufman et al. 2007, Stephens et al. 2015). Until recently, the low levels of large trees were due to past harvest from the European settlement period to the 1980s (McKelvey and Johnston 1992).

More recently, water stress, climate change, and possibly air pollutants have weakened large trees (Panek et al. 2013; Byternowitz et al. 2014). Outside of fires, large tree mortality has doubled in the last two to three decades across the western United States (van Mantgem et al. 2009). This

pattern is associated with increases in temperature and droughts. There are also high levels of air pollutants, primarily ozone and possibly nitrogen that are impacting forest health and contributing to increased tree mortality to an unknown degree (USDA FS 2013a). Ozone weakens trees and makes them more susceptible to drought and insects (see "Air Quality" section). These stresses are compounded by the competition for water from the dense, younger trees that surround many old trees (McDowell et al. 2008, Franklin and Johnson 2012).

Resilience of montane forests to high-intensity fire, drought, insects, pathogens, climate change, and air pollution is very low in most areas (Safford 2013, North 2012, Collins and Skinner 2014). Dense vegetation contributes to higher intensity fire and increased tree mortality from fires. Dense forests are more vulnerable to stress brought on by drought, insects, pathogens, and air pollution. Currently, in lower elevation pine and mixed conifer forests there has been and continues to be extensive tree mortality. In some areas more than 80 percent of the ponderosa pine trees are dead or dying (see "Insects and Pathogens" in the previous section and Figure 28). Mortality is extending up into the higher elevations in mixed conifer forests, particularly in sugar pine based upon aerial surveys conducted by the USDA Forest Service State and Private Forestry program (see Figure 8 in the "Insects and Pathogens" section). The mortality is from a combination of drought and insects. There may also be a contribution from ozone weakening the trees. This not only reflects decreased resilience but is also resulting in decreased forest diversity.

Figure 28. Recently dead sugar pine in mixed conifer forests on the Sequoia National Forest

Fires are less frequent but evidence is strong that they are on average larger and more severe in large uniform areas, than before European settlement (Collins and Skinner 2014, Safford 2013). Changes in fire have contributed to shrinking chaparral patches scattered within forests (Estes 2013a), and black oak patches and trees (Merriam 2013). Most of the montane area is likely to burn as crown fires during peak fire weather conditions. The mix of fire types (crown and surface fires), and resulting severity (high to moderate or low) is difficult to predict precisely. There are

many conditions that influence the type and effects of fires including the time of day, condition of the vegetation, and dryness of the vegetation and fuels. Overall, the more continuously dense vegetation is and dry, the more likely large areas of crown fire will occur. Recent trends in fires have been increased proportions of crown fire and high severity effects to forests, especially montane pine and mixed conifer forests (Miller and Safford 2012, Steel et al. 2015).

Moist Mixed Conifer Compared to Dry Mixed Conifer Forests

Historically and currently, there are differences in the composition and structure of forests in drier sites compared to moister parts of the landscape (Lydersen and North 2012). South and west-facing slopes are drier and more dominated by pines, whereas forests on north and east-facing slopes, with less sun, have a greater fir component (Fites-Kaufman et al. 2007). The slope location also affects the moisture level for plants (Lydersen and North 2012). Drainages and lower slopes are moister. Ridges and upper slopes are drier. Differences in forests and vegetation were more prevalent prior to fire suppression and historic logging. Now forests are more uniformly dense and have a higher proportion of shade-tolerant firs and incense cedar. Historically, under a frequent fire regime, both the moist and dry mixed conifer had higher levels of heterogeneity (Lydersen et al. 2013). It is unknown if there were differences in heterogeneity between dry and moist mixed conifer forests. Reconstructions of historic forest patterns suggest that moist forests were more dense than dry. The desired conditions for moist mixed conifer compared to dry mixed conifer reflect these differences.

Both moist and dry mixed conifer forests are dissimilar to desired conditions. Current dry mixed conifer forests are probably more dissimilar to desired conditions than moist mixed conifer forests. They are both considerably more dense and with lower heterogeneity and understory plant diversity and cover. However, the dry mixed conifer forests have increased the most in density and had the greatest shift in composition from dominance of pines that are more fire and drought tolerant to more white fir and incense cedar that are less fire and drought tolerant (Lydersen and North 2012). Compared to dry mixed conifer, moist mixed conifer forests have had fewer changes since historic conditions; the end result of fire suppression and past harvest practices is a similar low resilience to drought, climate change, insects and pathogens, and high-intensity fire. Both are highly likely to experience high levels of crown fire during hot and dry fire weather conditions.

Upper Montane Forests

The primary vegetation types in this zone include red fir forest, Jeffrey pine forest, and lodgepole pine forest, and montane chaparral (Potter 1998). These vegetation types and others (such as wet meadows) occur in a patchy mosaic across the upper montane landscape, depending on changes in elevation, topography, soils, climate, and prior disturbance history (like fire and insects). Fire is an important ecological process in the upper montane zone, influencing successional pathways and forest structural patterns, such as canopy patch-gap dynamics (van Wagtendonk and Fites-Kaufman 2006). However, decades of fire exclusion, timber harvest, and patterns of increasing high-severity fire in many upper montane forests have resulted in decreased heterogeneity and increased vegetation uniformity across the landscape (Meyer 2013a, Kane et al. 2014). Increased high-severity fire has also resulted in greater degrees of forest fragmentation and reduced forest connectivity in upper montane forests (Kane et al. 2014). These patterns of increasing fragmentation resulting from stand-replacing fire are often linked to warming climate and, in fire-excluded forests characterized with a frequent fire regime (such as Jeffrey pine forests), increased fuel loading (Miller and Safford 2012, Safford 2013).

Red Fir Forests

Red fir forests are common in westside, upper montane landscapes of the southern Sierra Nevada. This forest type is dominated by red fir and typically occurs on deeper, more productive soils on most slope positions except ridgetops. Mixed red fir stands may also contain white fir at lower elevations and lodgepole pine, Jeffrey pine, western white pine, or mountain hemlock at higher elevations (Potter 1998). The understory may include several species of shrubs or herbaceous plants, including pinemat manzanita, greenleaf manzanita, huckleberry oak, chinquapin, snowberry, Utah serviceberry, mountain whitethorn, pine-woods lousewort, and Brewer's golden aster.

Tree species composition is generally similar to the desired conditions, but understory species cover and diversity in fire-excluded stands is at the lower end of the desired conditions and the natural range of variation (Meyer 2013a).

Current stand structure conditions in red fir forests are dissimilar to desired conditions. There has been a considerable shift in the tree size class distribution to smaller diameters. Forest structure at the stand and landscape scales is more uniform and less heterogeneous. There has been a decrease in the density of large-diameter red fir trees in many areas (Meyer 2013a). Younger and intermediate-sized trees are denser than the desired condition, and there is a deficit of open-canopy mature and old forests in most of the planning area.

Resilience of red fir forests to drought, insects, pathogens, climate change and high-intensity fire is moderate but declining. Tree mortality rates associated with pathogens and moisture stress in red fir forests is increasing at a rate that will soon exceed the desired conditions and natural range of variation. Climate vulnerability of red fir forests is relatively high compared to other vegetation types. Because red fir is associated with colder winters and snow, it is particularly vulnerable to climate change. Resilience to high-intensity fire is moderate. Higher stand density, more uniform forests have resulted in increased high severity areas. Although some areas of high severity are within the natural range of variation (van Wagtendonk and Fites-Kaufman 2006), larger patches of high severity are becoming more common with drought and hot and dry weather.

Jeffrey Pine Forests

Jeffrey pine forests typically occupy more xeric, or very dry, locations in the upper montane zone of the southern Sierra Nevada. This forest type generally occurs on shallow, less productive soils on middle to upper slope positions. Jeffrey pine forests are dominated by Jeffrey pine but may be mixed with shade-tolerant white fir at lower elevations and red fir at higher elevations (Potter 1998).

There is a moderate difference between current species composition and the desired conditions. Because Jeffrey pine occurs on very dry sites, most often on shallow, rocky soils, vegetation is slow to change. Because of fire suppression, there has been an increase in shade-intolerant white fir and red fir trees.

Current stand structure conditions in Jeffrey pine forests are also different from desired conditions; however, there has been less change than with the red fir, lodgepole pine, or mixed conifer forests due to slower ingrowth of other species. There has been a shift in the tree size class distribution to smaller diameters, which has resulted in more uniform and less heterogeneous forest structure at stand and landscape scales. Overall canopy cover has increased, there are fewer canopy gaps or openings, and there has been a decrease in the density of large-

diameter Jeffrey pine trees (Safford 2013). There is a deficit of open-canopy mature forests throughout the planning area, compared to the desired conditions. Surface fuels and small trees that serve as ladder fuels are greater than the desired condition.

Resilience is moderate in Jeffrey pine forests. Climate vulnerability of Jeffrey pine forests is relatively low compared to other forest types in the upper montane and subalpine zones (Schwartz et al. 2013) and Jeffrey pine may exhibit greater resilience to projected increases in temperature and fire frequency in the Sierra Nevada (Monleon and Lintz 2015, Stephens et al. 2010). This is because Jeffrey pine is a very drought- and fire-tolerant species. Where forest density has increased more, these stands have moderate resilience. These areas are more likely to experience stress from drought, insects, pathogens, or fire-related mortality. Fire resilience is moderate to high. Fire is moderated in areas where Jeffrey pine is low density and has not increased, especially on very rocky sites.

Montane Chaparral

Montane chaparral occurs in various sized patches in the upper montane zone, varying from one to hundreds of acres. It occurs on two types of areas. First it occupies the rockiest and driest locations in the southern Sierra Nevada. Chaparral patches are often interspersed with Jeffrey pine forests. It may also occur on previously forested sites that burned at high severity once or several times. Montane chaparral is mostly a temporary vegetation type, or early seral stage of forest, and is invaded and replaced by forest over time in the absence of recurrent fire. In the upper montane zone, forests are slow to recolonize chaparral, so it can persist for tens or hundreds of years on potentially forested areas (Estes 2013a).

The diversity and composition of current montane chaparral is similar to the desired conditions. However, the density of advanced tree regeneration in some areas of montane chaparral may exceed the natural range of variation where fire has been excluded for more than a century. Fire favors chaparral shrub species, most of which sprout following a fire that kills most of the shrub above ground, or have seeds that are stimulated to germinate from heat. Most small conifers are killed during fires in chaparral because these fires burn at moderate to high intensity.

Current structural conditions in montane chaparral are similar to the desired conditions. Climate vulnerability of montane chaparral is relatively low compared to other vegetation types in the upper montane and subalpine zones because the shrub species are very drought and temperature tolerant. However, in some locations of the planning area, montane chaparral is currently threatened by the combination of invasive plant species (such as invasive annual grasses) and lack of fire. Lack of fire results in vegetation succession or shift to forests, mostly fir dominated. As the trees grow larger, they shade out the shrubs. Historically, fire returned on average every 30 to 50 years, which killed the young, growing conifers in many areas. Other areas would change to forests, and some forest patches would burn at high severity and change to chaparral. This has occurred less in the last 50 years, but recent fires have restored the pattern to some degree. More recent fires may have resulted in larger patches of chaparral because there may be a trend toward larger area burned at high fire severity, but there is uncertainty in this trend because of little information on historic patterns of fire severity in upper montane forests and chaparral.

Subalpine and Alpine Vegetation

The subalpine and alpine zone of the southern Sierra Nevada is characterized by mostly steep slopes, poorly-developed granitic-based soils, and a very high percentage of precipitation that falls as snow (van Wagtendonk and Fites-Kaufman 2006). The primary vegetation types in this

zone include subalpine and alpine forest (Potter 1998). Warming climate trends in the planning area are likely to lead to increased fragmentation and reduced connectivity of subalpine and alpine vegetation, especially in the latter half of the 21st century (Lenihan et al. 2008, Schwartz et al. 2013). These broad-scale changes have important implications for a wide array of species dependent on subalpine and alpine environments, especially southern Sierra Nevada endemics such as foxtail pine (subspecies *austrina*), alpine chipmunk, granite draba, Sierra Nevada leptosiphon, and sweet-smelling monardella (Meyer 2013a, Rundel 2011).

Subalpine Woodlands and Forests

Subalpine vegetation occurs near the highest elevations of the planning area. Subalpine tree-dominated areas form woodlands when trees are sparse or low density. Most subalpine tree-dominated areas are woodlands. In other areas, trees are moderate to high density, more often in smaller patches. These areas comprise subalpine forests. The subalpine vegetation type typically occurs on shallow, less productive soils on most slope positions including ridgetops and steep slopes.

Current overstory and understory species composition is similar to the desired conditions. Current subalpine woodland and forest structure is also mostly similar to desired conditions, although there is a recent increase in the density of small-diameter subalpine trees and a decrease in the density of large-diameter trees. This has been attributed to climatic warming trends, which has increased favorable growing conditions in this harsh environment (Meyer 2013b, Safford et al. 2012a).

Resilience of subalpine woodlands and forests was high until recently but is undergoing rapid changes due to climate warming. Climate vulnerability of subalpine forests is among the highest of all vegetation types in the planning area (Meyer 2013b, Safford et al. 2012a). Tree mortality rates associated with moisture stress and insects in subalpine forests dominated by high-elevation white pines is increasing at a rate that may soon exceed the desired conditions and natural range of variation. Resilience to fire is generally high (Meyer 2013b)

Alpine Vegetation

Alpine vegetation occurs at the highest elevations of the planning area (greater than 10,000 feet elevation). This vegetation type typically occurs on very shallow, low productivity soils on most slope positions including ridgetops and steep slopes. Alpine vegetation in the planning area is dominated by perennial herbaceous plants (like Mason's sky pilot) or dwarf shrubs (such as white heather), but may also contain small, isolated subalpine tree islands and krummholz (stunted) whitebark pine stands. Shallow bedrock may dominate much of the cover in many alpine landscapes of the planning area.

Current species composition and structure of alpine vegetation is very similar to the desired conditions. Resilience is low to moderate. The vegetation in the alpine areas establishes and grows very slowly. Climate vulnerability of alpine vegetation is among the highest of all vegetation types in the planning area (Lenihan et al. 2008, Safford et al. 2012a), and some alpine plant and animal species have recently shifted their geographic ranges to higher elevations in the planning area (Kopp and Cleland 2014, Moritz et al. 2008). With no other area to go to at higher elevations for cooler temperatures, these plants may decline in numbers or locations.

Kern River Drainage

The Kern River drainage includes the Kern Plateau, located east of the Kern River, which dominates the center of the Sequoia National Forest and a small area on the southwest portion of the Inyo National Forest. The canyon where the Kern River drains is also included in the Kern River drainage, especially in the north and middle sections of the watershed. Much of this area is remote and steep and as a result there have been multiple wildfires that have been managed to meet resource objectives in this area over the past 15 years (Meyer 2015). Most of the area is within the montane zone followed by the upper montane zone. There are smaller subalpine and foothill areas that are included. Some of the fires in the area have been very large, and mostly high intensity and severity, including the McNalley Fire. This was in the western portion, partly outside of the Kern River drainage. Most of the McNalley Fire was not beneficial because it had very large patches of high-severity fire, but the majority of the fires have been beneficial and have resulted in substantial movement toward desired conditions (Fites-Kaufman et al. 2003, Ewell et al. 2012, Meyer 2015).

On the Kern Plateau, extensive fires have occurred over the last 15 years in a range of weather conditions. Because the area is very dry, increases in forest density have been less dramatic than other mixed conifer areas. There has been less ingrowth of white fir. Because of these more moderate changes in forest density and composition, the effects of the fires in the last 15 years have been less severe in many areas. For many of these fires, there has been a greater proportion of moderate- and low-intensity fire and resulting low- and mixed-severity effects. As a result, large areas have had reductions in forest density toward the desired conditions. There has been an increase in heterogeneity at the landscape, patch and within-patch scales in forests and chaparral. These fires have restored understory plant composition and condition, since the majority of the species are adapted to and many benefit from fire. This includes the riparian areas. Examples include lupines, aspen, grasses and other sprouting plants. Overall, the montane and upper montane forests and chaparral in much of the Kern Plateau have a moderate to high similarity to desired conditions. The area has a moderate to high resilience to drought, insects, pathogens, climate change, and high-intensity fire. This is apparent in lower levels of tree mortality and increasingly restricted sizes of large fires. This has happened multiple times, mostly recently on the Rough and Cabin Fires on the Sequoia National Forest in 2015 (Reiner et al. 2016).

Eastside Vegetation Types

Arid shrublands and woodlands dominate the lower elevation, eastside landscapes in the planning area, primarily on the Inyo National Forest and some on the southeastern portions of the Sequoia National Forest. The primary vegetation types include pinyon-juniper, mountain mahogany, sagebrush, and xeric shrub/blackbrush. These vegetation types occur in an area of convergence among three biogeographic provinces: the Sierra Nevada, Great Basin, and Mojave Desert and as a result have high plant diversity and some unusual plant combinations. Changes in climate, and fire and grazing regimes in the late 19th and 20th centuries have been particularly important factors influencing the composition, structure and distribution of the different vegetation types within the planning area (Slaton and Stone 2013a, 2013b). These changes include an expansion of trees into open shrublands, and changes in vegetation successional patterns associated with modern livestock grazing and fire exclusion, although these patterns depend on several additional factors (such as vegetation type or climate). Invasive plants like cheatgrass and red brome have also significantly expanded their range in many arid shrublands and woodlands in recent years on the eastside of the planning area (Slaton and Stone 2013a, 2013b). In some cases this has led to type conversion from native shrub or woodland vegetation to non-native grasslands. This rate of invasion is expected to continue or increase in the future, although projected changes in climate

will alter the geographic distribution of these invasions in the later 21st century (Bradley 2009, Finch 2012).

Eastside montane and upper montane landscapes contain a patchy mosaic of forest, shrub, and herb-dominated (meadow) vegetation types that change with elevation, topography, soils, climate, and prior disturbance history. Jeffrey pine, red fir, lodgepole pine, mountain mahogany, and chaparral are the primary upland vegetation types. Extensive meadows also occur in many areas, especially on the Kern Plateau that occurs on both the Inyo and Sequoia National Forests. Fire is an especially important ecological process in the eastside montane and upper montane zones, influencing composition, structure, and resilience (van Wagtendonk and Fites-Kaufman 2006). Decades of fire exclusion, timber harvest prior to the 1990s, and patterns of increasing high-severity fire in many of these landscapes have resulted in changes at the landscape scale (Meyer 2013a, Safford 2013). Most forest areas have become more dense and uniform in structure. Increased high-severity fire has also resulted in greater degrees of forest fragmentation and reduced forest connectivity.

The conditions and trends in red fir and mixed conifer forests are similar to those described for the westside. Refer to these sections for more details. For the mixed conifer, refer to the dry mixed conifer type, since most of the mixed conifer forests on the eastside are similar to the dry type more than the moist type.

Sagebrush

This vegetation type occurs in the Great Basin portions of the planning area, mostly the Inyo National Forest but also small portions of the eastern Sequoia National Forest. The distribution of different sagebrush species are strongly correlated to temperature and precipitation regimes. Dominant species include all subspecies of big sagebrush, low sagebrush, bitterbrush, and black sagebrush (Slaton and Stone 2013a). Big sagebrush and black sagebrush are generally restricted to moist and frigid soils, with low sagebrush occurring on some cryic (cold) soils.

The condition of sagebrush areas depends upon the location and environment. The current composition and structure of sagebrush on some more productive substrates are different from the desired conditions for this vegetation type. The composition and structure on less productive, harsher (colder, drier, shallow and rocky) soils is mostly similar to desired conditions.

The extent of sagebrush has decreased substantially. On the Inyo National Forest, an estimated 25,000 acres of sagebrush has had encroachment of several trees per acre or more (Slaton 2013). These areas were historically dominated by sagebrush but pinyon-juniper, and in some cases Jeffrey pine and limber pine, have encroached into these shrublands due to a combination of fire suppression, livestock grazing, and climate change (Slaton and Stone 2013a). Projected changes in climate suggest that the geographic distribution of sagebrush will largely shift northward and to higher elevations due to increased summer moisture stress (Finch 2012). Resilience to invasion by pinyon and juniper or Jeffrey pine is low to moderate.

Overall, resilience of sagebrush is low to moderate depending upon the type of sagebrush, amount of non-native annual grasses and proximity to risk factors for fire and non-native grass invasion. Non-native invasive plant species are increasing in number and extent in sagebrush. Most notably the invasive annual grasses of cheatgrass and red brome have increased. The map in Figure 29 depicts the pattern of invasion of cheatgrass and red brome on the Inyo National Forest.

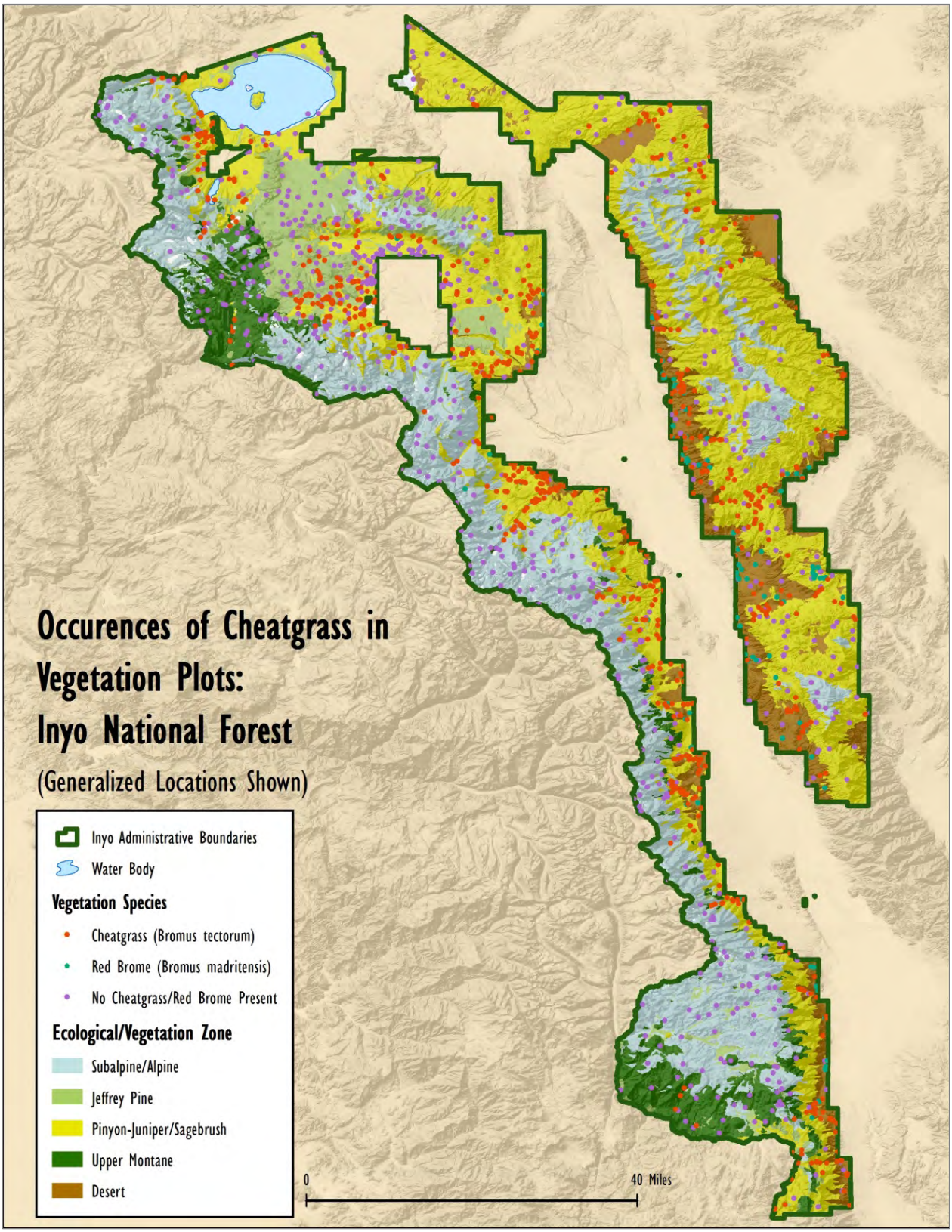

Figure 29. Occurrences of cheatgrass in vegetation plots, Inyo National Forest

Information is combined from the Forest Inventory and Analysis plots and Terrestrial Ecological Unit Inventory plots and vegetation maps. This map does not represent a complete distribution of these invasive grasses but shows the extent of their invasion. Where these invasive grasses have been detected at survey plots, they are shown as red and orange dots and plots with no detections are shown as purple dots. Higher elevation sagebrush areas, with colder soils and moderate to high native perennial grass cover are more resilient. These areas are more likely to resist type conversion to annual grasses, including after fire (Chambers et al. 2007).

In the eastside vegetation types, there are large sagebrush and pinyon-juniper areas that have decreased fire resilience because of non-native annual grasses (such as cheatgrass and red brome) that make them susceptible to more frequent fires that disrupt native vegetation composition and structure (Chambers et al. 2014).

Pinyon-juniper

Pinyon-juniper is extensive in the planning area, mostly on the Inyo National Forest. This vegetation type dominates mid-elevations on the eastside planning area, especially on the east slope of the Sierra Nevada, Great Basin, Mojave Desert, and portions of the Kern Plateau. Pinyon-juniper is dominated by single leaf pinyon and Utah juniper, although many stands in the planning area are dominated exclusively by single leaf pinyon (Slaton and Stone 2013a). Pinyon-juniper types may also be mixed with or located in close proximity to sagebrush, mountain mahogany, and xeric shrublands.

The condition of structure in pinyon-juniper compared to desired conditions varies with location and environment. Where pinyon-juniper grows on harsher sites (steep rocky slopes and ridges or sites with shallow and rocky soils), structure is generally similar to desired conditions (Slaton and Stone 2013a). On more productive sites, structure of pinyon-juniper is moderately dissimilar to desired conditions. Tree density is higher.

Resilience also varies with location and environment. On the harsher sites, the vegetation is generally resilient because the structure has remained more open and there is low understory vegetation cover. On the more productive sites, resilience is low to moderate. Higher tree density, accumulated fuels around the base of the trees, and higher and more decadent shrub, grass, and herb cover result in higher intensity fire and less resilience to drought, insects, and pathogens. There have been elevated levels of tree mortality in pinyon-juniper (see “Insects and Pathogen” section).

Mountain Mahogany

Mountain mahogany generally occurs on steep, rocky, and variable terrain and is frequently mixed with other types, such as Jeffrey pine forest, pinyon-juniper, and sagebrush. The current composition, structure, and resilience of mountain mahogany vegetation is broadly similar to the desired conditions and natural range of variation in the planning area. However, mineral development, roads, and dispersed recreation may be negatively impacting this vegetation type at localized scales. Here there have been changes to composition, structure and spatial pattern. In these localized areas, there has been a decrease in native plants and an increase in non-native annual grasses. The primary change has been increased fragmentation in small areas.

Xeric Shrub-Blackbrush (Desert)

Xeric shrub and blackbrush occupies the lowest elevations of the planning area. This type is dominated by one or more desert shrub species, including but not limited to blackbrush, saltbush, goldenbush, and horsebrush.

The current composition, structure, and function of most xeric shrub and blackbrush ecosystems are consistent with the desired conditions for this vegetation type. However, portions of these arid shrublands have been negatively impacted by too-frequent fire (post-fire recovery of blackbrush is typically more than 50 to 75 years; Brooks and Minnich 2006), mining, off-highway vehicle activity, livestock grazing, and invasive plants. In particular, non-native annual grasses, red brome and cheatgrass, are increasing in frequency in many xeric shrub and blackbrush communities. There is a corresponding decrease in native plants, away from the desired conditions. The increase in non-native annual grasses decreases resilience to fire dramatically. Non-native grasses increase the likelihood of fire, which is naturally rare in these sparsely vegetated areas. Projected changes in climate suggest that some xeric shrub ecosystems will expand in the planning area in the coming decades, and Mojave Desert associated species (such as creosote bush and Joshua tree) will shift northward into the lower elevations of the Great Basin (Finch 2012).

Eastside Jeffrey Pine Forest

Jeffrey pine forests are scattered along the escarpment of the Sierra Nevada, on the Kern Plateau, Glass Mountains, Mono Valley, and Upper Owens River area. This forest type generally occurs on shallow, less productive soils on middle to upper slope positions. Eastside Jeffrey pine forests typically occur in “pure” stands dominated by Jeffrey pine. In some areas it may be mixed with pinyon pine, white fir, red fir, lodgepole pine, western white pine, or limber pine. The understory usually consists of a low cover of herbaceous plants or shrubs such as sagebrush or bitterbrush.

Composition is low to moderate in its similarity to desired conditions. The overstory has had less fire and therefore an increasing proportion of white fir, red fir, and lodgepole pine. But in most areas, Jeffrey pine remains the dominant tree species. The understory has had more changes and has a low similarity to desired conditions. This is due to an increase in non-native, annual grasses that displace native understory plants. Fire suppression and grazing have also resulted in changes in understory composition.

Current stand structure conditions in eastside Jeffrey pine forests are different from desired conditions. There have been increased tree densities, a considerable shift in the tree size class distribution to smaller diameters, a decrease in heterogeneity and greater uniformity of forest structure at patch and landscape scales, increased canopy cover, and a general decrease in the density of large-diameter Jeffrey pine trees (Safford 2013). There is a deficit of open-canopy mature and old forests throughout the planning area. Surface fuels and small trees that serve as ladder fuels are greater than the desired condition.

Resilience of Jeffrey pine forests is low to very low. Increased density has made them more susceptible to drought, insects and pathogens, climate change, and high-intensity fire-related mortality. Climate projections of eastside Jeffrey pine forests suggest this forest type will shift upwards to the higher elevations on the eastside Sierra Nevada (Finch 2012, Schwartz et al. 2013).

Red Fir Forest

See “Westside Vegetation Types” section.

Mixed-conifer Forest

See "Westside Vegetation Types" section.

Subalpine and Alpine Vegetation

Subalpine forests on the east side of the Sierra Nevada crest are primarily covered in the "Westside Vegetation Types" section. However, eastside Sierra Nevada subalpine landscapes contain a number of species that are absent or rare on the westside, such as limber pine. There are other species that are limited to other areas in the eastside and Great Basin, notably the bristlecone pine. The White, Inyo, and Glass Mountains contain other subalpine and alpine species not found in the eastside of the Sierra Nevada, such as the bristlecone cryptantha, July Gold, White Mountains draba, and White Mountains wild buckwheat. Eastside elevation gradients tend to be more dramatic than on the west side, including in many subalpine landscapes, leading to rapid changes in species composition and structure of eastside, high-elevation ecosystems.

As with westside subalpine and alpine ecosystems, the current composition and structure of eastside subalpine and alpine ecosystems are mostly similar to desired conditions, with a few exceptions already noted in the "Westside Vegetation" section (Meyer 2013b). Resilience is similar as well. Climate vulnerability of eastside subalpine forests is also among the highest of all vegetation types in the planning area. The impacts of climate change will affect connectivity of subalpine forests, especially in the latter half of the 21st century.

Environmental Consequences to Vegetation Composition, Structure, and Resilience

This analysis focuses on vegetation types most departed from the natural range of variation and vegetation desired conditions in the draft forest plans. These vegetation types are also the focus of restoration actions (mechanical and prescribed fire treatments and managing wildfire to meet resource objectives) and where the greatest potential consequences will occur. This includes ponderosa pine, mixed conifer, eastside Jeffrey pine, black oak, pinyon-juniper, and sagebrush vegetation types. There will be some increased emphasis on restoration actions in upper montane red fir and lodgepole pine forests in some alternatives and on the eastside around developed areas. There will be some management of chaparral in westside foothills near developed areas. For other vegetation types, there will likely be little management activity and as a result, little to no expected consequences. This includes blue oak woodlands, subalpine, alpine, desert (xeric shrub/blackbrush) and mountain mahogany vegetation types.

Consequences Common to all Alternatives

Alternatives B, C, and D share most of the same vegetation desired condition plan components (Table 40). The differences are in some of the overlapping desired conditions for some wide-ranging wildlife species, namely the California spotted owl and Pacific fisher. Below is a discussion of the general nature and environmental consequences of the large number of shared vegetation desired conditions.

The vegetation desired conditions for these alternatives are specific to each major vegetation type and include desired ranges and often median levels of seral stages and canopy cover, basal area, snags, and large tree densities (Table 41). These are based on a combination of best available scientific information that reflects the natural range of variation (Safford 2013, Meyer 2013a, Slaton and Stone 2013b) and habitat requirements for wide-ranging federally-listed species or species of conservation concern (greater sage-grouse, California spotted owl, Pacific fisher; see

Vegetation Desired Condition supplementary report). There are more general desired conditions that are important, but there is no specific best scientific information to base them on. This includes forest heterogeneity (North et al. 2009, North 2012).

Table 40. Draft forest plan desired conditions for vegetation across all vegetation types

Vegetation Function	Desired Conditions
Mosaic providing ecosystem integrity and diversity. Provides habitat for native and desirable non-native plant and animal species.	TERR-FW-DC-01; SPEC-FW-DC 1
Resilience to climate change, drought, insects and pathogens	TERR-FW-DC-02
Conditions contribute to recovery and persistence of threatened and endangered species and species of conservation concern	TERR-FW-DC-03; SPEC-FW-DC-02
Provides landscape connectivity for wide-ranging habitat generalist (deer) and habitat specialist (old forest and sagebrush) species	TERR-FW-DC-04; SPEC-SG-DC 04;
Carbon carrying capacity is stable or improving	TERR-FW-DC-05
Fire occurs within ecologically appropriate regime and enhances ecosystem heterogeneity, habitat and species diversity. Vegetation conditions help reduce the threat of undesirable wildfires to local communities, ecosystems and scenic character.	TERR-FW-DC-06,7
Landscape sustainability provides a variety of benefits to people	TERR-FW-DC-08
Vegetation supports continued use by tribes	TERR-FW-DC-09

Table 41. Draft forest plan desired conditions by ecological zone and major vegetation types

Ecological Zone	Vegetation Types	Desired Conditions
Westside Foothill	Blue Oak Woodlands; Live oak/chaparral	TERR-BLU-DC 01-03; TERR-CHAP-DC 01-02
Montane Zone	Ponderosa Pine, Black Oak, Dry Mixed Conifer, Moist Mixed Conifer	TERR-MONT-DC 01-07; TERR-BLCK-DC: 01-03 TERR-POND-DC 01-05; TERR-DMC-DC 01-06; TERR-MMC-DC 01-06
Upper Montane Zone	Red fir, Jeffrey pine, Moist lodgepole pine, Dry lodgepole pine; Montane chaparral	TERR-UPPR-DC 01-03; TERR-RFIR-DC 01-07; TERR-UMJF-DC 01-07; TERR-MCHP-DC 01-02;
Subalpine/Alpine	Subalpine conifer, Alpine dwarf shrub	TERR-ALPN-DC 01-04
Pinyon-Juniper/Sagebrush	Sagebrush, Pinyon Juniper, Mountain Mahogany	TERR-SAGE-DC 01-04; TERR-PINY-DC 01-05; TERR-MOMA-DC 01-02; SPEC-SG-DC 08
Desert	Xeric Shrub/Blackbrush	TERR-XER-DC 01-04
Eastside Montane and Upper Montane	Eastside Jeffrey Pine	Inyo: TERR-OAK-DC 01; TERR-MJF-DC 01-07

For purposes of this analysis, it is assumed that when vegetation treatments move vegetation toward the vegetation desired conditions, the vegetation moves toward the natural range of variation and has associated benefits of moving toward ecological integrity and sustainability. The landscape amount and intensity of the treatments affect how much the vegetation moves toward desired conditions. Low-intensity treatments, where little area is treated or slight changes are made, would have a slight improvement in vegetation conditions (Schmidt et al. 2006, Stephens

et al. 2015). When more area is treated, particularly at the landscape scale, there is a greater positive impact on ecological integrity and sustainability. For example, in the "Fire Trends" section, the effect of restoring between 40 and 60 percent of the landscape was sufficient to result in reduced trends in large fires and associated large, high-severity patches that are considered outside the natural range of variation (van Wagtendonk and Fites-Kaufman 2006, Collins and Skinner 2014, Stephens et al. 2015).

The same treatment means are available across each of the alternatives but will be used to varying degrees. Treatments would include mechanical thinning (various prescriptions, understory, varied diameter), salvage, mastication, prescribed fire (small and landscape, by itself or with mechanical treatment) and wildfire managed for resource objectives. The environmental consequences depend upon the extent and intensity of the treatment, and the vegetation type it is applied in. Below is a brief description of the array of restoration treatments that will be used and a summary of the overall consequences for the major vegetation types they will be applied to. This includes the more recent and relevant best available scientific information. A more detailed discussion of the best available science is found in the Vegetation Ecology supplemental report.

Mechanical Treatments: Westside Montane Forests

Restoration treatments (mechanical, prescribed fire) can be highly effective at restoring forest structural features (canopy cover, tree density, heterogeneity) and overstory tree species composition in lower and upper montane forests (Larson et al. 2012, North 2012, 2014; North et al. 2007, 2009). However, the type and intensity of treatment can result in varying levels of change in forest structure.

In long-term monitoring plots on Forest Service study sites in California, both overstory and pole-sized tree densities were effectively reduced following mechanical treatment but fuels levels increased 8 years following treatment due to vegetation re-growth and dead fuel accumulation (Vaillant et al. 2015). Similarly, research fuel treatment plots also resulted in decreases in tree density (Stephens and Moghaddas 2005). There are two types of thinning that would occur in alternatives B, C, and D. One is thinning from below where smaller diameter trees are removed. The second is variable diameter thinning where smaller diameter understory trees and some larger diameter midstory or overstory trees are removed. There is no specific research to compare the effects of these two approaches on moving vegetation toward the desired conditions. However, in many stands that have densities exceeding the desired conditions, thinning from below will remove fewer trees and have a limited effect of moving stands toward desired conditions for canopy cover, basal area, or heterogeneity. This is especially likely where there are large numbers of mid-sized trees dominating a stand, such as following railroad logging.

Prescribed Fire and Wildfire Managed for Resource Objectives: Westside Montane Forests

Prescribed fire can restore understory species composition (Wayman and North 2007, Webster and Halpern 2010), and reduce tree density (Stephens and Moghaddas 2005, Valliant et al. 2015). The amount of reduction in overstory tree density depends on the intensity and size of the fire. Low-intensity fires have little to no effect on overstory tree density and composition, but moderate-intensity fire has been found to reduce forest density by up to 70 percent and basal area by 20 percent (Schmidt et al. 2006). There is little research on the effects of prescribed fire on heterogeneity, but the prevailing view is that prescribed fire can increase heterogeneity if it is incorporated into the burn prescription (Collins and Skinner 2014), especially if it is moderate intensity (Schmidt et al. 2006). Larger landscape prescribed fire or wildfire managed for resource

objectives are likely to restore heterogeneity at multiple spatial scales (Collins et al. 2011, Kane et al. 2013, 2014, Meyer 2015). This may be due in part to more varying fire intensity with larger burn areas, across a wider range of conditions (burning day and night, on different days).

Mechanical and Prescribed Fire Treatments: Westside Montane Forests

Many studies show that the combination of mechanical thinning and prescribed or wildfire managed to meet resource objectives are the most effective in reducing vegetation density, restoring understory and overstory composition, and increasing heterogeneity (North et al. 2007, Collins et al. 2007, Collins et al. 2014). This is especially the case for understory composition. Many plants in the analysis area in areas that had frequent fire historically, are fire adapted (Fites-Kaufman et al. 2006, van Wagtendonk and Fites-Kaufman 2006).

The longevity of restoration treatments depends largely on the growth rates of the plants that have been affected by the treatments. For understory trees and shrubs, reduced density only lasts 8 to 15 years because they grow back rapidly (Stephens et al. 2012, Chiono et al. 2012, and Vaillant et al. 2015). On the other hand, fire-induced reductions in tree density took up to 8 years to be realized in one prescribed fire study in the analysis area (van Mantgem et al. 2011).

Mechanical and Prescribed Fire Treatments: Westside and Eastside Upper Montane Forests

Most of the literature on the ecological restoration of upper montane forests is partially covered and summarized in the technical reports also devoted to lower montane forests (North et al. 2009, North 2012, Long et al. 2014, and Safford 2013). This overlap is especially evident for Jeffrey pine forests on the east and west sides of the Sierra Nevada crest. Consequently, information pertaining to the restoration of Jeffrey pine and some other upper montane forests are presented in the Westside Montane sections above.

The best information pertaining to the effectiveness of mechanical treatments at restoring structural heterogeneity in red fir stands comes from research conducted at the Teakettle Experimental Forest. Understory thinning in red fir-mixed conifer stands at Teakettle resulted in reduced stem density and a residual spatial tree pattern that was closest to historic conditions (that is, reduced tree clustering at smaller spatial scales; North et al. 2007). Consequently, understory thinning increased structural heterogeneity at smaller spatial scales. At the Teakettle Experimental Forest, prescribed burning decreased red fir-mixed conifer stand densities but had no effect on canopy cover. In contrast, stands at Teakettle treated with mechanical thinning followed by prescribed burning had substantially lower densities and canopy cover than untreated stands or those treated with prescribed burning alone (North et al. 2007). Consequently, post-treatment stand structure in the combined understory-thin and burn treatment was closer to the historic conditions and resulted in generally greater stand structural heterogeneity than found in stands treated with a single restoration treatment (mechanical thinning or prescribed burning alone). The combination of mechanical and prescribed fire treatments were most effective at restoring stand structure, but only in cases where the mechanical treatments retained the largest-diameter trees in the stand (North et al. 2007, 2009).

In red fir forests, low severity fire is especially conducive to increasing forest structural heterogeneity at multiple spatial scales (Kane et al. 2013). In addition, surface fuel loading tended to be two times higher in unburned than twice-burned red fir stands of Yosemite National Park, with high variation in fuel loading among burned and unburned sites (Meyer et al. 2015).

Mechanical and Prescribed Fire Treatments: Eastside Shrublands and Woodlands

There are three general purposes for treatments that will occur in eastside shrublands and woodlands. First, there is reduction of fire hazard around communities and developed areas where intensive treatments such as mechanical mowing or crushing will occur. Second, there is removal or reduction in density of conifers in sagebrush habitat. This generally includes thinning but the treatment of slash can vary from removal, to piling or scattering. Third, there are treatments to restore heterogeneity, age and size diversity, and understory in sagebrush areas.

Woody vegetation reduction by any means, either prescribed fire or burning can result in higher herbaceous cover (McIver et al. 2014). Where slash is removed there can be benefits to plant species richness and diversity (Brockway et al. 2002). Prescribed fire can be effective at removing woody vegetation but may result in a greater risk of invasion by non-native annual plants (Chambers et al. 2014, Miller et al. 2014a, and Pyke et al. 2014). Mechanical treatments can more directly target individual trees that are desired to be removed but also can lead to increased non-native plant invasion (Chambers et al. 2014, Miller et al. 2014a, and Pyke et al. 2014).

Treatment of shrub vegetation with mowing and prescribed fire have varying effects on the understory but different effects on the shrub layer. Some researchers found increases in native herbaceous and perennial grass species with prescribed fire or mowing (Bourne and Bunting 2011, Chambers et al. 2014, Miller et al. 2014a, McIver et al. 2014), whereas others found decreases (Pyke et al. 2014). Shrub cover responses varied with decreases reported after prescribed fire (Roundy et al. 2014) or mowing (Bourne and Bunting 2011). In some cases, shrub cover decreased for the first year (Bourne and Bunting 2011) but then cover and seedling density rebounded or increased by year three (Miller et al. 2014a). Miller et al. (2014a) summarized the shrub changes in terms of greater sage-grouse habitat and reported an increase of three times in shrub cover for prescribed fire and two times pre-treatment levels for mechanical treatments.

Mechanical treatments in eastside pinyon-juniper and sagebrush ecosystems may include the cutting and falling of encroaching conifers, followed by the piling or scattering of slash or removal of slash offsite. Mastication treatments can be applied to mow and mulch shrubs and small trees. Slash may be chipped to alter and redistribute surface fuels. Conifer removal and mastication treatments are generally effective at restoring ecosystem structure and are considered low to moderate intensity methods with less impact on biological soil crusts and invasive species spread than high intensity mechanical methods (e.g., chaining, bulldozing, plowing; Chambers et al. 2014, Miller et al. 2014a). Mechanical treatments of encroached conifers in sagebrush ecosystems generally result in increased native herbaceous plant cover and diversity (including native forbs and perennial grasses), increased native shrub abundance, reduced canopy and ladder fuel loading, and increased fine surface fuel loading (Roundy et al. 2014). Mechanical treatments are most effective in promoting native herbaceous plant and sagebrush cover and inhibiting cheatgrass cover with the application of post-treatment management approaches, such as delayed grazing coupled with post-treatment monitoring (Chambers et al. 2014, Miller et al. 2014a). Cheatgrass abundance may actually increase following mechanical treatments in the absence of these post-treatment measures (Chambers et al. 2007, Miller et al. 2014b).

Prescribed fire is often applied in pinyon-juniper and sagebrush ecosystems to restore ecosystem structure and composition (Chambers et al. 2014, Miller et al. 2014a, 2014b). Applied alone or in combination with mechanical treatments, prescribed fire can be effective at reducing the densities of encroaching conifers, increasing sagebrush seedling density, increasing native forb and grass cover, reducing ladder and surface fuel loading, and decreasing overall biomass (Miller et al.

2012-2, Rau et al. 2010). Prescribed fire is particularly effective at restoring ecosystem composition and mitigating cheatgrass invisibility within sagebrush ecosystems with relatively high ecological integrity (in the early to mid-phase of pinyon or juniper expansion; Chambers et al. 2014). In contrast, the application of prescribed fire can exacerbate cheatgrass invisibility in sagebrush ecosystems lacking sufficient pre-fire cover or seed banks of residual native grasses and forbs (as in the late-phase of pinyon or juniper invasion; Jones et al. 2015, Miller et al. 2014b). Additionally, prescribed fire (especially at higher burn intensities) can reduce the abundance of biological soil crusts (Miller et al. 2014b), which reduces the resistance of sagebrush ecosystems to cheatgrass invasion (Chambers et al. 2007). However, proper pre-fire fuel mitigation such as mechanical treatments and post-fire management (like grazing management) may help reduce some of the impacts of prescribed fire to biological soil crusts (Miller et al. 2014a).

Invasive Plant Treatments All Areas

Alternatives B, C, and D include similar measures to mitigate the invasion and spread of non-native species such as risk assessment and rapid identification and control where possible.

Ecological Fire Resilience

Ecological fire resilience is most important at the landscape scale. Individual small patches of high fire severity are within the natural range of variation (van Wagtendonk and Fites-Kaufman 2006). The consequences of large areas of high severity and proportions exceeding the natural range of variation are important. To analyze these consequences, ecological fire resilience was analyzed using “benchmark” or generalized landscape restoration levels of 15, 30, 60 and 100 percent of the landscape (see “Fire Trends” section, scenario modeling discussion). The specific locations of restoration treatments are not identified in the draft programmatic plans or alternatives. These results were used to make inferences on the consequences of the different levels and spatial patterns of restoration among the alternatives. See discussion in the “Fire Trends” section for more detail on the effects of landscape changes in vegetation and effects on fire and potential for large, high-intensity fires.

The changes in ecological fire resilience for the scenarios are shown in Figure 30. For the primary forest types where restoration would occur (ponderosa pine, mixed conifer, black oak-ponderosa pine, red fir, Jeffrey pine) high resilience is where less than 25 percent of the area would burn as crown fire. Low resilience is where more than 75 percent of these areas would burn as crown fire. While the scenarios were not developed specifically for the alternatives, alternative A would be most similar to the current condition or 15 percent restoration scenarios, alternative B would be most similar to the 15 percent or 30 percent scenarios, alternative C would be similar to the 15 percent scenario, and alternative D would be most similar to the 30 percent to 60 percent scenarios.

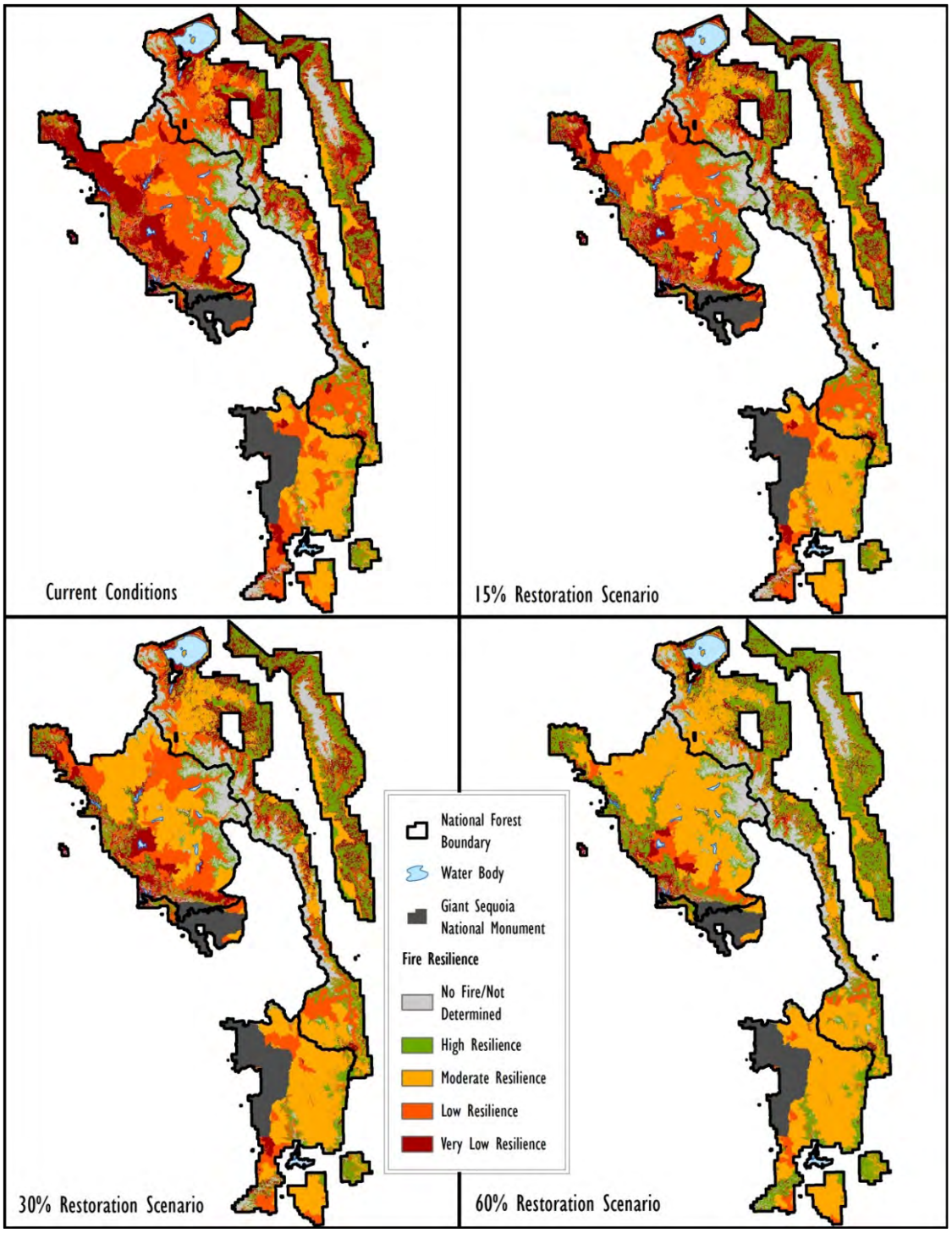

Figure 30. Landscape ecological fire resilience by restoration scenarios

Note: Areas in dark red are very low resilience, orange are low resilience, yellow is moderate resilience, and green is high resilience.

Comparison of Composition and Structure by Alternative

Table 42 through Table 47 show how similar vegetation composition and structure would be to desired conditions by ecological zone and vegetation type for each alternative. Table 42 shows westside foothill vegetation, Table 43 and Table 44 show westside montane vegetation, Table 45 shows upper montane vegetation, Table 46 shows eastside arid shrub and woodland vegetation (sagebrush, pinyon-juniper, and xeric shrub and blackbrush), and Table 47 shows the Kern River drainage (Jeffrey pine, mixed conifer, upper montane and subalpine forests and woodlands). This area is intermediate between westside and eastside vegetation. A discussion of the consequences by alternative follows.

Table 42. Similarity to vegetation composition and structure desired conditions for westside foothill vegetation by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Composition	Low to moderate	Moderate	Same as B	Same as B
Composition (Invasive plants)	Low	Low-moderate (restoration areas)	Low	Same as B, or slightly lower
Structure	Low to moderate	Moderate (restoration areas)	Low to moderate	Slightly greater than B

Table 43. Similarity to vegetation composition and structure desired conditions for westside montane vegetation by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Composition	Low (limited restoration)	Low-moderate (restoration areas in focus landscapes)	Low (limited restoration)	Somewhat greater than B (more restoration)
Composition (Invasive plants)	Moderate	Moderate, slightly greater than A (restoration areas in focus landscapes)	Moderate	Slightly less than B
Structure	Low (limited restoration)	Somewhat greater than A; Low (outside focus landscapes) moderate (restoration areas in focus landscapes within fire protection zones)	Low (limited restoration)	Somewhat greater than B (more restoration)

Table 44. Similarity to vegetation composition and structure desired conditions for westside montane vegetation by alternative and location relative to the fire protection zones and focus landscapes

Characteristic	Inside fire protection zones, outside focus landscapes	Inside fire protection zones and focus landscapes	Outside fire protection zones, inside focus landscapes	Outside fire protection zones, and focus landscapes
Composition	Low (limited restoration, slightly greater than A)	Moderate	Low to moderate (less in stands originating from railroad logging)	Low, similar to A
Composition (Invasive Plants)	Low (limited restoration, slightly greater than A)	Low to moderate (restoration areas in focus landscapes)	Low to moderate (less in stands originating from railroad logging)	Low, similar to A
Structure	Low (limited restoration, slightly greater than A)	Moderate	Low to moderate (less in stands originating from railroad logging)	Low, similar to A

Table 45. Similarity to vegetation composition and structure desired conditions for upper montane vegetation by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Composition	Low-moderate (Jeffrey pine) to Moderate (Red fir and lodgepole pine)	Increase Moderate (some restoration and increased managed fire)	Slight increase Low-moderate (increased managed fire)	Increase Slightly more than B
Composition (Invasive plants)	Moderate	Slight increase from A (restoration areas)	Moderate	Slightly greater than B (restoration areas)
Structure	Low (limited restoration)	Low-moderate (restoration areas, mainly increased managed fire)	Slight increase over A (increased managed fire)	More than B (more restoration)

Table 46. Similarity to vegetation composition and structure desired conditions for eastside pinyon-juniper ad sagebrush by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Composition	Low (limited restoration)	Low to moderate (restoration areas)	Same as B	More than B (more restoration)
Composition (Invasive plants)	Low to moderate (low in low elevations)	Slight increase from A (restoration areas)	Slight increase in similarity to desired conditions from A (restoration areas)	Less similarity to desired condition as compared to B (and similar to A)
Structure	Low (limited restoration)	Low to moderate (restoration areas)	Moderate (more similar to desired conditions because more treatments in sagebrush)	More than B (more restoration)

Table 47. Similarity to vegetation composition and structure desired conditions for eastside Jeffrey pine, mixed conifer, upper montane and subalpine forests and woodlands by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Composition	Low (limited restoration)	Low to moderate (restoration areas)	Same as B	More than B (more restoration)
Composition (Invasive plants)	Low to moderate (low in low elevations)	Slight increase from A (restoration areas)	Slight increase in similarity to desired conditions from A (restoration areas)	Less similarity to desired conditions as compared to B (and similar to A)
Structure	Low (limited restoration)	Low-moderate (restoration areas)	Less than B	More than B (more restoration)

Consequences Specific to Alternative A

Although the current plans aspire to treat 20 to 30 percent of the forest to reduce fuels, this has not been achieved. It is estimated that 5 to 10 percent of the montane and eastside sagebrush and pinyon-juniper areas have been treated since 2001. Most of the treatment would occur in the wildland-urban intermix and in the montane zone on the west side and in the sagebrush, pinyon-juniper and wildland-urban intermix area on the east side.

Westside Foothills Vegetation

There is limited treatment in alternative A in the foothills. Most will occur in the wildland-urban intermix defense and threat zones, near communities and key infrastructure (like communication towers). These treatments will be oriented toward fire protection and will move chaparral toward fire desired conditions. Blue oak woodlands will continue to be managed primarily for grazing. There may be occasional restoration projects in coordination with local tribes in areas of tribal importance. These will be limited in scale and number.

Composition. There would continue to be some areas that are similar to desired conditions that have been treated previously. But this is primarily from areas treated for fuel hazard reduction in wildland-urban intermix defense and threat zones. Ground-disturbing treatments in this zone could increase the amount and extent of annual invasive grasses, especially cheatgrass. There is plan direction to minimize the spread of invasive plants but it is difficult to keep out of restored areas because it is so prevalent in the foothill zone.

Structure. Treatment of chaparral in the wildland-urban intermix defense and threat zones would result in more uniformly younger seral stages. Outside of the wildland-urban intermix defense and threat zones, much of the chaparral is very old but not outside the natural range of variation. Increases in large, high-intensity fire may lead to large uniformly younger and fewer areas that are old. The Rough Fire in 2015 that burned in the Kings River Canyon burned at high intensity in old chaparral. While fires of these intensities are natural in chaparral because of the fuel conditions and typical locations in steep canyons, the size of the fire may have been larger than would have occurred historically.

Blue oak woodlands will continue to remain in the same condition they are now, but may worsen because of the stress of warmer climate (Rodriquez-Buritica and Suding 2013). This includes further reductions in regeneration and increases in overstory mortality rates. Little to no restoration occurs in blue oak woodlands and this trend would be expected to continue.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. Resilience to drought, air pollutants, climate change, insects and pathogens is declining and will continue to worsen in the near future (Sydoriak et al. 20130). The low levels of restoration treatments in the foothills would not substantially increase resilience in this vegetation zone.

Westside Montane Forests

Overall treatment rates are limited in alternative A. Generally, less than 5 to 10 percent of the landscape has been restored over the last 10 years. On most of the landscape, there is limited flexibility to restore composition and structure because of management direction for the California spotted owl that emphasizes retaining tree cover. The treatments in these forest types are usually low intensity due to restrictions on the amount of canopy cover that can be reduced. As a result, composition, structure, and resilience would remain dissimilar to vegetation desired conditions.

Composition. There would continue to be a high proportion of shade-tolerant and fire-intolerant trees in the overstory and understory. There would be limited opportunities to restore dominance or codominance of ponderosa or Jeffrey pine due to diameter limits that restrict removal of competing shade-tolerant species such as white fir and incense cedar that have grown quickly during a century of fire suppression. This is particularly a challenge in the nearly 100,000 acres (primarily on the Sierra National Forest) that were harvested in the early 1900s by railroad logging. In these stands, the trees are now mostly greater than 30 inches in diameter, but are growing densely and with a structure and composition that are moving away from the desired condition. Similarly, there would be limited opportunity to restore black oak overstory and understory primarily due to diameter limits and canopy cover requirements. There would be little opportunity to provide sufficient light for ponderosa or Jeffrey pine regeneration due to the direction to retain canopy cover and diameter limits that make it difficult to create sunny openings of sufficient size where pine seedlings and saplings can grow. Limited amounts of prescribed fire would result in little restoration of understory plants that are adapted to fire.

Structure. There could be restoration to increase heterogeneity, but restrictions on changing canopy cover in California spotted owl and Pacific fisher habitat limit how much change would occur. While treatments primarily reduce understory trees, there would continue to be a high dissimilarity to vegetation desired conditions in most of the landscape.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. The low proportion of the landscape that would be restored and the low intensity of treatments make it highly likely most of the area would continue to have a low resilience to drought, climate change, insects, pathogens, and large, high-intensity fire.

Westside Upper Montane Forests

There would continue to be limited mechanical treatment and prescribed fire restoration in upper montane forests in alternative A. There would be some wildfire managed to meet resource objectives, especially in the Kern River drainage and some wilderness areas. These managed fires would generally move upper montane forests toward vegetation desired conditions. Composition, structure and resilience of montane chaparral and upper montane Jeffrey pine would benefit from fire.

Composition. Restoration treatments would move understory tree composition toward desired conditions in Jeffrey pine forests. Shade- and fire-intolerant white fir would be removed up to the

diameter limit. Mechanical treatments and fire would have a similar beneficial effect. There would be little change in composition of red fir forests and lodgepole pine forests because they tend to be the dominant species, with or without restoration. Understory composition would continue to improve with restoration, especially where it includes fire (Wayman and North 2007). Where wildfire is managed to meet resource objectives, it would improve montane chaparral composition. Many of these species in montane chaparral are adapted to fire.

Structure. Restoration treatments would move some areas slightly toward desired conditions and others substantially. Mechanical treatments would move areas slightly toward desired conditions because of restrictions on changes in canopy cover and diameter limit for California spotted owl. There would be limited ability to reduce forest density and most importantly in the upper montane forests, increase heterogeneity. Where large areas have wildfire managed to meet resource objectives there would be increased heterogeneity and a decreased vegetation density. Chaparral would have more of a mosaic of age structure. Jeffrey pine and red fir forests would have increased heterogeneity, reduced and patchier surface fuels and increased resilience.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. Restoration treatments would continue to be at a very low level, except for more remote areas (like the Kern River drainage and wilderness areas) that have had and will likely continue to have wildfire managed to meet resource objectives. The more remote areas have a moderate level of resilience and the Kern River drainage would likely increase to a high level of resilience over the period of the plan. The other areas would likely remain at a low level of resilience.

Westside Subalpine and Alpine Vegetation

There is little direct management of subalpine and alpine vegetation in alternative A. Most of this vegetation is in wilderness areas, where natural processes are the dominant management approach. Exceptions are in limited locations where recreation use is concentrated.

Composition. Alternative A would continue to minimize the spread of invasive plants in subalpine and alpine environments where restoration treatment activities are supported (like ski areas).

Structure and Resilience. Subalpine and alpine vegetation are among the most vulnerable to climate change (Meyer 2013b, Sydoriak et al. 2013). Management in the remote areas, mostly wilderness where these vegetation types occur, would continue to be very limited. With changing climate, in the absence of restoration, mortality of some subalpine trees (like whitebark pine) would continue to increase.

Sagebrush

Restoration of sagebrush habitats would continue to implement the “Sage-Grouse Interim Management Policy” for greater sage-grouse; however, there is the least amount of restoration in sagebrush vegetation in alternative A. Restoration of composition and structure would be limited to small areas and a very small proportion of the extent that this vegetation type occurs, especially on the Inyo National Forest.

Composition. There would be limited areas that will move vegetation toward desired conditions. There would be fewer opportunities to remove conifers encroaching in sagebrush vegetation. Alternative A would continue to minimize the spread of invasive plants in arid shrublands and woodlands because there would be fewer restoration treatments.

Structure. There would continue to be many areas that are dissimilar to desired conditions for a mosaic of ages of sagebrush. There would continue to be large areas where many of the shrubs are older and decadent (lack new growth).

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would continue to be a low resilience to large, high-intensity fire and climate change. Low structural diversity and limited reduction of invasive plants would make it likely that resilience will decline further. There would continue to be a high dissimilarity to desired conditions.

Pinyon-Juniper Forests

Treatments in pinyon-juniper and arid shrublands are limited in alternative A. Most of it would continue to occur in the wildland-urban intermix defense and threat zones.

Composition. There would be limited opportunities to reduce or eradicate non-native invasive plants. These areas would continue to remain dissimilar to desired conditions for understory species composition. Targeted treatments to reduce or eradicate non-native invasive plants would continue to occur. However, there would likely continue to be an increase in the area occupied by non-native invasive plants.

Structure. Limited restoration would leave many areas with higher pinyon and juniper density where they exceed desired conditions. This is only a portion of the pinyon and juniper vegetation. Areas on very harsh sites would remain similar to desired conditions.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would continue to be large areas that are dissimilar to desired conditions and have high levels of insect-related mortality. Current trends of elevated insect and drought-related mortality are likely to increase. There would continue to be areas with low resilience to drought, climate change, insects and pathogens, and large, high-intensity fire.

Eastside Jeffrey Pine Forests

There would continue to be limited treatments to restore Jeffrey pine forests in alternative A. The treatments would continue to be focused on reductions in forest density with associated fuel wood production and prescribed fire.

Composition. Most areas would continue to remain dissimilar to desired conditions because of the limited levels of restoration. There are some areas with white fir ingrowth that would benefit from increased thinning. The greatest benefit of restoration on composition is to the native understory plants. Limited prescribed fire and thinning would result in many areas continuing to be dissimilar to desired conditions. Many of the plants in eastside Jeffrey pine forest are adapted to frequent fire.

Structure. Treatments to reduce forest density, increase forest heterogeneity, reduce surface fuels and restore fire would be limited in area.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. Restoration treatments would increase resilience to drought, climate change, insects, and pathogens in these treated areas but the negative effects of the stressors would outpace the restoration. There would be little to no increase in resilience to large, high-intensity fire because the area restored would be small and the intensity of treatments low. Resilience to large, high-intensity fire, drought, climate change, insects, and pathogens would remain very low to low.

Eastside Upper Montane Forests

There would continue to be limited treatments in red fir and lodgepole pine forests, except in the wildland-urban intermix. This is primarily in the Mammoth Lakes area. These treatments emphasize thinning of small trees (which contribute ladder fuels) and reducing surface fuels (by piling and burning).

Composition. These treatments can move the vegetation slightly toward the vegetation desired conditions for composition but the effect is minor. Pile burning tends to heat the soil in concentrated areas and decrease native seed and underground structures (such as tubers), while increasing the likelihood of establishment of non-native invasive plants.

Structure. The removal of small trees would decrease some tree density but fuel treatments tend to make vegetation more uniform and do not increase heterogeneity.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would be some limited benefits to resilience. Reductions in tree density would increase resilience in the localized area but not provide for landscape resilience that is needed for large, high-intensity fires.

Eastside Subalpine and Alpine Vegetation

See “Westside Subalpine and Alpine Vegetation” subsection on page 172.

Cumulative Effects of Alternative A

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration in alternative A (see “Climate” section). There would continue to be restoration on adjacent Federal, State and local agency lands (such as Los Angeles Department of Water and Power) that are similar to those on National Forest System lands. Restoration on these other lands would also be limited. There would continue to be urbanized development adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human-ignited fires and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see “Fire Trends” section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions.

Consequences Specific to Alternative B

In this alternative, plan direction for vegetation management would change desired conditions, objectives, standards and guides, management approaches, and goals that would affect vegetation composition, structure and resilience. The degree of change varies by vegetation type and location. The most overarching changes are described here and the remainder in specific vegetation types and locations as relevant.

All Areas

Throughout all of the analysis area, there are two fire-related management areas that have different vegetation-related plan direction and each would have different impacts. They are the strategic fire management zones and the community buffers.

Community buffers are linear areas surrounding communities and, on the Inyo National Forest, they surround developed recreation sites at high fire risk. The widths are based on expected fire behavior. The desired conditions for vegetation may be different in the community protection zone, with lower canopy cover, snag densities, log densities, and surface fuels (MA-CWPZ-GDL-01). Otherwise, management direction for fire-oriented treatments is consistent with desired conditions for terrestrial vegetation (MA-CWPZ-GDL-02).

There are several differences in plan components in the two wildfire protection zones compared to the other strategic fire management zones that would affect the mix and intensity of vegetation treatments and thus vegetation consequences. The direction on large-diameter trees differs as shown in Table 48.

Table 48. Application of large tree plan components across strategic fire management zones, alternative B

Plan Direction	Inside Wildfire Protection Zones	Outside Wildfire Protection Zones
TERR-FW-STD-01 (30-inch diameter limit)	Does not apply	Applies, same as alterative A
TERR-OLD-DC-07 (desired densities of large trees by forest type)	Applies	Applies

Although there are desired conditions for old forest, in the two wildfire protection zones there are no diameter limits on large trees that can be removed mechanically. This may result in more intensive thinning in some areas. It is not known how much. Outside of the two wildfire protection zones, the standard restricting removal of 30-inch diameter trees is retained (TERR-FW-STD-01). This may have consequences for old forests and is discussed in the following subsection on "Terrestrial Ecosystem Processes and Function." There would also be more use of wildfire managed to meet resource objectives, primarily outside of the wildfire protection zones. This would result in more restoration of vegetation using this treatment. This would most likely occur in upper montane and subalpine vegetation types.

Westside Areas

Focus landscapes are areas that have different suites of standards and guides in them. They may occur in both alternatives B and D. Focus landscapes are large areas where ecological restoration would be emphasized. Plan direction (by management approach) prioritizes these areas for restoration:

> Emphasize vegetation treatments in focus landscapes (10,000-80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.

This is a tool we think will help us move toward our desired conditions faster and more effectively because of the additional flexibility in meeting both resource protection values and addressing our vegetation needs for resilience and reducing high-severity fire risk. In these areas, different management direction for old forest species applies, specifically for the California spotted owl and Pacific fisher. They are designed to improve landscape resilience because small, isolated and independent treatment areas will not adequately restore ecosystem functions across landscapes, such as fire resilience (FIRE-FW-GDL-02). They may overlap with the fire protection zones but may also occur outside of them. The plans do not specify the particular locations.

Figure 31 shows an example of two possible focus landscapes. The example on the left is centered on the community wildfire protection zone and the example on the right is more focused on restoration of dry patch types. The blue lines represent example boundaries around focus landscapes. The yellow, linear areas are where treatments focused on strategic roads or ridges would be placed. The purple patches are representative, example patches that might be priorities for restoration. These occur near roads and are mostly on dry sites (tan color) but some are on moist sites (green color). The red areas are in the community fire protection zone. Although not shown in the examples, there would also be large prescribed fire patches between the purple areas. In these examples, at least 40 percent of the area would be treated.

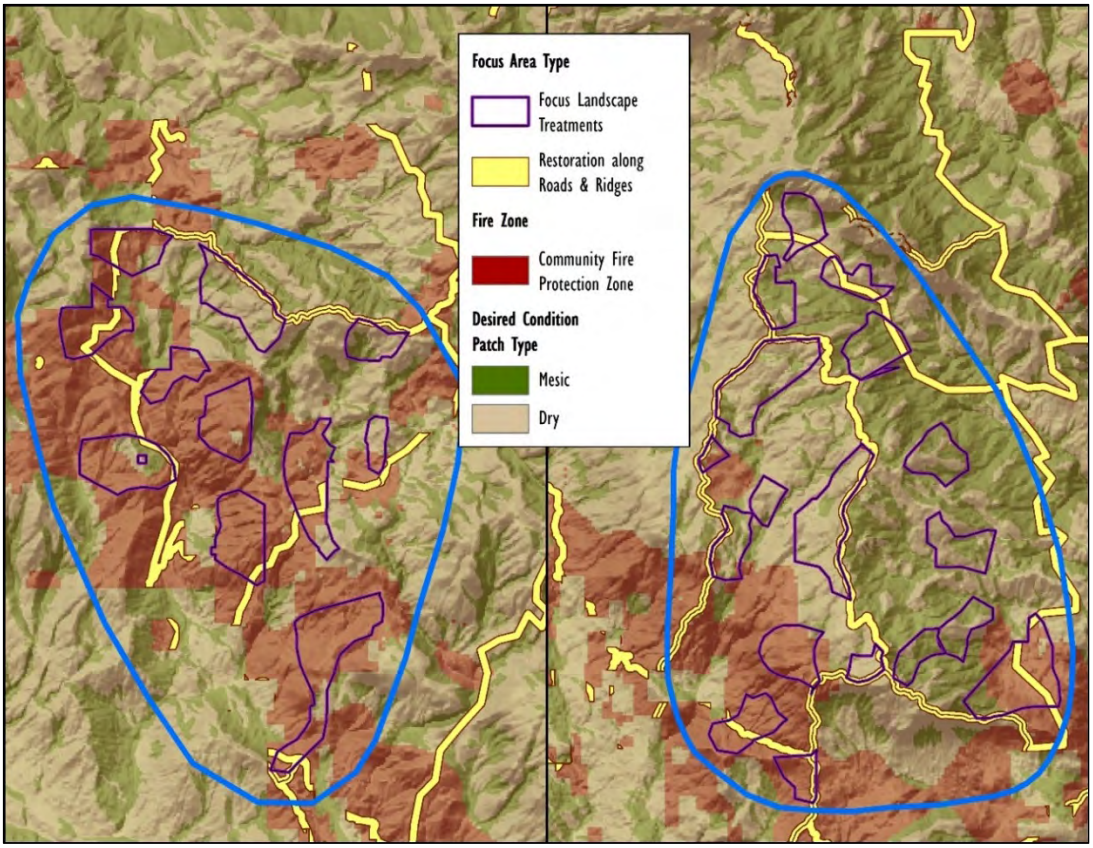

Figure 31. Example illustrating potential treatments in two possible focus landscapes

The plan direction for these species in the focus landscapes is less restrictive with an emphasis on restoration of habitat conditions relative to the natural range of variation. Vegetation structure and composition would be restored but within some constraints in California spotted owl protected activity centers and suitable fisher target cells. There are a different suite of standards and guidelines that apply to fisher and owl habitat in focus landscapes (and community buffers). Mechanical treatment would be allowed in protected activity centers (SPEC-CSO-STD-01), and the cumulative amount of mechanical treatment allowed in protected activity centers is increased from 5 to 10 percent per year and from 10 to 30 percent per decade (SPEC-CSO-GDL-07). For Pacific fisher limitations on mechanical treatments are increased from 13 percent of target cells over 5 years to up to 50 percent of target cells in focus landscapes or in community buffers (SPEC-PF-STD-02). These changes would increase opportunities to treat vegetation in more areas and with greater intensity making it more likely that vegetation will move toward desired conditions in the focus landscapes.

It is more likely that the mechanical treatment would result in more reduction in forest density and restoration of pine and oak-dominated composition on ponderosa pine and dry mixed conifer sites. There is also a waiver of limited operating periods for prescribed fire in fisher denning habitat in focus landscapes that would increase the likelihood of prescribed fire. The increased opportunity for mechanical treatment and prescribed fire would increase the amount of contiguous landscape areas that meet vegetation desired conditions that are resilient to fire. The concentration of treatments within contiguous landscape areas would provide greater reductions in potential high fire severity than when the treatments are spread out (see the "Fire Trends" section).

Three types of treatment arrangements would occur in alternative B. One is in patches across slopes. These would be emphasized in areas with road access where vegetation is most departed from the desired conditions. Many of these areas would be on drier ponderosa pine, black oak, and dry mixed conifer-dominated areas but not always. Another treatment arrangement would be along major roads and ridges that would increase the ability to conduct large, landscape prescribed fires or to manage wildfires. Most of these would also occur on dry sites. Both of these locations would result in movement of vegetation toward desired conditions. The third treatment arrangement would be in large, less accessible drainages or landscapes where large landscapes prescribed fires are the primary means of restoring vegetation and reducing potential fire severity. These may occur across all vegetation types and sites from the foothills to the upper montane zones.

Figure 32 shows another focus landscape in a representative area to illustrate how treatment areas would consider plan direction for wildlife. The focus landscape is bounded by the blue dotted line. Possible treatment patches are shown outlined with purple. The yellow lines are potential treatment areas along strategically located ridges and major roads. The light blue patches are California spotted owl protected activity centers. The green hexagon shapes surround suitable fisher habitat (suitable target cells). The red areas are the community wildfire protection zone management area. The tan patches are dry patch types, where the dry mixed conifer desired conditions would apply. The green patches are the mesic or moist patch types, where the moist mixed conifer desired conditions would apply. The black lines are roads.

Mechanical and prescribed fire treatments would help make vegetation conditions more similar to desired conditions (TERR-FW-GDL-01 to 02; TERR-BLCK-GDL-01 to 02; Old Forest; TERR-OLD-GDL-01 to 02; TERR-SH-STD-01; INV-FW-GDL-01 to 02; FIRE-FW-GDL-09; MA-GWPZ-GDL-01; SPEC-CSO-GDL-01, SPEC-PF-GDL-01). Exceptions would be in portions or all of the California spotted owl protected activity centers and suitable fisher habitat. Up to half of the fisher target cells, and at least two-thirds of the protected activity centers would retain more canopy cover when overlapping with the dry patches.

Treatments would primarily be variable density thinning and burning to restore heterogeneity, decrease overall forest density, decrease surface fuel continuity, and increase understory cover, density, and vigor, particularly of sun-loving plants. The approach would be as described in GTR 220 and 237 (North et al. 2009 and North 2012), emphasizing restoration of heterogeneity. There would be variable spacing in thinning and burning. Some areas would be thinned more and some areas less or not at all. There would be thinning across a range of diameters, between small- to medium-diameter trees. Some small openings would be created while clumps of trees would be retained in some areas. There would be retention and creation of heterogeneity in the understory as well, as described in the desired conditions. Some patches of high surface fuel would occur, and other areas would have little to none.

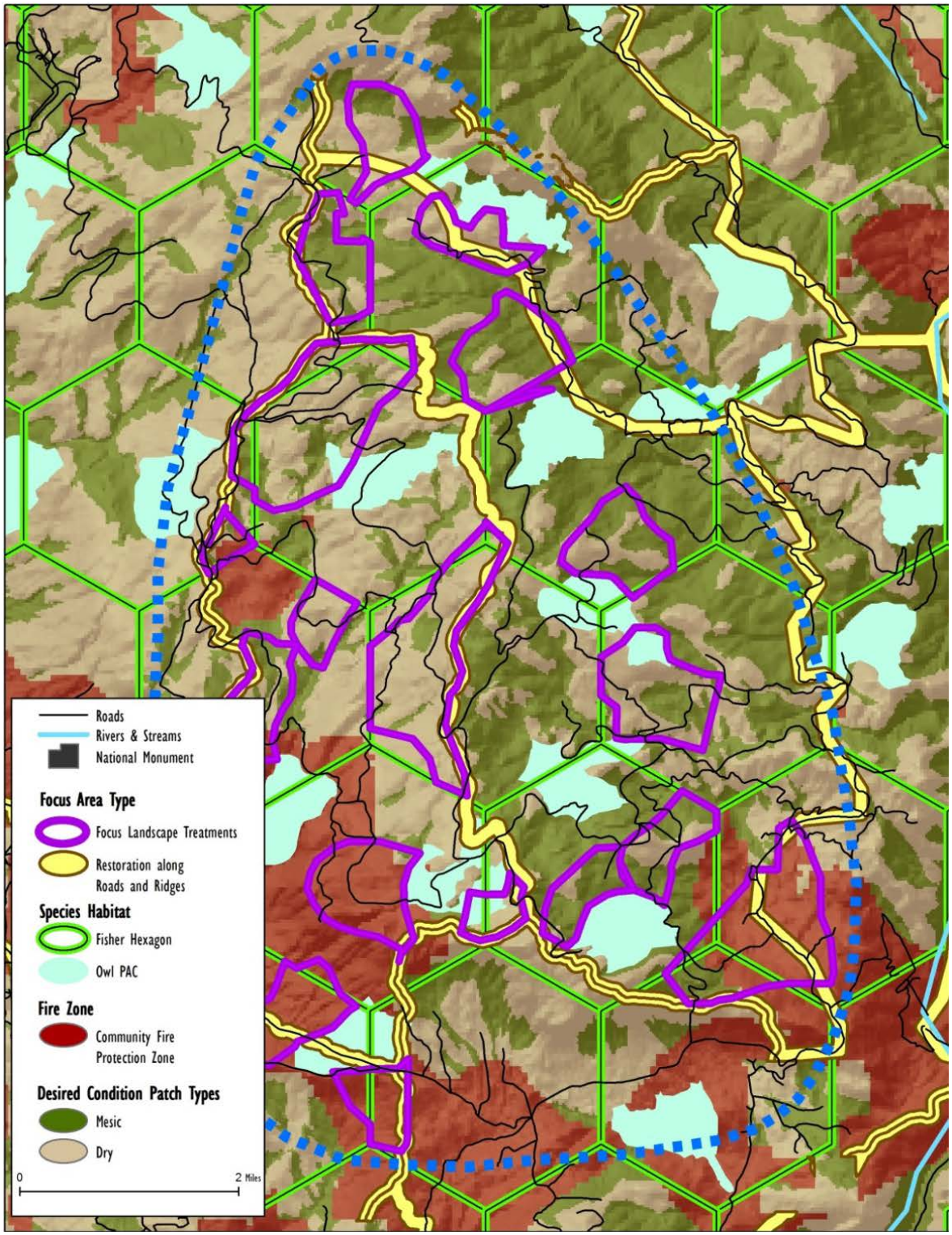

Figure 32. Example illustrating potential treatments in a possible focus landscape considering direction for wildlife

PAC = protected activity center

Figure 33 shows how the landscape would look after desired conditions were reached for an example area. The changes are based upon desired conditions for tree canopy cover that varies for dry (TERR-DMC-DC-01 to 06) and moist (TERR-MMC-DC-01 to 06) mixed conifer forests. The top left panel of the figure shows the ridges and dry patches would have dry mixed conifer desired conditions applied. The mesic patches would have the moist mixed conifer desired conditions applied. The intermediate patches would have a combination of the moist and dry mixed conifer patches, depending on the soil moisture and presence of understory plants indicating moisture conditions (as described in the introduction to the montane section of the plan). The top right panel of the figure shows the average forest canopy cover across the example area, as measured by remote sensing in the existing vegetation. The lower left panel shows how restoration toward desired conditions of heterogeneity and canopy cover might look. This shows that even dry patches would have some clumps of trees with higher canopy cover but that they would be less common than on the moist patches. This example does not show the type of additional clumping that would occur in owl protected activity centers, where mechanical treatments would be limited to one-third of individual protected activity centers, where at least half of the protected activity center falls into dry patches (SPEC-CSO-STD-02). This would leave multiple large patches of higher canopy cover in many areas since protected activity centers are well distributed in most areas (Figure 32) and prescribed fire in the montane areas would tend to be lower intensity and would have a slight change to overstory tree cover if at all (Schmidt et al. 2006, Vaillant et al. 2015).

There are no set number of focus landscapes or areas that would fall into focus landscapes. For purposes of this analysis, estimates of the amount of focus landscapes and encompassed area were developed. This was done by taking the proposed area (percent or acres) in the objectives and separating out how much might be treated outside of the community buffers. Although there are multiple community buffers on each national forest, the extent of the area is relatively small. Similarly, the extent of likely roads and ridges restored for tactical fire purposes (MA-GWPZ-GDL-01) are limited. It is reasonable to assume that at least half of the areas for restoration in the objectives would occur in the focus landscapes. At least one-third of these areas would overlap with the fire protection zones and achieve dual benefits of restoring habitat and old forest that is highly departed from desired conditions and at risk (management approaches: Pacific Fisher 01; Terrestrial Ecosystems 01, 02; Timber 02 and 03), and reduce fire risk to communities (MA-GWPZ-GOAL-02).

> To protect old forest components from uncharacteristic fire, prioritize restoration in key old forest areas. Methods of protecting existing old forest components on the landscape may include thinning or selective harvest, prescribed fire, and wildfires managed to meet resource objectives.
>
> Prioritize ecological restoration in landscapes around key linkage areas and areas with suitable habitat at highest fire risk.
>
> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience, and fire resilience and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.

Based on these assumptions, there could be three to six focus landscapes on the Sierra National Forest and two to four on the Sequoia National Forest. There is a smaller number on the Sequoia National Forest because over one-third of the area is wilderness and more remote areas where managed fire has been the primary management tool in the last 15 years.

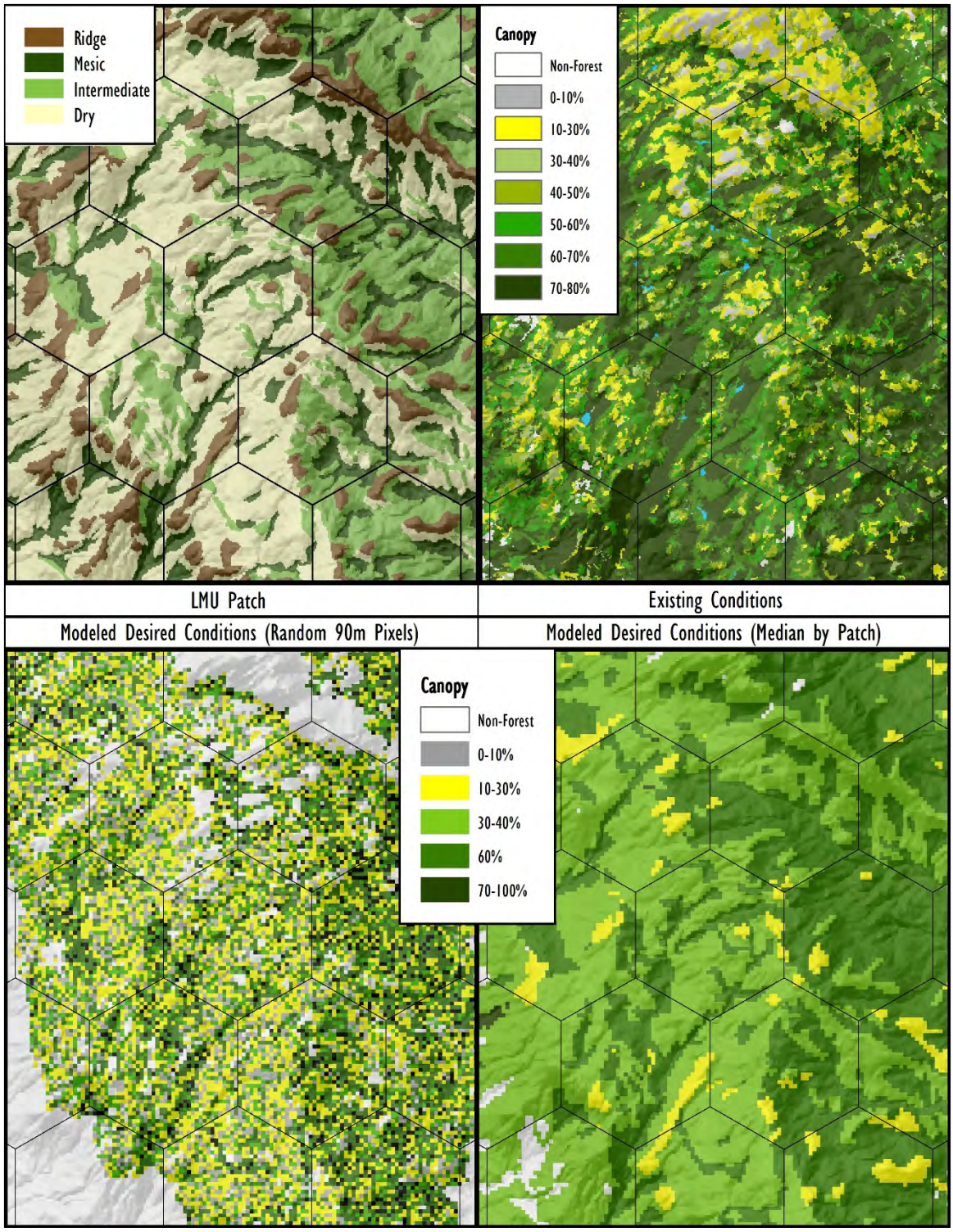

Figure 33. Changes in tree canopy cover from current to modeled desired conditions for a representative area

Note: The random pixels represent "heterogeneity" and the median by patch, the average across patches.

Westside Foothills Vegetation

There would be some increase in restoration in the foothill zone in alternative B because of management direction including desired conditions and goals to reduce fire risk to communities (MA-CWPZ-DC-01 to 02; MA-CWPZ-01 to 02; MA-GWPZ-DC-01 to 02) and the management approach "Prioritize fuel treatments in areas that pose the greatest threat to communities and highly valued resources.

The fire protection zones are larger than the current wildland-urban intermix threat zones and may result in increased treatments. This includes but is not limited to treatments in community buffers, ecological restoration along ridges and roads that would be used for evacuation routes and as anchors for fire operations during large prescribed fires or wildfires, and treatments in focus landscapes. Other areas may be restored in areas of tribal importance where multiple sites are planned for restoration (Sequoia: TERR-FW-OBJ-04), especially oak woodlands that are traditional gathering sites (Lake and Long 2014).

There may be restoration near developed recreation sites, a number of which are in foothills areas, and there are objectives to restore some of these areas (REC-FW-OBJ-01; SCEN-FW-OBJ-01). There is additional management direction specific to blue oak woodlands and chaparral that is more specific than management direction in the current forest plans (alternative A). This includes desired conditions that were absent before (TERR-BLU-DC-01 to 03; TERR-CHAP-DC-01 to 02). Other management direction limiting livestock browsing of oak and removal of large live oaks and snags remains the same (RANG-FW-STD-01; TERR-FW-GDL-04). There are new guidelines that direct management toward heterogeneous mosaics of chaparral and avoid type conversion to annual grasslands (TERR-CHAP-GDL-01 to 02).

There are specific objectives to restore vegetation composition on 600 acres of areas with non-native plant invasions on each of the Sierra and Sequoia National Forests (INV-FW-OBJ-01). Most of this area will be in the foothill zone where non-native invasive plants are most prevalent.

Composition. There would be a slight increase in the area that is similar to desired conditions in alternative B because of some restoration in community buffers, along ridges and roads in the fire protection zones and because of work with tribes on cultural, ecological restoration. These would include projects targeted to reduce non-native plants. There is plan direction to incorporate best practices to reduce the further spread of non-native plants in all projects (INV-FW-GDL 01 to 05).

These improvements may be offset to an unknown degree by non-native invasive plant expansions in restoration areas, despite best management practices, since climate change enhances invasive species. Direction to retain mature blue oak remains but there is increased emphasis on maintenance and restoration of blue oak regeneration (seedlings) and recruitment (saplings and poles; TERR-BLCK-GDL-01 to 02). Current livestock grazing management through allotment management plans would continue to improve conditions in blue oak woodlands (RANG-FW-DC-02). There is also specific management direction to increase and emphasize ecological restoration for vegetation types or in areas of tribal interest, including specific restoration objectives on the Sequoia National Forest (TERR-FW-OBJ-04), and goals (TRIB-FW-GOAL-01) on both the Sequoia and Sierra National Forests. Some of this would be focused in blue oak woodlands and some in chaparral. This restoration would likely involve improvements in hardwood stands, reducing fire threats to sites of tribal cultural value, and improving the quality and quantity of important gathering sites. Treatments that involve reductions in non-native annual grasses and other plants and restoration of native understory plants would also benefit tribal resources and gathering.

Structure. There would be a slight improvement in vegetation structure in the foothill zone due to ecological restoration, mostly in blue oak woodlands. In the community buffers and fire protection zones there may be changes in chaparral that are toward the lower end of the natural range of variation by shifting older vegetation successional stages toward more early-stage (younger growth) patches because of the emphasis on community and infrastructure fire protection. These changes would be limited to a small proportion of these areas, and mainly occur along ridges and roads or directly surrounding communities at high fire risk. Most of the chaparral would remain in an older condition outside of recent fire areas. There might be some prescribed fires that restore a mosaic of ages in steeper more inaccessible areas where high-intensity fire would threaten communities.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would be a slight increase in ecological resilience overall and a moderate increase at sites where restoration occurs. Restoration of blue oak woodlands is very difficult (Rodriquez-Buritica and Suding 2013), particularly restoration of the native understory plant community that is more resilient and, as a result, the increase in resilience would be slight.

Westside Montane Forests

Alternative B would increase the amount of vegetation restoration in the montane zone through several objectives (Table 49).

Table 49. Vegetation restoration objectives that include most or all of the westside montane zone, Sequoia and Sierra National Forests, Alternative B

TERR-FW-OBJ	Sequoia National Forest	Sierra National Forest
1. Restore composition, structure, and heterogeneity	9,000 to 15,000 acres of the montane, upper montane and portions of foothill landscape	10 to 20 percent of mixed conifer, ponderosa pine and portions of foothill landscape
2. Restore beneficial low and moderate severity prescribed fire	5,000 to 15,000 acres	50,000 to 60,000 acres
3. Manage wildland fire, as safety allows	83,000 acres	170,000 acres
4. Restore areas of tribal importance	3 to 10 areas	3 to 10 areas

The area with restoration treatments could potentially double from current levels (alternative A), including mechanical treatment and prescribed fire individually but mostly together. Between 15 to 25 percent of the montane landscape is expected to be restored under this alternative, except for the Kern River drainage where up to 50 to 90 percent of the landscape is expected to be restored. The Kern River drainage already has more than 40 percent of the area restored and would increase by at least 20 percent. Although wildfires managed to meet resource objectives has occurred extensively in the Kern Drainage, the new plan direction that provides for managing wildfires to meet resource objectives would make this more likely to continue to occur or increase (MA-WRZ-GOAL-01, MA-WRZ-STD-01, MA-WMZ-DC-02, and MA-WMZ-STD-01 to 02).

Most of the restoration would occur within focus landscapes, an estimated one-half to two-thirds of the planned treatment area in the plan objectives. This would be an estimated 20,000 to 50,000 acres of treatment areas within a combined focus landscape area of at least 50,000 to 125,000 acres on the Sierra National Forest based on the objectives (TERR-FW-OBJ-01 to 02). On the Sequoia National Forest there would be an estimated 9,000 to 20,000 acres of treatment areas

within a combined focus landscape area of at least 22,000 to 50,000 acres (TERR-FW-OBJ-01 to 02). On the Sequoia, there would also be large landscape areas (40,000 to 100,000 acres) that would be restored or maintained in a restored condition in the more remote portions of the Kern Drainage (TERR-FW-OBJ 03).

Restoration in these areas would move at least 40 percent of these landscapes toward desired conditions, including both vegetation and fisher and owl habitat plan direction (SPEC-CSO-DC-01, SPEC-PF-DC-01 to 02; SPEC-PF-DC-07). Although much of the restoration would be focused on the dry sites that have the greatest departure from desired conditions (SPEC-CSO-DC-03), some would also occur in moist patches and riparian areas to provide more effective change in future landscape fire behavior or to facilitate larger prescribed burns. There would be some restoration of California spotted owl protected activity centers that occur primarily on dry sites, allowing mechanical treatment in up to one-third of a protected activity center per decade (SPEC-CSO-STD-02). Restoration in focus landscape areas would result in a higher likelihood that these areas would burn at lower intensities during wildfires (see "Fire Trends" section) and retain mature forest.

There are large areas on the Sierra and Sequoia National Forests that were railroad logged in the late 1800s and particularly the early 1900s (Laudenslayer and Darr 1990). These areas are now dominated by uniform stands of mostly medium and large-diameter young trees (less than 110 years old) trees. Outside of the fire protection zones but within the focus landscapes, the large tree diameter limit may result in very little movement toward desired conditions for structure in the railroad logged areas because many of the trees are at or slightly above 30 inches in diameter. This condition is estimated to extend across 95,000 acres for the northern portion of the Sierra National Forest alone.

Outside of the focus landscapes, the emphasis would be on retaining California spotted owl and Pacific fisher habitat in protected activity centers and denning habitat in the short term (SPEC-CSO-DC 02; SPEC-PF-DC 05). Canopy cover retention would be emphasized in these areas toward the upper end of the desired conditions, such as greater than 60 percent cover in half of each target fisher cell and across all individual owl protected activity centers. At least one-third and up to one-half of these sites fall on dry patches with a median desired canopy cover level of 40 percent. Restoration treatments would be less intense, with fewer pole and medium-sized trees removed (Roberts 2015; Fry et al. 2015) and less opportunity to create heterogeneity. There would be less ability to create small openings or variable spacing of overstory, mid-sized trees to increase heterogeneity because of canopy retention requirements and limits on removing larger trees outside of the two wildfire protection zones.

Where areas are outside of focus landscapes and in the fire restoration and maintenance zones, the direction for large trees changes, but the canopy cover retention direction for fisher and owl habitat remains the same. Here, there is no limit on the diameter of large trees that can be removed and instead desired conditions for large tree densities apply (TERR-OLD-DC-03 to 04). In most of the montane likely treatment areas, the greatest limitations on implementation to reach vegetation and old forest desired conditions is the plan direction limiting removal of canopy cover and treatment amount in spotted owl and fisher habitat (SPEC-CSO-DC-02, -04; SPEC-PF-DC-05; SPEC-PF-STD-02 to 03; SPEC-CSO-GDL-06). In these areas, there would be a limited movement toward vegetation and old forest desired conditions because relatively few trees could be removed. Because of these limitations, it is assumed that restoration treatments would cost more outside of the focus landscapes. This would result in less total area treated, since it would

cost more per acre to treat and no timber or biomass receipts would be available to treat nearby areas in the landscape.

There is a moderate level of uncertainty about how seasonal restrictions would impact the ability to meet the restoration objectives (see Table 49) in alternative B because of the limited operating periods for the California spotted owl in and outside of focus landscapes (SPEC-CSO-GDL-03) and for Pacific fisher outside of focus landscapes (SPEC-PF-GDL-04). There is a high concentration of California spotted owl protected activity centers in much of the montane landscape. With drought and increasingly more severe fire conditions during the summer, mechanical operations in the forests are often restricted on high fire danger days. This limits the number of days for mechanical restoration and can create a backlog of work that result in economic hardships on contractors and can make restoration projects less economically feasible. Similar limitations to prescribed fire are discussed below.

The amount of prescribed fire and wildfire managed to meet resource objectives could increase in alternative B (TERR-FW-OBJ-02; TERR-FW-DC-06; TERR-MONT-DC-04), although there are some uncertainties about the amount of increase. The amount could double that in alternative A. The increase would be due to the greater amount of mechanical restoration which would facilitate more prescribed burning both in and outside of mechanically treated areas. Larger prescribed fires would be more feasible because the prioritized restoration along ridges and roads would provide "anchors" for burn operations (MA-CWPZ-GDL-02; MA-GWPZ-GDL-01). In the focus landscapes vegetation would be less dense, making desired fire effects and fire control more achievable (MA-GWPZ-GOAL-02; MA-WRZ-GOAL-01; MA-WRZ-DC-01). There would likely be more prescribed fire within treated areas and to connect treated areas into larger landscape scale burns. Wildfires managed to meet resource objectives would still be very limited in most montane areas due to concerns that wildfires could become uncontrollable in the dense forests if they burn into these areas (except for in the Kern Drainage).

In alternative B, there is a moderate level of uncertainty in how much prescribed fire could occur in montane areas. There is uncertainty that there would be sufficient time periods or "windows" to conduct prescribed burning because of recent drought, longer fire seasons, limited operating periods for California spotted owl, mitigations for other wildlife, and air quality regulations. Within focus landscapes, there is no limited operating periods for Pacific fisher for prescribed fire but there is a limited operating period for California spotted owls (SPEC-CSO-GDL-03). This limited operating period can be waived on up to 5 percent of the protected activity centers in any year to allow early season prescribed burning. This waiver may not be sufficient in many areas where there is a high concentration of protected activity centers and there would be limitations on the amount of prescribed fire. There is a backlog of areas previously mechanically treated that have not had follow-up prescribed burning or are in need of maintenance prescribed burning. Alternative B emphasizes designing larger landscape prescribed burns where feasible to incorporate these backlogged areas. The fire management strategy emphasizes restoration along ridges and roads to increase capacity to conduct large prescribed burns:

> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed to meet resource objectives.

Restoring prescribed fire in mechanically treated areas is needed to best achieve some of the vegetation desired conditions because mechanical treatments cannot fully mimic the ecological function of fire (TERR-MONT-DC-04), including beneficial effects to fire-adapted plants (see next section on "Terrestrial Ecosystem Processes and Function"). Prescribed fire can reduce and

maintain desired conditions by reducing understory vegetation density (like tree seedlings and saplings), reducing and creating shrub decadence (dead branches), and reducing surface fuels and creating patchy distributions of fuels that would result in improved fire resilience. If the backlog of prescribed burning continues, there would be less positive response of fire-adapted understory plants.

Composition. Restoration treatments would move vegetation toward desired conditions substantially in treated areas (TERR-MONT-DC-03; TERR-POND-DC-01; DMC-DC-01; TERR-MMC-DC-01). Treatments would increase the dominance and codominance of ponderosa and Jeffrey pine, and black oak (where it occurs), especially on dry sites within the two wildfire protection zones. Desired conditions and direction to increase open mature forest patches (TERR-MONT-DC-01; TERR-POND-DC-02, -03; TERR-DMC-DC-03, -04; TERR-MMC-DC-02 to 03) tree density (cover and basal area), and increase heterogeneity (TERR-FW-GDL-01) would favor the shade-intolerant pine and oaks. The health and resilience of large pines and black oaks would be improved by reducing stand density around them, although clumps and groups of large and old trees would be retained. This would increase the likelihood that the current pine and black oak trees survive stresses from drought, air pollutants, and climate change (temperature increases). Restoration of heterogeneity through mechanical thinning, and especially prescribed fire would move the composition, condition, and diversity of native understory plants toward desired conditions. Shrubs, flowering plants, and grasses that are adapted to fire would have more vigorous and dense foliage, increased flowering and fruiting, and increased density in a patchy pattern (Fites-Kaufman et al. 2006, Wayman and North 2007, Webster and Halpern 2010).

There would be less restoration toward desired conditions for composition in areas outside of focus landscapes, and in focus landscapes outside of the two wildfire protection zones. In these areas, canopy cover desired conditions and retention guidelines in California spotted owl and Pacific Fisher habitat would result in limited changes in overstory canopy cover. This is especially true in the areas that overlap with old railroad logging sites where most trees, including the younger trees are now greater than 30 inches in diameter.

Structure. In alternative B, it is expected that over the life of the plans between 15 and 25 percent of the montane landscape would move toward desired conditions, particularly in the focus landscapes. Tree density would be lower and heterogeneity considerably higher in treated patches and across large areas of the landscape. Landscape forest structure would be most changed in the treated portions of focus landscapes and other areas with large prescribed fires. This would move some of the landscape toward desired conditions, including heterogeneity at the landscape, patch, and within-patch scales. The greatest changes toward desired conditions would occur within the focus landscapes, except areas outside of the fire protection zones that overlap with younger, even-aged stands or larger trees originating from railroad logging. This might include one-half of the potential focus landscape areas on the Sierra National Forest.

Ecological Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In montane forests, alternative B would promote the resilience to fire, climate change, drought, air pollutants, insects, and pathogens in treated patches, (TERR-FW-DC-02; TERR-MONT-DC-01, -05) especially in the focus landscapes where restrictions on the amount and intensity of restoration in California spotted owl and Pacific fisher habitat are reduced. The elevated restoration treatment rates would build greater adaptive capacity in montane landscapes. Decreased tree density and increased heterogeneity at the landscape and site scales would improve resilience to the multiple stressors (North 2012). Restoration of more vegetation species resilient to drought, climate and fire (especially ponderosa pine, Jeffrey pine, and black oak)

would improve overall forest resilience. Increased fire resilience will be most effective in the focus landscapes and in the Kern Drainage where managed fires have been prevalent (Meyer 2015) because a sufficient proportion of the landscape would be restored to result in changed fire intensity at the landscape scale (the scale of fires; see the "Fire Trends" section).

Figure 34 shows potential changes in ecological fire resilience based on restoration of representative focus landscapes and treatments in the community wildfire protection zones. This example shows changes from mechanical thinning only and does not incorporate additional large prescribed fires or wildfires managed to meet resource objectives that could occur, especially at higher elevations. Ecological fire resilience is the same as defined in the forest assessments. In general, it is based upon the proportion of crown fire that would occur in a landscape area under 97th percentile weather conditions. High resilience is defined as less than 25 percent of the area would burn as crown fire; moderate resilience is defined as 25 to 50 percent; low resilience as 50 to 75 percent; and very low resilience as greater than 75 percent crown fire.

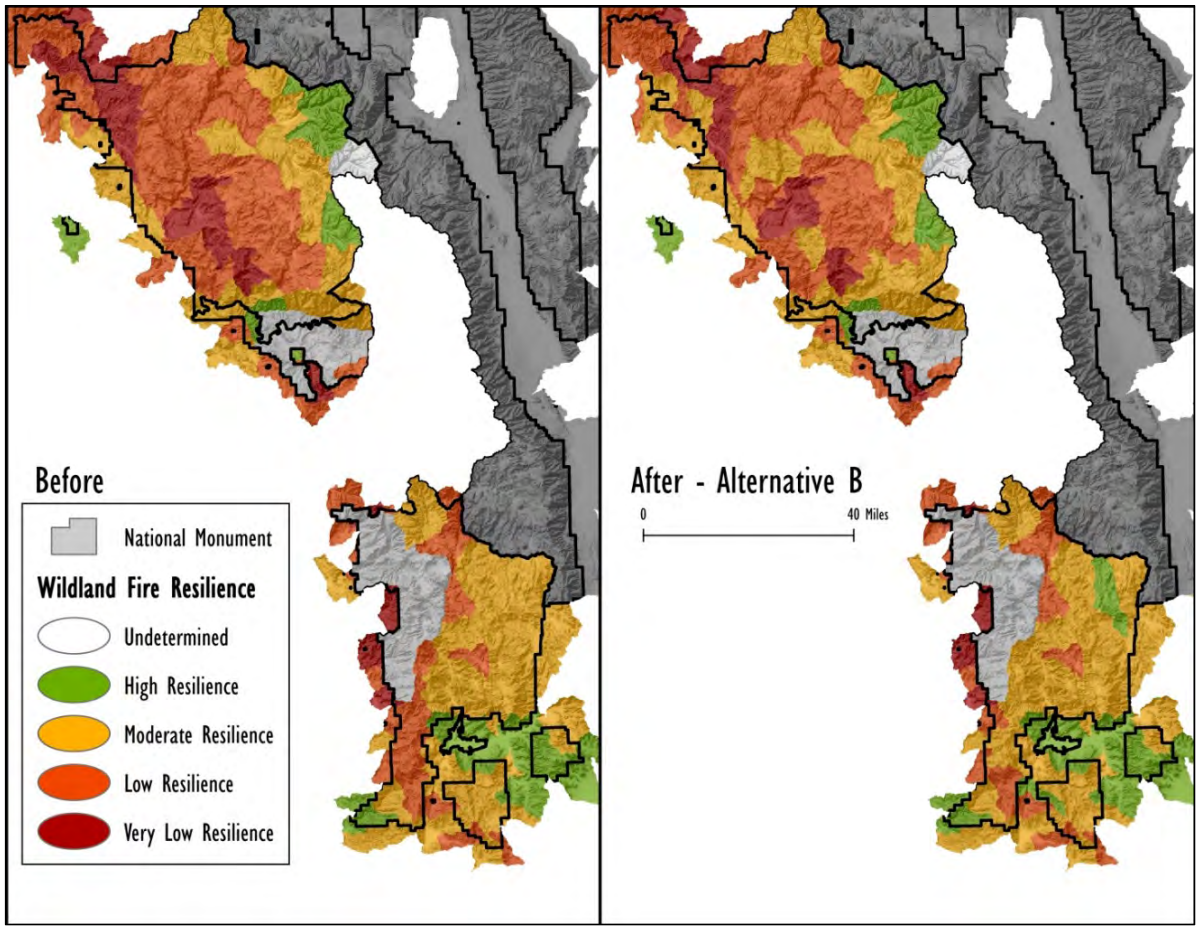

Figure 34. Illustration of potential changes in ecological fire resilience under alternative B
Note: This does not include improvements in resilience from wildfire managed for resource objectives. There would be further improvements from these managed fires, primarily in the Kern Drainage.

In Figure 34, representative focus landscapes show how treatments might result in an improvement from low or very low resilience to moderate fire resilience. This means that in the 15 to 25 percent of the montane zone restored in focus landscapes, overall fire intensity would

change to lower amounts of crown fire during the hot and dry parts of a typical fire season. Crown fire would decrease from covering more than 50 to 75 percent of the area to between 25 and 50 percent of the area, more a mixed fire regime. This is a substantial movement toward desired conditions.

There is uncertainty in how much resilience would change in the portions of the focus landscape that are outside of the two wildfire protection zones and overlap with even-aged, young stands or large trees that originated from railroad logging. In these stands, the diameter limit for large trees may result in a limited ability to reduce tree density and restore heterogeneity.

Upper Montane Forests

There would be an increased amount of some kinds of restoration in upper montane forests in alternative B compared to alternative A. Restoration using mechanical treatment would be similar to alternative A and limited, except around communities at high fire risk (MA-CWPZ-DC-01 to 02). There may be other areas that are restored outside of the focus landscapes and community buffers that are in priority areas for the forest where treatments occur in the upper montane zone, such as near developed recreation sites (Sequoia: REC-FW-OBJ-01). Most of the increase in restoration would be from wildfire managed to meet resource objectives (Sequoia: TERR-FW-OBJ-03 and FIRE-FW-GOAL-06). Much of the upper montane landscape is in the wildfire maintenance zone, where there is the greatest opportunity for wildfire managed to meet resource objectives (MA-WMZ-GOAL-01; MA-WMZ-DC-01 to 02; MA-WMZ-STD-01 to 02). There would be improvements in the effects to composition, structure, and resilience from alternative B because of the greater emphasis on detailed, ecologically based desired conditions (see Table 49 at beginning of alternative B consequences section above). Similar treatments and management direction (including focus landscapes) would occur in the lower elevation upper montane forests as in the montane forests (see above). This is where red fir and Jeffrey pine are codominant with white fir.

Composition. Alternative B would result in limited changes in tree composition in red fir and lodgepole pine forests because these forests tend to be single species dominated and are not highly departed from desired conditions (Meyer 2013a). Restoration would promote or sustain the dominance of Jeffrey pine forests through ecological restoration treatments toward desired conditions. Most of the treatments would be focused at lower elevations and not in Jeffrey pine forests, but some would occur. In these areas, younger white fir and red fir would be reduced through restoration treatments. This is particularly true in the Kern River drainage where large areas have already been restored with fire managed to meet resource objectives and more is expected to occur in these remote areas. In areas with restoration treatments there would be some enhancement of the cover and composition of native understory vegetation.

Structure. Alternative B would improve structural conditions in upper montane forest patches through ecological restoration treatments (especially the restoration of fire) that are based on principles described in North et al. (2009) and North (2012). Alternative B would also promote greater structural heterogeneity at a landscape scale through the broader application of wildfire managed to meet resource objectives in some upper montane landscapes, especially in the wildfire maintenance zone.

Ecological Resilience to Drought, Climate Change, Insects, and Pathogens, and Fire. In upper montane forests, alternative B would promote resilience because restoration would decrease forest density and increase heterogeneity. In restored areas, this would increase resilience to drought, and build greater adaptive capacity to climate change. There may be

increased fire resilience where large landscape areas are restored. This would depend upon the amount of wildfire restored to meet resource objectives because most of the restoration in upper montane vegetation would occur in these fires.

Subalpine and Alpine Vegetation

There would be slight increases in the amount of restoration in subalpine and alpine vegetation. This would be from increased opportunities for wildfire managed to meet resource objectives and potentially from restoration of whitebark pine to reduce damage from white pine blister rust (TERR-ALPN-DC-03; Sequoia: TERR-FW-GOAL-01). In general, most subalpine and alpine vegetation occurs within wilderness areas where natural processes are the primary emphasis of maintenance and restoration (Sequoia: MA-OC1-DC-02; MA-WILD-DC-02 to 03). Little restoration would occur and where it does, it would primarily be limited to small areas in need of rehabilitation from concentrated recreation impacts or invasive species (MA-WILD-GDL-01 to 02).

Composition and Structure. Alternative B would improve composition in subalpine and alpine areas through targeted restoration in highly impacted areas (Sequoia: MA-OC1-DC-02 and MA-OC2-DC-02) and wildfire managed to meet resource objectives. There might be some limited restoration treatments involving control or eradication of non-native invasive species (like cheatgrass) that would benefit native vegetation, but most of this would occur in foothill or montane areas where they are more impacted. Although fire is naturally infrequent in subalpine and alpine areas, it is an important natural process. More opportunities to manage wildfire to meet resource objectives would restore the effects of this natural process on subalpine and alpine composition and structure.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In most subalpine forests, alternatives B would promote increased resilience to fire, climate change, drought, insects, and diseases because of higher restoration treatment rates (specifically the restoration of fire). Wildfire would increase resilience primarily through the reduction of stand densities, increased heterogeneity, and promotion of seral class diversity and tree regeneration. In addition, whitebark pine forests located in recreation areas (like ski areas) would be more ecologically resilient under alternative B. Alternative B would likely have greater treatment rates in recreation areas based on a regional whitebark pine restoration strategy. Despite differences among alternatives, many whitebark pine and other subalpine forests would be heavily impacted by insects and diseases associated with increased moisture stress and warming climate conditions under all alternatives (Meyer 2013b, Schwartz et al. 2013).

Sagebrush (Eastside)

There would be substantially more restoration of sagebrush in alternative B compared to alternative A especially on the Inyo National Forest (TERR-FW-OBJ-01 to 02). This would be to maintain and restore habitat for the greater sage-grouse (SPEC-SG-OBJ-01), reduce fire risk to communities and developed recreation sites, and restore resilience to forests, woodlands and riparian areas (MA-RCA-OBJ-01; FIRE-FW-GOAL-01,-03 to 04). Most of the restoration would be to treat areas with conifer invasion (SPEC-SG-DC-05). There would be more mechanical restoration, primarily thinning or removal of juniper that has invaded historic sagebrush areas. There would be some increases in prescribed fire (TERR-FW-OBJ-02), but it would be limited to smaller areas and carefully applied to avoid invasion and expansion of non-native annual grasses (like cheatgrass and red brome). There would be restoration of some areas to reduce and eradicate non-native annual grasses (SPEC-SG-DC-06; INV-FW-OBJ-01) and measures to minimize the

spread of noxious weeds (SPEC-SG-GDL-04) and non-native invasive plants (INV-FW-GDL-01 to 05). Vegetation treatments and post-soil or other disturbance activities in sage-grouse habitat would be followed by seeding or replanting of sage brush where appropriate (SPEC-SG-GDL-05 to 06). The restoration would occur around communities, in greater sage-grouse habitat that is in poor condition, and in areas of tribal importance (TERR-FW-OBJ-03).

In sagebrush, pinyon-juniper and Jeffrey pine areas, management approaches would be applied that minimize the invasion and spread of non-native plant species and restore vegetation composition, structure, and resilience. These include:

> Projects in sagebrush should prioritize restoration treatment to remove trees from shrublands, which include recent expansion areas of pinyon and juniper into sagebrush ecosystems and other adjacent shrublands.
>
> Prevention of unwanted fire in priority habitat can be accomplished through managing sagebrush systems to be resilient, implementing proactive fire prevention and limiting cheatgrass expansion.
>
> An adaptive management strategy shall be used when conducting vegetation treatments within sage-grouse habitat. Treatment methods and intensities will be determined based on the results of past treatments as information from those past treatments becomes available. If the results of past treatments show that those treatments have caused an increase in non-native annual grasses and poor sagebrush recruitment, further treatments within sage-grouse habitat will not adhere to the same prescription.
>
> Where sage-grouse habitat is being degraded due to wild horse and burro use, determine site-specific measures to improve or restore sage-grouse habitat.
>
> Work with tribes to determine priority areas for weed prevention and control, especially focused on traditional gathering areas that are threatened by weed infestations. Consult with tribes before using pesticides or herbicides that may affect traditional gathering.
>
> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, non-native species.
>
> Integrate terrestrial ecosystem desired conditions into spatial patterns for fuel reduction treatments. Incorporate heterogeneity by increasing variation in tree spacing, enhancing tree clumps, creating canopy gaps, promoting fire resilient tree species, increasing the ratio of large to small trees, and using topographic variation (e.g. slope, aspect, and position) to guide treatment prescriptions.
>
> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.

Composition. Alternative B, would promote or sustain the dominance of sagebrush and perennial herbaceous plants in these arid landscapes through ecological restoration treatments. There are specific desired conditions and direction for implementing treatments that would reduce conifer encroachment into sagebrush areas and restore native perennial grasses. Management direction for sage-grouse habitat restoration emphasizes maintenance and enhancement of native plant communities and movement toward vegetation desired conditions (SPEC-SG-DC-05 to 06; SPEC-SG-STD-01, -03, -09). Composition would move toward desired conditions in these areas. However, control and eradication efforts are unlikely to keep up with the proposed increase in treatment rates. Increases in invasive plants are one of the negative effects that the management

direction tries to minimize, knowing that the benefits of restoration treatment outweigh this negative effect. Restoration treatment does not eliminate the effect. Where prescribed fire is applied, there would be primarily positive changes in species composition. This is because fire would be applied in areas with little to no existing cheatgrass, and projects would be designed to benefit native perennial grasses and other native species. Fire would be applied in a mosaic pattern that would be beneficial to fire-tolerant species and have limited impacts on fire-intolerant species (Brooks and Minnich 2006).

Structure. Alternative B would improve structure in sagebrush vegetation. Removal of juniper, pinyon pine or Jeffrey pine from sagebrush areas would be the primary means (SPEC-SG-DC-05). Where prescribed fire is restored in sagebrush areas there would be an improvement in structural and age diversity toward the desired conditions.

Ecological Resilience to Fire, Drought, Climate Change, Insects, and Pathogens. Alternative B would improve resilience to fire, and climate change in sagebrush, because the elevated restoration treatment rates under these alternatives build greater adaptive capacity in arid ecosystems than alternative A. Reduced numbers of pinyon and juniper trees, reduced or minimized non-native annual grass introduction and spread, promotion of native perennial grasses, and increased age and structural diversity of sagebrush would improve resilience to climate and reduce the likelihood of large, high-intensity fires, high-severity fire effects, and poor recovery from fire.

Pinyon-Juniper Forests

Alternative B would have increased vegetation restoration over current levels (TERR-FW-OBJ-01 to 02). There would be more mechanical restoration, primarily thinning or removal of juniper that has invaded historic sagebrush areas. There would also be some restoration of pinyon-juniper to meet desired conditions in areas of tribal importance and in community buffers (TERR-FW-DC-09; TRIB-FW-DC-03 to 05; TERR-FW-OBJ-03). There would be restoration of some areas to reduce and eradicate non-native annual grasses.

Composition. Alternative B restoration would include actions to control or eradicate invasive plant species in arid landscapes, as described above for sagebrush areas. This would move composition more toward desired conditions. However, as described in the “Sagebrush” section, control and eradication efforts are unlikely to keep up with the proposed increase in treatment rates. There would also be additional restoration in areas of tribal interest that would benefit understory composition, in part through restoring fire with prescribed fire. This would be a result of the relatively greater restoration treatment rates under this alternative compared to alternative A. Where prescribed fire is applied, it would be aimed at primarily positive changes in species composition. This is because fire would be applied in areas with little to no existing cheatgrass and fire prescriptions would be designed to benefit native perennial grasses and other native species. Fire would be applied in a mosaic pattern that would be beneficial to fire-tolerant species and have limited impacts on fire-intolerant species (Brooks and Minnich 2006).

Structure. Alternative B would improve structure in restoration areas. Removal of juniper from sagebrush areas would be the primary means. In other areas, trees would be thinned and heterogeneity increased. There might be some pruning of lower branches where prescribed fire or hand treatments are applied. In restoration areas, vegetation would move toward desired conditions.

Ecological Resilience to Fire, Drought, Climate Change, Insects, and Pathogens. Alternative B would improve resilience to fire, drought, insects, and pathogens to some degree, because of the elevated restoration treatment rates. Restoration would build greater adaptive capacity to climate change than alternative A. Thinning and control and minimization of non-native invasive grasses would be the primary changes that would increase resilience. There would continue to be elevated levels of insect-related tree mortality in large areas because trees would remain at higher densities in untreated areas. This would especially be the situation on lower elevation sites and more productive sites that have high tree density due to the fire suppression effect.

Eastside Pine, Jeffrey Pine Forests

There would be a substantial increase in restoration treatments in alternative B compared to A. More areas of Jeffrey pine forests would move toward desired conditions. A large portion of the planned mechanical treatment and prescribed fire restoration would occur in Jeffrey pine forests (TERR-FW-OBJ-01 to 02) on the Inyo National Forest, and wildfire managed for resource objectives on the Kern Plateau on the Sequoia National Forest (Sequoia: TERR-FW-OBJ-03). Restoration would emphasize reducing density, increasing heterogeneity, increasing the proportion of large trees (TERR-FW-GDL-01 to 02), and retaining large trees (greater than 30 inches diameter; TERR-FW-STD-01; TERR-OLD-GDL-02). The same management direction to minimize the establishment and spread of non-native plants described for sagebrush and pinyon-juniper types above, applies to Jeffrey pine areas.

Composition. Composition would move toward desired conditions in areas treated for restoration. Restoration would improve composition by thinning that will increase light to the forest floor, reducing litter, and improving conditions for fire-adapted species. Increased overstory heterogeneity would create more small openings that would improve habitat for some understory plants that may have been suppressed where overstory trees currently are more uniformly spaced and denser than historically.

Structure. In large areas of Jeffrey pine forests, structure would improve because there would be an increase in heterogeneity, reduced overall forest density, and a shift in size and age structure toward larger and older trees. With decreased density, and especially where prescribed fire is used, there would be an increase in seedlings and saplings in healthy condition because they benefit from sunlight and access to mineral soil. In addition to changes in forest structure, reductions in surface and ladder fuels would reduce the impacts from a return to more frequent fire.

Ecological Resilience to Fire, Drought, Climate Change, Insects, and Pathogens. There would be an increase in ecological resilience in areas treated. Decreased forest density, increased heterogeneity, and decreased surface fuels (where there is prescribed fire) would contribute movement toward desired conditions for resilience. Fire resilience would be increased the most when landscape areas are treated, with at least 40 percent of the area restored (see “Fire Trends” section). Many areas of Jeffrey pine are already in this landscape condition on the Kern Plateau (Fites-Kaufman et al. 2003; Vaillant 2009; Meyer 2015) and this would continue to increase.

Eastside Upper Montane Forests

Many of the consequences for upper montane forests in the eastside are similar to those described for the westside. The primary difference is that there would be more treatments in the red fir and lodgepole pine forests on the Inyo National Forest in community buffers and areas around major developed recreation sites (REC-FW-OBJ-01), such as in the upper montane forests in the

Mammoth and June Lakes areas. The restoration in these areas would move composition, structure and resilience toward vegetation and old forest desired conditions overall or would minimize adverse effects, such as at developed recreation sites (REC-FW-GDL-02 to 03). There may be some areas that are restored more toward the lower end of the desired conditions for basal area, tree density, and snag and log density in these areas compared to the majority of eastside upper montane forests. Management approaches would integrate terrestrial ecosystem desired conditions into fuel reduction treatments:

> Integrate terrestrial ecosystem desired conditions into spatial patterns for fuel reduction treatments. Incorporate heterogeneity by increasing variation in tree spacing, enhancing tree clumps, creating canopy gaps, promoting fire resilient tree species, increasing the ratio of large to small trees, and using topographic variation (e.g. slope, aspect, and position) to guide treatment prescriptions.

Cumulative Effects of Alternative B

There would continue to be effects of warming and drier climate into the foreseeable future. In some areas, where there is less restoration, the effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration (see “Climate” subsection). Areas where there are substantial treatments that would result in improved climate resilience and adaptation are the westside montane and foothill areas in focus landscapes, the Kern River drainage, and restored eastside Jeffrey pine, sagebrush and pinyon-juniper.

There would continue to be restoration on adjacent Federal, State and local agency lands (like Los Angeles Department of Water and Power) that are similar to those on National Forest System lands. Restoration on these other lands would also be limited. There would continue to be urbanized developed adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human-ignited fires and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see “Fire Trends” section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions outside of areas with concentrated restoration. This represents between 15 to 25 percent of the low and mid-elevation areas. Higher elevation areas would mostly remain moderately similar to desired conditions. Vegetation in the Kern River drainage would potentially increase to high similarity to desired conditions with increased fire because the landscape is moderately resilient to fire and more fire would increase overall resilience.

Consequences Specific to Alternative C

There is a goal of increased prescribed fire and wildfire managed to meet resource objectives in alternative C. There is a moderate to high uncertainty that increased prescribed and wildfire managed to meet resource objectives would occur in alternative C. One reason is that there would be less mechanical treatment and less opportunity to restore vegetation along ridges and roads that would be used to “anchor” prescribed fire and wildfire managed to meet resource objectives. This is especially a limitation at lower and mid-elevations in the foothills, montane, Jeffrey pine, pinyon-juniper and sagebrush areas where there are fewer natural features (like rock outcrops) that could be used to burn from or contain fires. Another uncertainty comes from less intense reduction of vegetation density, particularly in ponderosa pine and mixed conifer forests. This makes prescribing or managing wildfires more difficult because fuel conditions are greater and the risks of managing fires safely and within adequate management control become higher.

Westside Foothills Vegetation

There would be a slight increase in composition, structure and ecological resilience in foothill vegetation in alternative C. The rate of restoration would be limited, similarly to alternative A but otherwise, most of the management direction for blue oak woodlands and chaparral would be the same as in alternatives B and D. There would be specific management direction to increase and enhance collaboration with tribes on ecological restoration. This would move vegetation toward desired conditions.

Westside Montane Forests

Alternative C would provide some restoration in montane forests but less than in alternatives B and D, at a level similar to alternative A, assuming the rate of prescribed burning compensates for the reduction in mechanical thinning. Most of the mechanical thinning would occur in the wildland-urban intermix defense zone which is managed similar to alternative A, but with additional direction to retain habitat for Pacific fisher and additional restrictions on treatment in designated habitats for the California spotted owl. There would be some restoration along ridges and roads but it would be of lower intensity because of limitations on treatment in California spotted owl and Pacific fisher habitat. There would be little reduction in forest density and little to moderate increases in heterogeneity in areas treated mechanically. This is because of management direction for protection of fisher and owl habitat that limits canopy reductions at the landscape scale and limits the size of trees removed. The entire montane zone is occupied by Pacific fisher and California spotted owl. There is an increased emphasis on prescribed fire but there is a moderate to high uncertainty that much prescribed fire or wildfire managed to meet resource objectives would occur due to most areas continuing to have high fuel levels and conditions that favor high-intensity fire. There is additional direction for management of fisher habitat during wildfires that may increase the beneficial effects of fire during wildfires. But there is a higher likelihood of very large, high-intensity fires in alternative C, according to the fire-climate scenario predictions (see “Fire Trends” section).

Composition. The effects of alternative C on composition would be similar to alternative A. Most areas would continue to have a high dissimilarity with desired conditions. There is a potential for more prescribed fire that would improve the condition of understory plants that benefit from fire, but there is a high to moderate uncertainty that this would occur. There would continue to be large areas with higher canopy cover at levels outside the natural range of variation and would result in large areas where shade-intolerant pines and hardwoods are in poor condition. There would be less restoration of overstory composition toward desired conditions. Less mechanical restoration and limitations on restoration in California spotted owl and Pacific fisher habitat would result in less reduction in tree density that shades out a large portion of the understory plants. Where prescribed fire is used in place of mechanical thinning, it could result in less reduction of high density of understory seedlings and saplings, especially of shade- and fire-intolerant species such as incense cedar and white fir because the fires may have to be designed to burn with lower intensity to balance damaging larger trees that are desired to be protected. By burning at lower intensity, it may require several re-burn entries over time to achieve the same desired change in composition as achieved in alternatives B and D.

Structure. The effects of alternative C on structure would be similar to alternative A because of the restrictions on canopy cover reductions in Pacific fisher and California spotted owl habitat. There would continue to be large areas that are highly dissimilar to desired conditions. There is the potential for restoration of forest structure toward desired conditions with fire but there is a

high uncertainty that prescribed fire and wildfires managed to meet resource objectives would occur to a great extent.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. The effects of alternative C on ecological resilience would be similar to alternative A. Resilience would continue to be very low to low across most of the landscape because vegetation density would remain high and heterogeneity low. Denser vegetation is more susceptible to any additional stress because plants compete more for water, nutrients and light. Wildfire could potentially restore resilience but there is a moderate to high uncertainty that it would occur.

Upper Montane Forests

Alternatives C provides moderate support to maintain or restore upper montane vegetation toward desired conditions. Mechanical treatments are limited in most areas but large areas of upper montane Jeffrey pine, red fir, and chaparral in the Kern River drainage would continue to be maintained and restored toward desired conditions with wildfire managed to meet resource objectives as described in alternative B above.

Composition. Similar to alternative A, there would be limited restoration in upper montane vegetation in alternative C using mechanical treatment. Alternative C would provide less benefit to native understory plant cover and composition and result in decreased potential to remove or control invasive plants due to the limited treatment rates under this alternative compared to alternatives D and B.

Structure. Alternatives C provides moderate support for the restoration of structural conditions due to the limited treatment rates with both mechanical thinning and prescribed fire.

Ecological Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. Alternative C results in relatively lower climate change resilience compared to alternatives B and D due to the lower treatment rates under this alternative. In the short term there may be similar levels of wildfire to meet resource objectives in upper montane vegetation in alternative C compared to the other alternatives. This would provide increased resilience to fire, drought, climate change and possibly insects and pathogens because fire would increase heterogeneity and decrease density and surface and ladder fuels in some areas. There is a moderate level of uncertainty about how much wildfire managed to meet resource objectives would occur over the long term because of less ecological restoration of ridges and roads that could be used to “anchor” fire actions when decisions are made on how to best manage a wildfire.

Subalpine and Alpine Vegetation

Alternative C would have similar effects in subalpine and alpine vegetation as Alternative B because management direction in higher elevation and wilderness areas are similar. Although there is more wilderness in alternative C, the additional wilderness is primarily in lower elevations and not in subalpine and alpine vegetation.

Eastside Vegetation

Overall, there is substantially less vegetation restoration in alternative C in the eastside. The consequences of the reduced restoration is that most areas would remain at the same level of dissimilarity to desired conditions as they are now, or decline because of continued effects of fire, spread of non-native invasive plants, recreation use, and warming climate. Invasive plant treatments would be conducted similarly to other alternatives.

Sagebrush

Areas with restoration treatments would move toward desired conditions for composition, structure, and resilience similar to alternative B. Most of the restoration would involve removal of invading conifers from sagebrush that provides habitat for the greater sage-grouse. Many untreated areas would continue to have a low similarity to desired conditions. There is slightly less restoration treatments than in alternatives B and D due to some stewardship opportunity from mechanical thinning in montane vegetation but more than alternative A.

Pinyon-Juniper and Arid Shrublands

Similar to sagebrush, there would be an increase in restoration of pinyon-juniper areas in alternative C compared to alternative A. There would be movement toward desired conditions of composition, structure, and resilience similar to alternative B in the restored areas. Similar to sagebrush, the amount of restored area would be slightly lower than in alternatives B and D. The result is that overall, there would continue to be large areas that have a low to moderate dissimilarity with desired conditions.

There would be very limited restoration of xeric shrub/blackbrush and mountain mahogany, associated primarily with treatment in community buffers. The net effect would be that there would be a limited and negligible movement toward desired conditions of composition, structure, and resilience in these vegetation types.

Eastside Jeffrey Pine Forests

There would be some restoration in Jeffrey pine in alternative C, but at a lower intensity than in alternatives B and D. There would be less reduction in density and less restoration of heterogeneity because of the emphasis on thinning small trees and not multiple diameters (small to medium). There would be similar levels of restoration to alternative A and substantially less restoration than in alternatives B and D. Although there is the potential for more restoration using wildfire to meet resource objectives, there is a high uncertainty that this would occur because of the limited amount of mechanical treatment and proximity of most eastside Jeffrey pine areas to communities and developed recreation areas. Mechanical treatments make it more likely that ladder and fuel conditions allow controlled and safe fire management. The result is that there would be limited movement toward desired conditions at the landscape scale for composition, structure, and resilience.

Eastside Upper Montane Forests

There would be limited treatment in eastside upper montane areas in alternative C. Much of this vegetation occurs around communities and developed recreation areas (like Mammoth Lakes). There would be fewer areas treated near communities and recreation sites on the Inyo National Forest in alternative C than alternatives B and D. The consequences of the treatments would be similar to those described for alternative B. Overall, composition would remain moderately similar to desired conditions. Composition is expected to continue to be dominated by red fir, Jeffrey pine, and lodgepole pine. There would be a slight increase in the similarity to desired conditions for non-native invasive plants because of additional direction to eradicate and control these plants during all types of restoration. There would be a slight movement toward desired conditions for structure, because there would be more of an emphasis on thinning small diameter trees, and not a range of diameters (except large trees) that would reduce density and increase heterogeneity. Resilience would show a slight increase.

Eastside Subalpine and Alpine Vegetation

Consequences of alternative C on subalpine and alpine vegetation would be similar to alternative B.

Cumulative Effects of Alternative C

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration in alternative C (see "Climate" subsection). Like other alternatives, there would continue to be restoration on adjacent Federal, State and local agency lands that are similar to those on national forest lands. Restoration on these other lands would also be limited. There would continue to be urbanized developed adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human fire ignitions and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see "Fire Trends" section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions.

Consequences Specific to Alternative D

The greatest amount of restoration would occur in alternative D (chapter 2, Table 6 through Table 8). It could be double what is in alternative B, which is potentially double the amount in alternative A. The increased restoration would include mechanical treatment, prescribed fire, and wildfire managed to meet resource objectives. On the Inyo National Forest, the combined area of restoration increases from an estimated 48,000 acres in alternative A, to between 90,000 and 100,000 acres in alternative B, to 140,000 acres in alternative D. On the Sequoia National Forest the combined area of restoration is 48,000 acres in alternative A, 97,000 to 113,000 acres in alternative B, and 175,000 to 190,000 acres in alternative D. On the Sierra National Forest the combined area of restoration increases from 55,000 acres in alternative A, to 225,000 to 290,000 acres in alternative B, to up to 447,000 acres in alternative D. Some of these may include areas that are overlapping treatments, meaning some of the areas may be treated with both mechanical treatment and prescribed fire or mechanical treatment and managed fire.

Most of the increased restoration would occur in the montane ponderosa pine and mixed conifer forests on the westside and in the Jeffrey pine and pinyon-juniper and sagebrush types on the eastside. Overall, alternative D emphasizes more rapidly restoring vegetation resilience recognizing there may be short-term consequences. There are fewer wildlife-related restrictions on vegetation restoration in alternative D, especially more flexibility in limited operating periods and an increase in the amount of habitat that can be restored in the short term to achieve greater long-term benefits.

The greater flexibility in limited operating periods in westside montane and upper montane forests comes from an earlier end date to California spotted owl limited operating periods, a smaller avoidance area for California spotted owls, and a doubling of the area in focus landscapes where the Pacific fisher limited operating periods are waived (SPEC-PF-GDL-04). In the focus landscapes, there are fewer limitations on restoration in California spotted owl habitat. More protected activity centers can be treated (SPEC-CSO-GDL-07) and more protected activity centers can be restored using mechanical treatments because they are allowed in focus landscapes and the area in focus landscapes would double (SPEC-CSO-STD-01). The amount of fisher target habitat cells that can be restored remains at 50 percent (SPEC-PF-STD-02) but with double the focus landscapes, this level would more likely be reached. Areas in focus landscapes would be

more likely to move vegetation toward desired conditions to a large degree. The total amount of focus landscape could reach 40 percent or more of the entire montane landscape area. This reaches a level of restoration across the landscape that achieves widespread landscape resilience, not just resilience in the restored locations.

Restoration in alternative D would include the same management direction as alternative B described above to limit the introduction and spread of non-native invasive plants. Any associated improvements to native plant composition may be offset to an unknown degree by non-native invasive plant expansions in restoration areas, despite best management practices since climate change can favor the growth and spread of invasive species.

On the west side, the restoration would primarily occur in three different locations. First, treatments would be prioritized in community buffers and along ridges and roads in the community and general fire protection zones. Second, the treatments would be prioritized in the focus landscapes. The number of focus landscapes would be double that in alternative B. Third, there would be other areas restored for resilience to fire, drought, climate change, insects, and pathogens in the ponderosa pine, mixed conifer and some of the upper montane forests.

On the east side, the restoration would be similar to alternative B in location but the area restored would increase substantially. This includes areas around communities and developed recreation sites, sagebrush areas with encroaching conifers, Jeffrey pine departed from the desired conditions, dense pinyon-juniper woodlands, and some other areas with non-native plant invasions.

Westside Foothills Vegetation

There are similar trends toward desired conditions for vegetation in the foothills in alternative D as in alternative B but there is a substantially greater area that would benefit.

Composition. There would be an increase in the area that is similar to desired conditions in alternative D due to an emphasis on restoration in the two wildfire protection zones, where most of the foothill vegetation occurs, and work with tribes on cultural, ecological restoration. These improvements may be offset to an unknown degree by non-native invasive plant expansions in restoration areas, despite best management practices since climate change can favor the growth and spread of invasive species.

Structure. There would be a moderate improvement in vegetation structure in the foothill zone due to ecological restoration. There may be changes in chaparral that move toward the lower end of the natural range of variation, by treating more late seral patches and move them to early seral patches because of the emphasis on community and infrastructure fire protection.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would a moderate increase in ecological resilience overall and a moderate increase at sites where restoration occurs. Increased mechanical restoration and more flexible management of wildlife habitat, including more flexible limited operating periods would provide more opportunities for large prescribed fires. Much of the foothill landscape includes steep, inaccessible areas that are not forested, where large prescribed burns are the primary restoration option. This type of restoration would move chaparral/live oak vegetation toward more of a fine-scale mosaic of different age and size structure. This would increase resilience to fire and reduce the likelihood of development of large high-intensity fires that create uniformly young chaparral over large areas and threaten communities and adjacent forests. Restoration of blue oak

woodlands is very difficult, particularly restoration of the native understory plant community that is more resilient.

Westside Montane Forests

Alternatives D would have the greatest amount of vegetation restoration in the montane zone. Between 40 to 60 percent of the montane landscape in many places is expected to be restored over the life of the plan. Alternative D would have the greatest amount of restoration with much of the restoration within focus landscapes. Restoration in these areas would move at least 40 percent of these landscapes toward desired conditions that are based largely on the natural range of variation. Restoration would include both dry and moist mixed conifer, and nearby riparian areas where needed. There would be restoration of California spotted owl protected activity centers that occur primarily on dry sites. The concentration of restoration in landscape areas would result in a higher likelihood that these areas would burn at lower intensities during wildfires and retain mature forest. Within the focus landscapes, projects would be larger and more effectively thin vegetation and restore more fire to the landscape to move toward desired conditions. Mechanical thinning would remove some larger trees and more mid-sized and small trees which would increase the economy of scale and enable more area in the landscape to be treated, especially with a variety of stewardship opportunities.

The amount of prescribed fire and wildfire managed to meet resource objectives would be greatest in alternative D. The amount would be up to double that in alternative A. The increase would be due to the greater amount of mechanical restoration and emphasis on increasing the use of fire as a restoration tool and to restore it as an ecosystem process to these frequent fire adapted and fire deficit ecosystems. The mechanical restoration would focus first on strategically placed areas on ridges and along major roads, in addition to patches in the focus landscapes. The purpose of these strategic areas is to improve the ability to safely and effectively conduct large prescribed fires, suppress fires, and to manage wildfires in a manner that results in lower intensity and a mosaic of severity that enhances protection of communities and restores ecosystems. There would also be more prescribed fire in and between areas restored mechanically. Larger prescribed fires would be more feasible because vegetation would be less dense, making desired fire effects and fire control more achievable. There would be a lower likelihood of sustained crown fire. There is a moderate level of uncertainty that the planned amount of prescribed fire would not occur because of air quality constraints.

Composition. Restoration treatments would substantially increase the dominance and codominance of ponderosa and Jeffrey pine, and black oak (where it occurs), especially on dry sites. Desired conditions and direction to achieve them include decreased tree density (cover and basal area) and increased heterogeneity. These will favor the shade-intolerant pine and oaks. The health and resilience of large pines and black oaks will be improved by reducing stand density around them, although clumps and groups of large and old trees would be retained. This would increase the likelihood that the current pine and black oak trees survive stresses from drought, air pollutants, and temperature increases related to climate change.

Restoration of heterogeneity through mechanical thinning, and especially prescribed fire and fire managed to meet resource objectives would improve the composition, condition and diversity of native understory plants. Shrubs, flowering plants, and grasses that are adapted to fire would have more vigorous and dense foliage, increased flowering and fruiting, and increased density in a patchy pattern.

Structure. In alternative D, it is expected that between 40 and 60 percent of the montane landscape would move toward desired conditions. Tree density would be lower and heterogeneity considerably higher across large areas of the landscape. The landscapes would be most changed in the protection zones, but also in the restoration zones accessible by road and equipment and feasible for large landscape prescribed fire. This would move substantial portions of the landscape toward desired conditions.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In montane forests, alternative D promotes the greatest resilience to climate change, drought, air pollutants, insects, and pathogens because the elevated restoration treatment rates under this alternative builds greater adaptive capacity in montane landscapes than other alternatives. Decreased tree density and increased heterogeneity at the landscape and site scales would improve resilience to these multiple stressors. Higher levels of prescribed fire associated with increased mechanical treatments and large prescribed fires in other areas would decrease surface fuels and increase resilience to large, high-intensity fire more than other alternatives.

Figure 35 shows potential changes in ecological fire resilience based on restoration of representative focus landscapes and treatments in the community wildfire protection zones. This does not incorporate additional large prescribed fires or wildfires managed to meet resource objectives that could occur, especially at higher elevations.

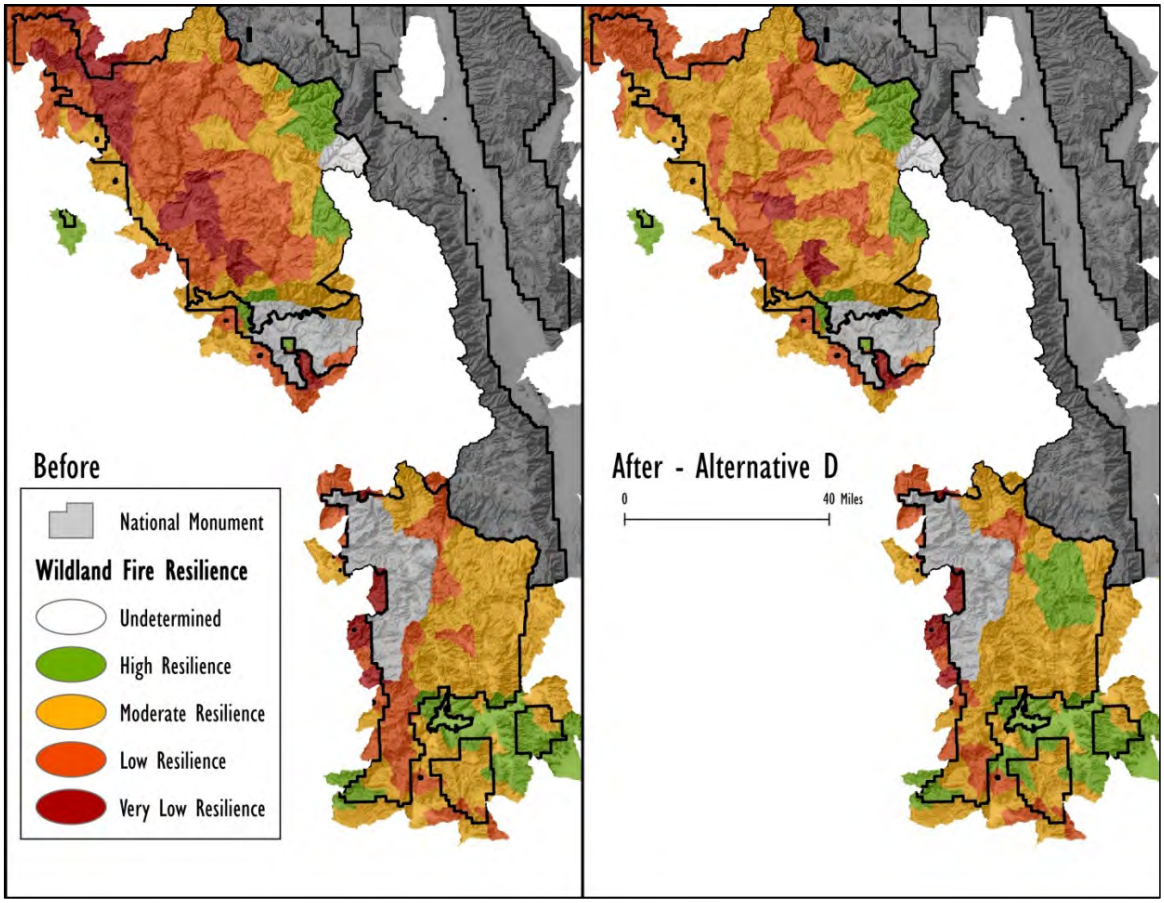

Figure 35. Potential changes in ecological fire resilience, alternative D

Note: This does not include improvements in resilience from wildfire managed for resource objectives. There would be further improvements from these managed fires, primarily in the Kern Drainage.

Upper Montane Forests

Ecological fire resilience is the same as defined in the forest assessments. In general, it is based upon the proportion of crown fire that would occur in a landscape area under 97th percentile weather conditions. High resilience is where less than 25 percent of the area would burn as crown fire; moderate resilience as 25 to 50 percent; low resilience as 50 to 75 percent; and very low resilience as greater than 75 percent crown fire.

The consequences of alternative D on upper montane vegetation would be similar to alternative B. Most of the restoration would be through wildfire managed to meet resource objectives. There would also be increased amounts of mechanical and prescribed fire restoration in upper montane forests that are highly departed from desired conditions and have low resilience to insects and pathogens. Overall resilience would increase and move toward desired conditions.

Subalpine and Alpine Vegetation (Eastside and Westside)

Overall, alternative D would have similar consequences to alternative B and C in subalpine and alpine vegetation. Wildfire managed to meet resource objectives would increase resilience fire, drought, climate change, and to insects and diseases primarily through the reduction of stand densities and promotion of diversity of species, and structures, and tree regeneration. Whitebark pine forests located in recreation areas (like ski areas) would potentially be more resilient to insects and diseases under alternatives D. Alternative D would have greater treatment rates in recreation areas based on a regional whitebark pine restoration strategy.

Despite differences among alternatives, many whitebark pine and other subalpine forests would be heavily impacted by insects and diseases associated with increased moisture stress and warming climate conditions under all alternatives.

Eastside Vegetation

The dominant eastside vegetation types (sagebrush, Jeffrey pine, and pinyon-juniper) would all move toward desired conditions with restoration treatments, similarly to alternative B. There would be substantially more area restored in the middle and low elevations in alternative D that would result in movement toward desired conditions for composition, structure, and especially resilience at the landscape scale. There would be more removal of invading conifers in sagebrush areas, along with control and eradication of non-native invasive plants. There would be larger areas of Jeffrey pine where tree density is reduced, heterogeneity is increased, surface fuels reduced, and understory composition restored. There would be substantially more area of pinyon-juniper with reduced density and non-native invasive plants eradicated or controlled.

Alternative D promotes the greatest resilience to climate change in arid shrublands and woodlands, because the elevated restoration treatment rates under these alternatives build greater adaptive capacity in these arid ecosystems than alternative A. A substantial portion of the landscape would have increased resilience to large, high-intensity fire and lower risk of non-native invasive plants spreading in burned areas, especially cheatgrass and other highly flammable grasses. Decreased non-native plant spread would have an additional positive effect of further reducing the likelihood of large, high-intensity fires. These long-term improvements may be offset to an unknown degree by non-native invasive plant expansions in restoration areas, despite best management practices since climate change and treatment activities themselves can favor the growth and spread of invasive species.

Cumulative Effects of Alternative D

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be somewhat reduced because of the increased climate resilience that results from the substantial amounts, scale, and intensity of restoration treatments in alternative D (see "Climate Change" section). Restoration and development on adjacent agency and private lands, as well as urbanization and increased human use would be the same as described for the other alternatives, with increased fire ignitions and invasive plant spread occurring. The size and area of large, high-intensity fires may decrease near the end of the restoration period because the amount of landscape restored would exceed 40 to 60 percent in substantial portions of the low and mid-elevation areas (see "Fire Trends" section). Overall, vegetation composition, structure, and resilience would become more similar to desired conditions.

Analytical Conclusions

Westside Foothills Vegetation

Both alternatives B and D would move the most area toward and closest to the desired conditions for vegetation ecology. The most restoration would occur in alternative D, up to double the amount in alternative B. There would be more opportunities for restoration, including work with tribes that would benefit vegetation composition, especially understory plants. There would be increased restoration of native plants and eradication of non-native, invasive plants to some extent, especially annual grasses. However, it is difficult to completely eradicate invasive annual grasses across large areas and no alternative is expected to achieve this. Alternative C would have similar levels of restoration as alternative A, which are low in the foothill zone. Overall, alternative D would result in the most area moved toward desired conditions in the foothill zone, followed by alternative B.

Montane Forests

Alternative D followed by alternative B would move the most area toward and closest to the desired conditions for vegetation ecology. The higher rates of treatment and emphasis on treating across larger areas would be more likely to result in entire landscapes that are restored within the next 10 to 15 years. This increases the likelihood that large landscape areas are not only restored but that they can withstand fires of all intensities and still maintain much of their forest structure and composition with moderate or mixed severity and limited large patches of high-severity fires. While small, distributed pockets of high-severity fire can provide heterogeneity and special habitats (see "Complex Early Seral Forests" in the following section), very large fires are outside of the desired condition.

The beneficial effects of alternative D are substantially greater than in alternative B. In alternative D, over half of the landscape is likely to be restored fully to desired conditions. This would result in a high level of resilience across large landscape areas that would improve the resilience of adjacent areas. In alternative B, there are some areas that would have landscape treatments, but only some of these landscapes would have intense enough treatment to move substantially toward desired conditions. Outside of the fire protection zones and in areas that originated from railroad logging in the early 19th century, there would be limited ability to thin sufficiently to restore heterogeneity and reduce density to achieve desired conditions or resilience. This may represent half to two-thirds of the potential focus landscape areas.

Alternatives A and C are both likely to result in low levels of restoration treatments. Vegetation is likely to remain highly dissimilar to desired condition for structure, composition and resilience across most of the landscape. The increased emphasis in alternative C on prescribed fire and wildfire managed to meet resource objectives may result in some increases in areas restored by fire. But these may be more limited than intended because of the low levels of accompanying mechanical treatment in strategic locations that would aid in conducting more large prescribed burns or benefiting from wildfires.

There is a relative difference among the alternatives in the cumulative environmental consequences. This is especially the case with the overlaid consequences of climate warming and increased probability of large, high-intensity fires on top of the restoration treatments. The trend for increasing large, high-intensity fire is highly likely to continue in all alternatives, but there will be a substantially lower probability in alternative D and a slightly lower probability in alternative B based on the fire-climate restoration scenario research (Westerling et al. 2015).

Upper Montane Forests

Alternative D followed by B would move the greatest amount of upper montane vegetation toward the desired conditions. The higher treatment rates and emphasis on a landscape-scale approach would more likely result in landscape-scale restoration within the next 10 to 15 years, especially for forest ecosystems. These greater restoration treatment rates in upper montane landscapes increases the capacity of ecosystems to resist undesirable fire effects (such as large, high-severity patches that exceed the desired conditions), recover from insect and pathogens, and maintain much of their desired structure and composition despite climate change. Alternative A followed by alternative C would likely result in lower restoration treatment rates than alternatives D and B. Consequently under alternative A, vegetation would likely remain dissimilar to the desired condition in structure, composition, and resilience across many upper montane landscapes.

Alternatives D, B, and C would likely result in increased opportunities in the use of fire for restoration in many upper montane landscapes, especially in areas more conducive to wildfires managed to meet resource objectives. However, fewer of these opportunities may be available under alternative C, because this alternative provides fewer strategically-placed mechanical treatments that support more opportunities in the use of prescribed fire and wildfire managed to meet resource objectives. These strategically placed mechanical treatments would often be critical to ensure that high valued resources and assets are sufficiently protected from undesirable fire effects following planned and unplanned ignitions.

The trend for increasing large, high-intensity fire is highly likely to continue in all alternatives as described for montane forests above. Due to the increased amounts of restoration treatments, there would be a substantially lower probability in alternative D and a somewhat lower probability in alternative B based on the fire-climate restoration scenarios (Westerling et al. 2015).

Subalpine and Alpine Vegetation

Alternatives B, C, and D would move the greatest amount of subalpine and alpine vegetation toward the desired conditions. The higher restoration treatment rates under these alternatives build greater adaptive capacity in many subalpine landscapes than alternative A. Alternative A will likely support the slowest rate of return to desired conditions and promote the least long-term resilience to stressors. This is a consequence of the lower treatment rates under alternative A,

especially the use of wildfires managed to meet resource objectives. Alternative A is also the only alternative that does not involve the creation of an interagency whitebark pine conservation and restoration strategy. Under alternatives B, C, and D, this strategy would enhance the success of whitebark pine and other subalpine forest restoration efforts in the southern Sierra Nevada. This would be particularly evident in recreation areas where increased treatment rates would build greater adaptive capacity.

Under all alternatives, alpine vegetation would have low resilience to climate change, because these high-elevation vegetation types have high exposure to the effects of climate change and low adaptive capacity to changing climate under all climate scenarios (Safford et al. 2012a; Lenihan et al. 2003, 2008). Active management is also similarly limited in alpine environments in all alternatives, which further limits the adaptive capacity of alpine ecosystems under any one alternative. Consequently, there are no differences among alternatives with respect to the maintenance of desired conditions in alpine ecosystems.

Eastside Sagebrush

Alternative D followed by alternative B would move the greatest amount of sagebrush shrublands toward the desired conditions. The higher treatment rates in these alternatives would more likely result in landscape-scale restoration in the next 10 to 15 years. The greater restoration treatment rates in sagebrush landscapes increases the capacity of component ecosystems to resist non-native plant invasions and maintain much of their desired structure and composition despite climate change. Alternative A would likely result in lower restoration treatment rates than other alternatives. Consequently under alternative A, vegetation would likely remain dissimilar to the desired condition in structure, composition and resilience across many arid landscapes. Alternative C would have only slighter greater restoration treatment levels than alternative A, resulting in continued dissimilarity of sagebrush vegetation to desired conditions in most areas.

Eastside Pinyon-Juniper and Arid Shrublands

Similar to sagebrush vegetation, alternative D followed by alternative B would move the greatest amount of pinyon-juniper vegetation toward desired conditions. Increased treatment rates and intensity would restore less dense and more heterogeneous structure, and reduce non-native invasive plants. These changes would increase the resilience to drought, insects and pathogens, climate change, and fire. Alternative A would have the least restoration of all alternatives, but alternative C would have only slightly more restoration treatments. Under both alternatives A and C, most of the pinyon-juniper vegetation would remain dissimilar to vegetation desired conditions.

Under all alternatives, there would be a similar, low amount of restoration in xeric shrub/blackbrush and mountain mahogany vegetation types. These vegetation types would remain moderately dissimilar to desired conditions. There would be beneficial effects of all alternatives on these arid shrublands, through eradication or control of non-native invasive plants on adjacent sagebrush, pinyon-juniper and Jeffrey pine vegetation. This would reduce the likelihood of spread of non-native invasive plants into the arid shrublands.

Eastside Jeffrey Pine Forests

Alternative D followed by alternative B would move the greatest amount of Jeffrey pine forests toward desired conditions. These alternatives would have substantial amounts of mechanical thinning and associated prescribed burning in Jeffrey pine forests that would decrease forest density, increase heterogeneity, decrease surface fuels, restore understory composition, and

increase resilience. Alternative D would restore landscape level resilience more than alternative B because at least 40 percent of the area would be restored. Alternatives A and C restore the least amount of Jeffrey pine area and the treatments are lower intensity, limited to small-diameter trees.

Terrestrial Ecosystem Processes and Functions

Background

Functions of terrestrial ecosystems can refer to many things. Here the primary functions considered include how vegetation and terrestrial ecosystems provide for carbon cycling and regulation, fire regimes as an ecological process, special habitats, and connectivity for species across landscapes. Special habitats include old forests, complex early seral forests, habitat for pollinators and tree cavity excavators (like woodpeckers).

This section also contains an integrated analysis of varied aspects of biodiversity and ecological sustainability from other sections and multiple supplemental reports. This includes an integrated analysis of ecosystem condition in relation to tribal uses, fire regime and fire effects information, and special habitats. Tribes have lived with and relied upon terrestrial (and aquatic and riparian) ecosystems in the analysis area for thousands of years. In this section, the condition of plants, animals, and overall terrestrial ecosystems in relation to tribal uses is analyzed. Overall sustainability will draw upon broad measures of ecological integrity identified in the National Ecological Sustainability Frameworks (2004, 2010) including vegetation condition, air pollutant exposure, insect and pathogen levels, and fire regimes. All of these aspects of terrestrial ecosystem function are described below.

Analysis Methods and Data Sources

The overall approach in this analysis was to evaluate the similarity of current and estimated future conditions to the desired conditions where possible. The desired conditions for most of these indicators are broadly defined because there is less specific best available scientific information and other sources on which to base them, or there is more uncertainty as to what desired conditions should be. Therefore, the evaluation is mostly a qualitative evaluation of relative differences in trends toward the desired conditions. In some cases there was quantitative information available to make the evaluation, such as aspects of old forest and complex early seral forests. For both types of evaluations, the specific indicators, measures, thresholds for levels of similarity between desired conditions and current or future conditions, and associated assumptions were identified.

Indicators and Measures

Fire Regimes and Fire as an Ecological Process

Fire is a “keystone” ecosystem process in most of the analysis area (McKelvey et al. 1996, van Wagtendonk and Fites-Kaufman 2006, Brooks and Minnich 2006; Wills 2006). This means that it has important and often dominant influences on ecosystem composition, structure, and function. Fire shaped most of the ecosystems. Deserts and alpine ecosystems are two exceptions.

Fire Regimes

The fire regime is the pattern of frequency, intensity, severity, seasonal timing, and spatial pattern of fires (Sugihara et al. 2006a). Three measures of fire regimes were used here: (1) the frequency of fire, (2) the fire regime condition class, and (3) a qualitative analysis of fire regime integrity. Fire regime integrity refers to the similarity of all aspects of fire regimes compared to the historic

patterns (prior to European settlement). Additional analysis and discussion of fire regimes by individual major vegetation types is addressed in the "Terrestrial Vegetation Ecology" section. This includes fire severity and spatial patterns.

Fire Effects

Ecological fire effects refer to how vegetation is affected by fire (for example, whether it is invigorated and sprouts, or killed). Many plants in the analysis area are adapted to fire and can respond positively to it, depending upon the intensity and duration of the fire and the extent (Fites-Kaufman et al. 2006). Here a broad analysis was conducted. Specific effects to different vegetation types are described in the "Terrestrial Vegetation Ecology" and "Aquatic and Riparian Ecosystems" sections.

Carbon Stocks, Sequestration, and Stability

The primary criteria used to analyze carbon stocks, sequestration, and stability were the resilience to fire, climate, and insects and pathogens. In dry forest systems, there can be dramatic changes in carbon stocks and sequestration capacity with one large, high-intensity fire (North 2014). Carbon stability was a focus of analysis because managing for long-term carbon stability, within a carbon carrying capacity, is a forestwide desired condition. Carbon stocks and sequestration are both dependent on the carbon carrying capacity, and, consequently, highly related to the carbon stability of an ecosystem. In arid, eastside shrublands and woodlands, soil carbon was emphasized.

Connectivity

The ability for species to move throughout a landscape is important for ecological integrity (Rudnick et al. 2012). Species that are wide ranging are able to maintain genetic diversity and sustainability in the face of changes to their population or environment (Gilbert-Norton 2010). Connected landscapes allow other species to migrate in the face of climate change or other pressures (Heller and Zaveleta 2009). Despite its ecological importance, in practice connectivity is a very difficult concept to apply because it depends on the species and its associated life history and dispersal characteristics (Cushman and Landguth 2012). Connectivity for wide-ranging habitat specialists (like the greater sage-grouse or Pacific fisher) are different than for generalists (like bears) or short-dispersal specialists (like plants growing on certain rock types). For this analysis, the emphasis was on broad patterns of vegetation structure or landscape arrangement of vegetation and some aspects of connectivity function. Functional aspects included existing and predicted habitat fragmentation for vegetation types and specialized habitat (like old forest) and landscape patterns of broad management intensities including less managed areas (such as wilderness), varying road densities (Cushman and Landguth 2012), and different large fire probabilities.

Terrestrial ecosystem connectivity was analyzed at multiple spatial scales. These are all related but focus on different aspects of terrestrial ecosystem connectivity. Most of the analysis was qualitative, based upon key sources of connectivity presented in the assessments (such as the State of California Essential Habitat Connectivity project, fisher conservation strategy, Sierra Nevada Ecosystem Project Areas of Late Successional Emphasis) and maps of broad management regimes (like wilderness) by alternative. Connectivity of special habitats, especially old forest and complex early seral habitats are described in more depth in the supplemental reports on that topic.

Thresholds were based upon general connectivity theory, especially for wide-ranging wildlife. There are many different ways to measure connectivity but for a general view, percolation theory

is useful. Percolation theory suggests that when the majority of a landscape has conditions suitable for movement, then movement is more likely to occur (Turner 1989, Metzger and Decamps 1997, Kindlemann and Burel 2008). It matters less how habitat is arranged when there is more of it. The thresholds vary by species habitat requirements and mobility. For this analysis, we assumed that landscapes with greater than 60 percent habitat suitable for movement provided high connectivity. Some research suggests that the threshold is greater than 40 percent. For this analysis we assumed that 40 to 60 percent provided moderate levels of habitat connectivity. In addition to the amount and distribution of habitat, areas that block or constrict movement, such as large reservoirs or major highways can influence connectivity. Since this is a general landscape view of connectivity, we assumed that relative differences in the number of major barriers provided relative differences in the ability of wide-ranging species to move through the landscape.

Criteria and thresholds for environmental analysis of landscape connectivity across vegetation types within ecological zones in westside foothill, montane and upper montane ecological zones are shown below.

Indicator: Connectivity for wide-ranging forest species (bear, deer, fisher; see also old forest below in special habitats)

Criteria:

9. Major barriers and connecting habitat with hiding cover (overhead shrub and/or tree cover).
10. Location of and amount of barriers (such as large reservoirs, developed areas, major roads, high road density)

Thresholds and Evaluation Approach:

- High: No major barriers preventing dispersal of sensitive species; greater than 60 percent of the landscape with hiding cover.
- Medium: Pinch points or barriers exist in limited places; 30-60 percent of the landscape with hiding cover.
- Low: Multiple pinch points or barriers; less than 30 percent of the landscape with hiding cover

Criteria and thresholds for environmental analysis of landscape connectivity across vegetation types across eastside landscapes (sagebrush and pinyon-juniper) are shown below:

Indicator: Connectivity for sage grouse and other sagebrush dependent species.

Criteria:

1. Major barriers and, amount and distribution of connecting sagebrush habitat
2. Location and amount of barriers (such as large reservoirs, developed areas, major roads, high road density).
3. Extent of area with moderate sagebrush cover without encroaching conifers (like juniper)

Thresholds and Evaluation Approach:

- High: No major barriers preventing dispersal of sagebrush species, greater than 60 percent of landscape with sagebrush cover.

- Moderate: Pinch points or barriers exist in limited places, 30-60 percent of the landscape with sagebrush cover.
- Low: Multiple pinch points or barriers exist. Less than 30 percent of the landscape with sagebrush cover.

Terrestrial Biodiversity

The analysis of special habitats and keystone species groups adds to the course filter vegetation analysis above. These are important aspects of biodiversity and support the fine-filter analysis of biodiversity by individual species in the "At risk Terrestrial Wildlife Species" section. It provides an evaluation of the extent to which plan components that provide ecosystem diversity will also provide the ecological conditions necessary to support species of conservation concern.

Special Habitats

Taking a broad ecosystem approach, the vegetation analysis emphasized dominant vegetation types. There are plant communities or habitats that are less common and contain specialized or more uncommon plant and animal species (Table 52). Some are uncommon because they occur in scattered locations, such as marble rock outcrops but they are important for ecological integrity because they are "hotspots" of biodiversity. In some cases, though not always, special habitats support species of conservation concern or federally listed threatened, endangered, and proposed species. Others are uncommon because of extensive periods of past management that differs from what is commonly practiced today. This includes old forest (Table 50) and complex early seral forests (Table 51).

Old forest was analyzed by comparing conditions and trends with similarity to desired conditions for large tree densities and landscape proportions of old forest (Table 50). These desired conditions recognize a "gradient" approach to defining old forest (Franklin and Fites-Kaufman 1996; Spies 2004). That means that there are different degrees of what is considered old growth. Areas that have high densities of large trees relative to the natural range of variation (the median and high range of desired conditions) are at one end of the old forest spectrum, and areas with low densities of large trees (the low range) are at the other end of the spectrum. Because of the long history of selective removal of large, old trees in the analysis area (McKelvey and Johnston 1992), areas that have low densities are more common (Franklin and Fites-Kaufman 1996). While even single large, old trees can be ecologically important given this history and current patterns, old forest is still focused on large, old trees within an area. The analysis reflects this gradient approach and wide range in current conditions in large tree densities.

Table 50. Indicators, criteria and thresholds used to analyze environmental consequences for the old forest special forest habitat

Characteristic	Criteria	Thresholds for Qualitative Evaluation of Trends
Large trees	Densities compared to desired conditions	Relative trends (increase, decrease, stay the same)
Amount of old forest	Proportion of landscape with large trees (size varies by species, see desired conditions)	high = more than 60% of landscape moderate = 40-60% of landscape low = less than 40% of landscape
Large snags (larger than 20 inches diameter at breast height; montane and upper montane forests only)	Density (per 10 acres) and variability (range in densities) compared to desired condition	high = 20-40 per 10 acres moderate = 5-20 per 10 acres; low = less than 5 per 10 acres

Table 51. Indicators, criteria and thresholds used to analyze environmental consequences for complex early seral habitat special forest habitat

Characteristic	Criteria	Qualitative Evaluation of Consequences
Amount of landscape	Proportion of area (across forest) that occurs in complex early seral in the landscape	Relative evaluation of the trends in amount
Spatial Pattern	Evenness in distribution across landscape, and grain (size of patches) relative to natural range of variation	Relative evaluation of pattern compared to desired conditions

Table 52. Indicators, criteria and thresholds used to analyze environmental consequences for limited habitat types special forest habitats

Special Habitat	Indicator	Criteria
Alkali Flats and Pumice Flats	Plant habitat and plant condition	Amount of ground disturbance (equipment or trampling)
Rock Outcrops (especially marble and limestone, slate)	Plant habitat and disturbance.	Amount of ground disturbance or plant trampling.
Caves	Condition and access to wildlife	Amount of disturbance and types of entrance closure structures.
Cliffs	Condition and disturbance	Amount of human or equipment disturbance and presence
Meadow edges	Condition and disturbance	Moisture status of the meadow and amount of trampling (from people or grazing animals)

Keystone Groups (Pollinators and Cavity Excavators)

Some plants, animals, insects, and fungi stand out in their role in ecosystem function. Pollinators are one such group. They include mostly insects, including butterflies and bees, but also other animals, like hummingbirds. Without these pollinators, many flowering plants would fail to persist or be rare on the landscape. This would then have repercussions on other insects and animals that use these plants for food and shelter.

Another standout group are woodpeckers and other primary cavity excavators (such as nuthatches and sapsuckers) because they make cavities that are used by many other birds and mammals. For this analysis, these two keystone groups were selected as important, but it is not meant to imply that there might not be other ones. These are two groups that might be impacted by treatments. The analysis of consequences to pollinators and cavity excavators was qualitative. Findings on climate, fire, insects, pathogens, vegetation, special habitats, and at-risk species were synthesized.

For pollinators, three recent management strategies were used to identify measures and practices to analyze. These all incorporate summaries of research key elements of pollinator habitat and management approaches. These include the “Pollinator Research Action Plan” by USDA and EPA (2015), “Region 5 Draft Pollinator Best Management Practices” (Van Zuuk 2014), and “Pollinator Friendly Best Management Practices for Federal Lands” (USDA and USDI 2015). The key element of pollinator habitat is the abundance, condition, and spacing of flowering plants in the landscape. Openings in forests and sunny areas are identified as important, and dense forests a concern. Also important are nearby water sources, and nesting habitat that is widely varied and can include holes in the ground, logs, hollow or pithy shrub stems, and snags. Continuously

burned areas can be detrimental but fire can also improve understory plant flowering. Any activity or management action that removes or reduces flowering can have impacts including intensive grazing, recreation use, mowing, or herbicides. For this analysis, changes to forest heterogeneity that create openings, and restoration of low and moderate-intensity fire were used to evaluate environmental consequences as described below.

Indicator: Understory plant composition, condition and distribution

Criteria:

1. Amount of sunny openings or overstory heterogeneity in forests.
2. Amount and type of fire relative to the natural fire regime (enhances native flowering plants).

Thresholds:

- High: Dominant vegetation is mostly (greater than 60 percent) within the desired conditions for structure and fire regimes. Fire is restored to many areas in historically frequent fire ecosystems. Non-native plants are limited in extent.
- Moderate: Dominant vegetation is somewhat (30 to 60 percent) within the desired conditions for structure and fire regimes. Fire is restored to some areas in historically frequent fire ecosystems. Non-native plants are present in some areas.
- Low: Dominant vegetation is mostly (less than 30 percent) outside of the desired conditions for structure and fire regimes. Fire is restored to limited areas in historically frequent fire ecosystems. Non-native plants are present in numerous areas, dominant in some larger areas.

For primary cavity excavators, primarily woodpeckers, snags are a primary habitat. Many species of woodpeckers use a variety of snag sizes in a variety of forest conditions. This includes small to large snags in young to old forests (used by white headed and pileated woodpeckers; Bull and Holthausen 1993, Morrison et al. 1987, Raphael and White 1984), or unburned to burned forests (used by black-backed woodpeckers; Saracco et al. 2011, Fogg et al. 2014 Siegel et al. 2014). The amount and distribution of snags in varied forest conditions was used to evaluate environmental consequences as described below.

Indicator: Amount and distribution of snags in both burned and unburned forests. Diversity of snag habitats.

Criteria:

- Density and variation in size and age of snags compared to desired conditions. Spatial pattern (evenness across larger areas but clumpy patterns at smaller scales). Presence in multiple forest conditions and settings (young forests, old forests, burned forests, and unburned forests).

Thresholds:

- High: Snag densities and distribution are within the desired conditions across most the landscape. These occur in a variety of forest ages and burned and unburned conditions.

- Moderate: Snag densities and distribution are somewhat within the desired conditions across the landscape. These occur in a variety of forest ages and burned and unburned conditions but may be missing in some areas.
- Low: Snag densities and distribution are within the desired conditions across limited areas the landscape. These occur in some of forest ages and burned and unburned conditions but are missing across significant areas.

Tribal Uses and Biocultural Diversity

Native Americans have lived throughout the analysis area for thousands of years (Lake and Long 2014). The people of various tribes have historically and are currently tied to different ecosystems across the area that provide for basic life needs of food, shelter, and culture. Plants, animals, springs, and seeps across all elevational zones and vegetation types are often important to tribes. There are strong ties between tribes and all components of ecosystems. The condition of biodiversity thus can impact cultural diversity, or the ability of tribes to maintain their culture. The condition and distribution of these culturally important aspects of ecosystems is the focus of this section.

A qualitative analysis was conducted for tribal uses and biocultural diversity. This included a synthesis of the findings in the Vegetation Ecology, Fire Ecology, and Vegetation Resilience supplemental reports, and discussions in numerous tribal forums over the last several years.

Terrestrial Ecosystem Sustainability

The National Forest Sustainability Framework (USDA FS 2004, 2010) was used to evaluate terrestrial ecosystem sustainability considering aspects of biodiversity and ecosystem processes (Table 53). This includes ecosystem resilience, connectivity, vegetation condition, insect and pathogen processes, fire regimes, species diversity and at-risk species. This section draws upon findings in the sections discussing agents of change, terrestrial vegetation ecology, fire ecology, and at-risk species.

Table 53. Characteristics from the National Forest Sustainability Framework used in the analysis

Characteristic	Analysis
Area affected by insects and pathogens beyond natural range	Summary from the “Insects and Pathogens” section in the “Agents of Change” section
Area affected by air pollutants that may cause negative effects	Summary from the “Air Quality” section
Area affected by invasive species	Summary from the “Terrestrial Vegetation Ecology” section
Area with fire condition class outside of natural range	Summary from the “Fire Regimes and Fire as an Ecological Process” section
Area with vegetation condition outside of natural range	Summary from the “Terrestrial Vegetation Ecology” section

Affected Environment

A summary of the current conditions of carbon, connectivity, old forest, complex early seral habitat, limited habitat types, and tribal uses are shown in Table 54. The conditions are described in broad terms in relation to the desired conditions by ecological and elevation zone or dominant vegetation types (see “Terrestrial Vegetation Ecology” section for descriptions).

Table 54. Summary of the similarity of current conditions to desired conditions for major indicators of terrestrial function by ecological/elevational zone

Ecological Zone	Fire Regimes and Fire as an Ecological Process	Carbon Stability	Landscape Connectivity	Old Forest Condition and Amount	Complex Early Seral Forest	Limited habitat (marble rock outcrops, alkali flats)	Tribal Uses, Biocultural Diversity (Conditions)
Foothill	Moderate	Low	Low	Low	Moderate	Moderate	Low
Montane	Low	Low	Moderate	Low	Moderate	Moderate	Low
Upper montane	Low to moderate	Low to moderate	High	Moderate	Moderate to high	Moderate	Moderate
Subalpine	High	Moderate	High	High	Na	High	Moderate
Alpine	High	Moderate	High	NA	NA	High	High
Sagebrush	Moderate	Moderate	Low To Moderate	NA	NA	Moderate	Low
Pinyon-Juniper	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Eastside Jeffrey Pine	Low	Low	Moderate	Low	Low to moderate	Moderate	Low
Desert	Moderate	Moderate	High	NA	NA	High	Moderate

NA = not applicable

Fire Regimes and Fire as an Ecological Process

Fire Return Interval Departure

Historically (before 1800), area that burned in the analysis area and California overall was estimated to be vastly greater than current patterns (Stephens et al. 2007). These changes have not been uniform. The frequency of fire has decreased the most in montane and eastside ponderosa pine, Jeffrey pine, and mixed conifer. These areas used to burn on average every 10 to 15 years. Higher elevation red fir forests have changed less, only missing one burn cycle on average. Subalpine and alpine areas have changed little if at all. Although lightning strikes often hit the crest where they occur, the sparse vegetation carries little fire. In eastside sagebrush, pinyon-juniper and desert types, the changes vary. Where there have been invasions of non-native, annual cheatgrass, fire is more frequent than historically. Other areas have had some declines in fires, but fires were more varied historically.

The fire return interval departure index is one way of showing the changes in fire frequency (van de Water and Safford 2011). The maps below show fire return interval departure for the Inyo (Figure 36), Sequoia (Figure 37), and Sierra (Figure 38) National Forests. These maps are based on van de Water and Safford (2011). The departure is based upon the difference between the current fire frequency (average years between fires) and historic fire frequency. High departure can represent a lack of fire (shown in red, minus 66 percent) or too frequent fire (shown in dark blue, plus 66 percent). A moderate departure, can represent a lack of fire (orange, minus 33 percent) or too frequent return of fire (light blue, plus 33 percent). A low departure, shown in green and yellow, represent less than a 33 percent change in fire frequency. Recent fires are shown as transparent shaded areas. The fire return interval departure values are being updated but the process is not complete at this time.

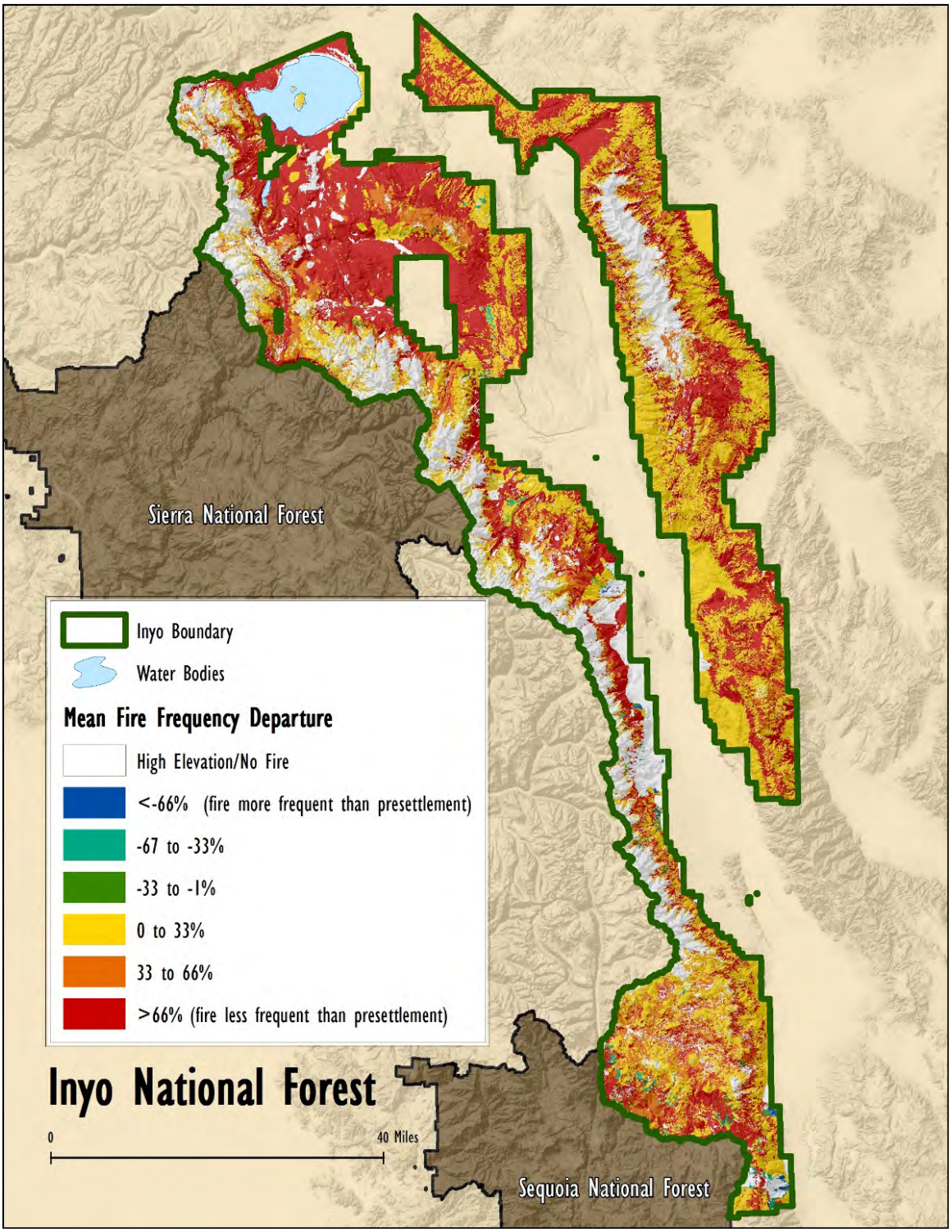

Figure 36. Map of fire return interval departure, Inyo National Forest

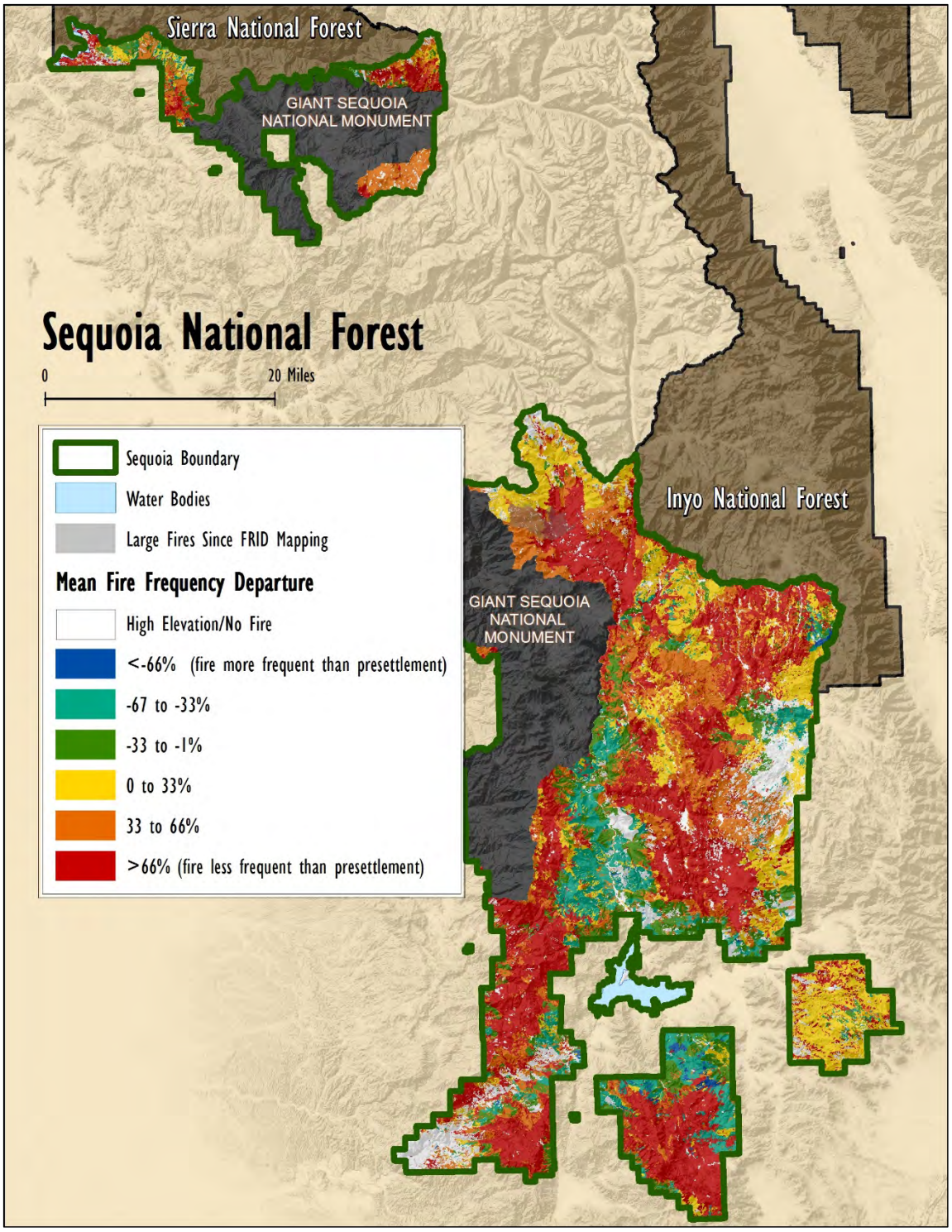

Figure 37. Map of fire return interval departure, Sequoia National Forest

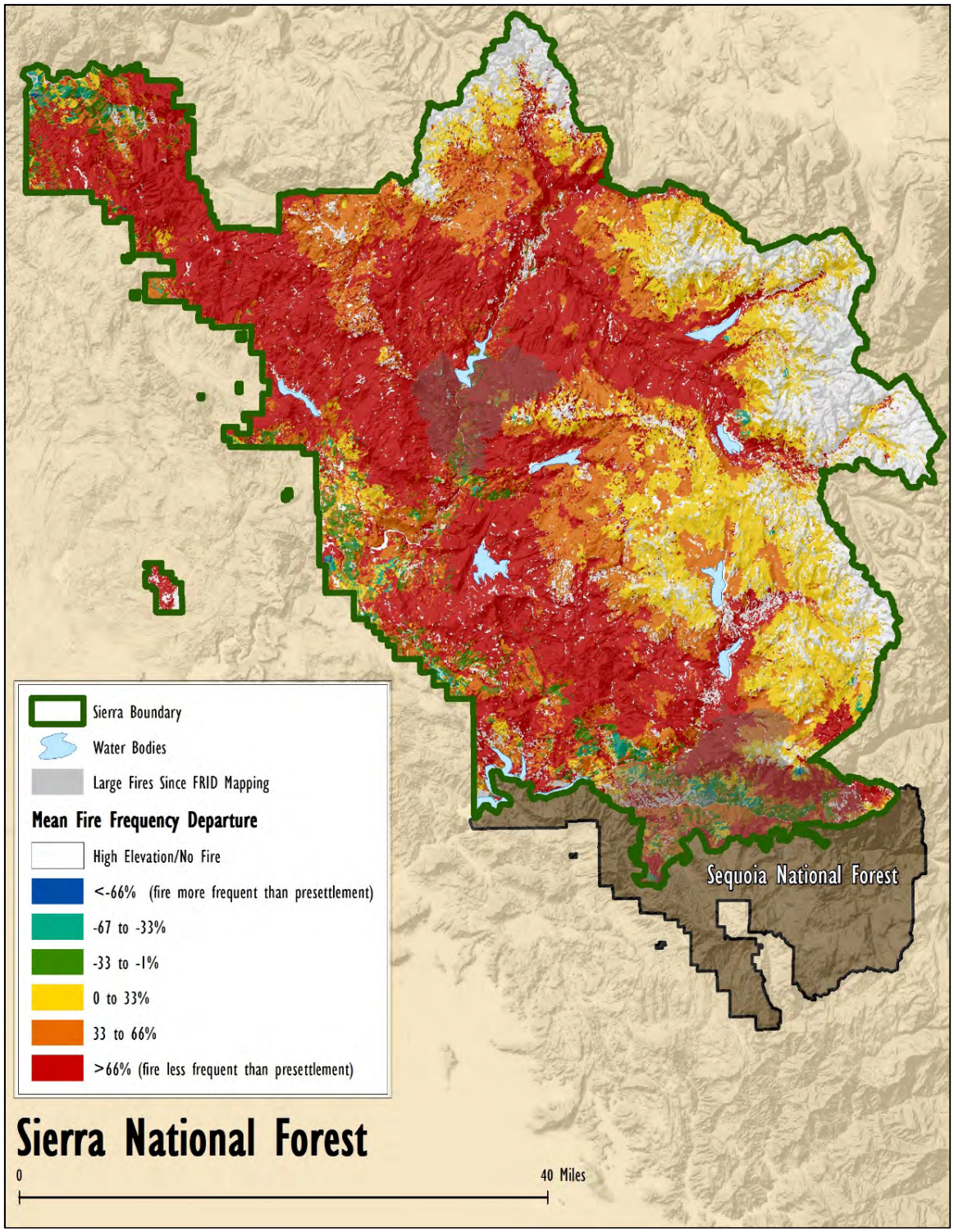

Figure 38. Map of fire return interval departure, Sierra National Forest

Vegetation types where fires burned most frequently in the past, such as yellow pine or mixed-conifer, have undergone the sharpest decline in condition. Yellow pine, mixed conifer, and hardwood forests and woodlands have generally experienced a two-thirds decrease in mean fire return interval. Historically they burned on average every 10 years; currently, the average is more than 100 years. In the Kern Plateau, across the southern Inyo National Forest into a broad expanse in the eastern portion of the Sequoia National Forest, there are large areas with low levels of departure (fire return intervals are closer to the natural range). This is because there have been extensive areas of wildfires managed to meet resource objectives (Meyer 2015).

Subalpine forests, where fires were historically less frequent due to the patchier and sparse vegetation and shorter fire season, have undergone fewer changes. Upper montane red fir and lodgepole pine forests have had some departure in fire frequency, but because fires were historically less frequent. Currently the departure is low in these areas but it is projected to be increasing in the near future.

The departure in eastside sagebrush and pinyon-juniper ecosystems is varied from low to moderate. Where cheatgrass has invaded, fires are more frequent than historically. Similar patterns are occurring in desert ecosystems.

Fire Regime Integrity

In addition to the occurrence and frequency of fire, the type and severity of fire are important aspects of fire regimes. Many factors influence how severe a fire affects vegetation. This includes the density, size, and species of vegetation as well as the intensity (heat level), speed (spread rate), and duration (length of time heat) of a fire. In much of the analysis area, decreased fire frequency as a result of aggressive fire suppression in combination with past forest management has led to denser, more uniform vegetation leading to higher severity fires and low to moderate fire regime integrity. Table 55 shows the current condition of fire regime integrity for the westside ecological zones and vegetation types, and Table 56 shows conditions for the eastside. Dense, uniform vegetation conditions are especially the case in montane ponderosa pine, Jeffrey pine and mixed conifer forests (Steel et al. 2015). In upper montane red fir forests, there has been less of a notable change. In eastside sagebrush and pinyon-juniper there has been a more complex change. Cheatgrass invasion has led to more frequent and larger fires than historically. Conversely, fire suppression has resulted in an ingrowth of conifers (pinyon pine, juniper, and Jeffrey pine) into sagebrush areas. Now, when sagebrush areas burn, they burn hotter because of the conifers.

Table 55. Summary of current condition of fire regime integrity by ecological zone and vegetation type in westside areas of the Sequoia and Sierra National Forests

Ecological Zone	Vegetation Type	Current Condition Fire Regime Integrity
Foothill	Chaparral, Oak Woodland	moderate
Montane	Ponderosa pine-black oak, Dry mixed conifer, Moist mixed conifer	low
Upper Montane	Red fir	moderate
Upper Montane	Jeffrey Pine	low
Montane and Upper Montane	Kern Plateau forests	moderate
Subalpine and Alpine	Subalpine and Alpine	high

Table 56. Summary of current condition of fire regime integrity by vegetation type in eastside areas in the Inyo and some of Sequoia National Forests

Vegetation Type	Current Condition Fire Regime Integrity
Sagebrush and Pinyon-juniper	moderate
Eastside Jeffrey pine	low
Mountain mahogany	moderate
Desert (xeric shrub/black brush)	moderate
Upper Montane Red fir and moist lodgepole pine	moderate

Carbon Stocks, Sequestration, and Stability

The foothill, montane and eastside pine areas have low carbon stability because vegetation is dense and it is at a high risk of high-intensity fire (see "Fire Trends" and "Fire Management" sections). Subalpine, alpine, sagebrush, and pinyon-juniper landscapes have moderate carbon stability. They have less standing carbon and have a moderate to low risk of high-intensity fire. Upper montane forests (especially red fir forests) have low to moderate carbon stability. At the lower elevations in this zone, forest density and fire risk conditions are similar to montane forests and carbon stability is low. At higher elevations, near subalpine areas and on rockier sites within the upper montane zone, the carbon stability is moderate because fire risk is moderate.

Most of the landscape area on the eastside is dominated by nonforest vegetation, primarily sagebrush. In these areas, soil and belowground carbon are important (the stability of this carbon is described in the Assessment reports; USDA FS 2013b, 2013c, 2013d). Restoration of degraded arid shrublands and woodlands can also enhance carbon stocks and sequestration, including areas invaded by invasive grasses (Finch 2012). These restoration approaches may increase belowground carbon storage, especially in deep-rooted shrub and perennial grass species, and increase the resilience of arid ecosystems to future stressors. This increase in resilience supports a greater long-term carbon carrying capacity and provides for improved carbon stability in arid landscapes.

Landscape Connectivity

Landscape connectivity is moderate to high in all areas except for the foothill zone, where it is low. The foothill zone is low because it is fragmented by nearby and intermixed developed and urbanized areas. Connectivity is low to moderate in sagebrush landscapes because of the invasion of conifers and areas of large high-intensity fire where cheatgrass has invaded.

Special Habitats

Old Forests

Old forests in the analysis area are highly varied and world-renowned from the ancient, gnarled, bristlecone pines in the White Mountains to the massive giant sequoia, towering ponderosa, sugar and Jeffrey pines, and sprawling old oaks. Across elevations and ecosystems, all old forests in the area share the presence of large, old trees, for their species and site productivity (Franklin and Fites-Kaufman 1996). The density of large old trees, size, arrangement, and density of the forests they are embedded in varies greatly by ecosystem. Old forests at the highest elevations often have trees that are several hundred to a thousand or more years old, but are open and scattered. Old forests at lower elevations contain trees that are much larger and are embedded in forests with a wide variety of densities and canopy covers. The majority of the giant sequoia old forests are found in the Giant Sequoia National Monument and Sequoia and Kings Canyon National Parks.

Management of sequoia groves is covered in the Giant Sequoia National Monument management plan (USDA FS 2012-4) and is not included here.

The current condition of old forests varies by location and ecosystem. At the highest elevations in the subalpine zone, old forests are similar to the desired condition and natural range of variation. Old forests in the upper montane zone, the red fir and Jeffrey pine forests described above, are more intact but have had some changes over the last 150 years. There has been some harvest of the largest trees and a decrease in the structural complexity or heterogeneity (the variation in tree spacing and sizes). Lack of fire has contributed to an increase in the density of smaller trees and has increased the understory live fuels, or "ladder fuels" (vegetation that helps carry ground fires into the crowns of trees).

The condition and amount of old forest is low in montane forests and low to moderate in eastside pine and foothill areas. These areas were most impacted by preferential logging of large and old trees during European settlement and more recent forestry practices up until the early 1990s (See "Forest Products" section and Vegetation Ecology supplemental report). Large trees have been killed by large, high-intensity fires (such as the McNally fire on the Sequoia National Forest), and stress-related factors (van Mantgem et al. 2009). More recently, many trees are dying throughout ponderosa pine and mixed conifer forests on the western slopes of the Sierra and Sequoia National Forests due to ongoing drought and related insect outbreaks (see the "Insects and Pathogens" section). The condition and amount of old forests in the upper montane and pinyon-juniper forests are moderate because they have had less of these impacts. Subalpine old forests are generally highly similar to desired conditions because they have had little management, although there are increasing levels of white pine blister rust and insect-related mortality in the white bark pines (see below and the "Insects and Pathogens" section).

Among the subalpine conifer forest types, the Great Basin bristlecone pine is especially noteworthy. Known for being the oldest living trees on the planet, the bristlecone pines are afforded extra protection on the Inyo National Forest within the congressionally designated Ancient Bristlecone Pine Forest, a special interest area managed to protect the bristlecone pines for public enjoyment and scientific study. Whitebark pine has recently been listed as a candidate species by the U.S. Fish and Wildlife Service, indicating concern for the long-term viability of this keystone species. This is primarily because whitebark pines are dying across much of its range due to white pine blister rust and other causes, as well as projected trends in climate. White pine blister rust is a non-native pathogen killing whitebark pine in other parts of its range. Mountain pine beetle, a native insect, is currently affecting whitebark pine on the Inyo National Forest, likely driven by current, regional warming trends (Millar et al. 2012). Whitebark pine mortality currently occurring on the Inyo National Forest may continue to spread in the coming years, but ongoing monitoring indicates the trees have high resilience to initial attack (Meyer et al. 2014). There is a high climate vulnerability of subalpine conifer forests, including bristlecone and whitebark pine (Meyer 2013b). Movement of pinyon pine up into bristlecone pine forests has also been observed (Slaton and Stone 2013a).

Complex Early Seral Forests

Early successional forests represent an important ecological stage that supports diverse ecological processes, ecological communities, and structures (Swanson et al. 2011). The concept of complex early seral forests is based on ecological function and not just the age of the vegetation. This habitat type is created by stand-replacing disturbance events, including fires, insects, and wind throw. These disturbance events create clumps, patches, or larger areas of early successional (young) forest where overstory trees are temporarily absent or rare. Consequently, this forest

successional stage represents a transitory period immediately following a stand-replacement event and prior to the ensuing period of forest development and canopy reestablishment.

Complex early seral forest is a type of early successional forest that contains structural, compositional, or functional elements of ecological complexity or integrity. This complexity and integrity in early seral forests often comes from the presence of elements created by the disturbance, such as snags, logs, isolated live trees (or tree clumps), young shrubs, herbaceous plants, regenerating trees, and sprouting hardwoods. Spatial heterogeneity (variation) in vegetation composition and structure during recovery after a disturbance is another important element of complexity in early seral forest (Swanson et al. 2011).

Lastly, increased adaptive capacity of early successional forests greatly contributes to the integrity of complex early seral forests. This increased adaptive capacity and integrity is supported by the presence of native vegetation (including trees, shrubs, and herbaceous plants), mycorrhizae and other essential soil biota, nitrogen-fixing plant species (like bear clover), and keystone species (such as pollinators, cavity excavators).

The ecological importance of individual legacy structures following a disturbance like fire (such as large snags and logs, resprouting hardwoods, and understory plant diversity) has long been recognized. Recently there has been recognition that their combined presence provides a unique habitat condition that supports early-successional-associated species such as woodpeckers and arthropods (Betts et al. 2010, Swanson et al. 2011), and fire-dependent plants (like knobcone pine). Salvage and reforestation that removes some of elements such as snags and logs, or creates conditions like artificial reforestation may not provide the same level of complexity or habitat for associated species (Swanson et al. 2011, Noss et al. 2006). Some habitat elements like pine snags often have limited longevity regardless of the level of management after a fire, such as salvage logging (Ritchie et al. 2013).

The condition of complex early seral forest is the most difficult to assess because of uncertainty in the existing amount and uncertainty of what the natural range of variation is for the amount and distribution of complex early seral forest. The condition of complex early seral forest habitats in the subalpine and upper montane forests is likely similar to the natural range of variation because these forests have missed the fewest fire cycles since fire suppression. However, in some upper montane forests, where fires have occurred, past practices included extensive salvage and reforestation practices. There are extensive areas in the Kern River drainage where recent wildfires managed to meet resource objectives have occurred and most of these areas are remote (in wilderness or inventoried roadless areas) and have not been salvaged or reforested. These provide large areas of complex early seral forest habitat. Most of these fires resulted in a complex spatial pattern, with most of the high-severity fire occurring in a variety of patches and sizes, including many small and medium patches across extensive areas in multiple fires (Meyer 2015). Some of these fires occurred in montane mixed conifer and Jeffrey pine forests as well.

In montane, foothill and eastside pine forests, there is a low similarity of complex early seral forest habitat condition compared to desired conditions. This is likely a result of extensive fire suppression for the last 100 years in addition to the long-term effects of post-fire management activities. There is evidence of more high-severity fire now compared to historic conditions, specifically within ponderosa pine and eastside yellow pine forests (Mallek et al. 2013, Safford 2013). This is partially a consequence of increased fuel loading associated with long-term fire exclusion in these forests (Steel et al. 2015). Even more evident is the lack of low- to moderate-severity fire in nearly all forest ecosystems of the Sierra Nevada compared to the pre-European settlement period (Mallek et al. 2013). Scientific consensus is that there are larger patches of

high-severity fire in yellow pine and mixed conifer forests (Safford 2013), but high-severity fire patch size remains unchanged in most upper elevation forests (Meyer 2013a, 2013b). Where fire has been restored with prescribed fire or wildfires managed to meet resource objectives, it tends to result in more desirable fire effects dominated by patches of low- to moderate-severity fire (the exception are patches previously burned at high severity). While there is some uncertainty as to exactly how much high-severity fire occurred historically in montane and eastside pine forests, most evidence indicates this to be a smaller proportion of the burned area in these forest types (Safford 2013). It is also likely that high-severity fire patch sizes have increased considerably within these forests over the past few decades (Miller and Safford 2012, Westerling et al. 2016). Historically there were likely more frequent, small areas of high-severity fire, resulting from mortality of individual, clumped, or small groups of trees. Historically, fires were frequent in these types so while the amount in individual fires may have been low, cumulatively, they would have occurred throughout the landscape. Fires in the last 50 years in these forest types have had large patches of high-intensity fire and continuous tree mortality. This is a dramatic change in pattern of potential complex early seral forest. In addition, much of these areas have had salvage logging or reforestation of large fires prior to the early 1990s, reducing some or much of the characteristics of complex early seral forest. On recent large burned areas, only smaller proportions of the burned areas have been salvaged or reforested.

Limited Special Habitats

There are several types of special habitats: (1) those limited to small areas with uncommon rock types and/or soils types, called “edaphic habitats;” (2) remnant plant communities (such as giant sequoia groves); and (3) communities of unusually high biodiversity, such as aspen. There is draft plan direction that specifically addresses special habitats. That direction is not limited to but includes these habitats described here.

Edaphic habitats. These include some uncommon plant communities that are limited to certain rock types and outcrops such as marble or a location that is at the junction of distinct bioregions such as the Mohave Desert, Tehachapi Mountains, the Great Basin, California Valley, and the Southern Sierra Nevada. Some of these areas are in designated botanical areas or special interest areas. Here the focus is on some of the primary types of these communities, but it is not meant to be comprehensive. Rather, the description is to encompass the range of conditions to enable an analysis of their contribution to ecological integrity and consequences of the alternatives on their conditions. This includes marble and limestone rock outcrops, pumice flats, and alkali flats. These tend to occupy small areas with unusual soils and sometimes provide habitat for plants only found there (endemic) that are often uncommon or rare (USDA FS 2013f, 2013g, 2013h, and “At-risk Species” and “Species of Conservation Concern” sections). Other related habitats include cliffs and caves where wildlife such as peregrine falcons and bats nest and roost.

Remnant Plant Communities. There are two giant sequoia groves to the north and outside of Giant Sequoia National Monument on the Sierra National Forest. These are isolated groves and are managed specifically for giant sequoia. These groves are currently impacted by fire exclusion, insects, pathogens, climate change, and other stressors (USDA FS 2013g). Increasing tree densities and fuel loading, and the removal of fire as a key ecological process have contributed to the degradation of giant sequoia health and sustainability, and have resulted in fewer regenerating trees and increased risk of uncharacteristic fire. Although grove boundaries have remained stable for the last several hundred years, climate change threatens the long-term persistence of small and isolated giant sequoia groves such as the Nelder and McKinley Groves. Climate projections

indicate that giant sequoia trees, especially the largest specimens, will be highly vulnerable to climate change in the 21st century (Sydioriak et al. 2013).

Aspen Communities of High Biodiversity. Aspen supports a high level of plant biodiversity, with many wildlife species using aspen stands during some stage of their life cycle (Kuhn et al. 2011). Most aspen on the west side occurs in smaller, isolated patches within wet areas, around meadows or streams, or where subsurface water is shallow. On the east side, large areas of aspen occur in drier landscapes, particularly on the eastern slopes of the Sierra where the water source is not apparent but is present. Detailed condition information is only available for the Inyo National Forest. The life cycle of aspen is closely tied to fire and other natural disturbances. Based on surveys of aspen on the Inyo National Forest, over 40 percent are at moderate to high risk of loss. Poor aspen regeneration due to ingrowth of conifers, disease, lack of characteristic fire, and browsing by cattle and wildlife are the primary recorded factors. The ingrowth of conifers is due mostly to fire suppression, since fire favors the sprouting aspen and kills young conifer trees (Estes 2013b). Climate change may also be a factor, as noted in the Rocky Mountains, and climate models indicate moderate climate vulnerability in the Sierra Nevada in the 21st century (Estes 2013b).

The condition of limited special habitats is generally moderate across all ecological zones and vegetation types. However, at some specific sites, there may be poor conditions because of unregulated ground disturbance (such as dispersed recreation).

Keystone Species Groups

The current condition of pollinators and cavity excavators (such as woodpeckers) is uncertain, and there is little direct information available. For pollinators, forests with dense vegetation conditions lacking characteristic fire have lower levels of flowering understory plants, especially those dependent on higher light environments (Webster and Halpern 2010, Wayman and North 2007). These conditions are common for the majority of the montane forest areas (see “Terrestrial Vegetation Ecology” section). Restoration treatments, especially prescribed fire, increase the diversity of native pollinators, such as butterflies (Huntzinger 2003). Canopy arthropods also benefit from ecological restoration treatments, if the treatments also enhance tree, shrub, and herbaceous plant diversity within forest stands (Rambo et al. 2014). Invasive, non-native plants can reduce pollinator habitat, especially if the non-native plants are wind pollinated grasses such as cheatgrass. Large areas in the foothill zone and eastside lower elevation areas have had cheatgrass and other non-native annual grass invasions. Pollinator habitat is greatly reduced in these areas.

Habitat for cavity excavators (especially snags) is highly varied. In conifer forests, the average number of snags in an area are within the lower end of the desired conditions but are highly variable spatially and often within or above the natural range of variation (Safford et al. 2013, Meyer et al. 2013a). This high spatial variability means that there are many areas that have no snags and other areas that have more than the average number. Overall, large snag levels, especially very large snags (greater than 30 inches in diameter) may be limited in the forest landscape, especially within plantations, the wildland-urban intermix, and areas impacted by windstorms. There are fewer snags in oak woodlands than conifer-dominated areas. However, in oak woodlands, dead branches on live trees often provide suitable habitat for cavity excavators.

Tribal Uses and Biocultural Diversity

As mentioned previously, the people of various tribes in the area are and have been tied to different ecosystems across the bio-region that provide basic life needs of food, shelter, and

culture (See "Tribal Relations and Uses" section). This includes gathering and tending trees such as black oaks and pinyon pines for primary food sources, medicinal plants, basketry and shelter from plants, fish and game harvest (Anderson and Moratto 1996; Anderson 2006), and culturally important activities including cross-Sierra travel and trade trips, and sacred ceremonies.

There was and to a lesser degree currently is an interaction between Native American land uses and management and ecosystem condition and function. Native Americans often used fire or other means to improve basketry or food materials, to improve habitat conditions for game species such as deer, and to maintain meadow ecosystems. This use of fire included riparian areas, because a high proportion of plants that are important for basket weaving occur there.

On the west side, plants such as willow, dogwood, or big-leaf maple sprout following top removal (Fites-Kaufman et al. 2006). The stems grow straighter, with fewer insect nests when they have been burned or cut (Anderson 2006). Although fire naturally occurred in riparian areas at different intervals throughout the bio-region, it is well documented that Native Americans supplemented lightning ignitions with targeted burning. Other species that require regular burning to maintain their viability and quality as weaving materials include beargrass, deer grass, redbud, *Ceanothus* species, giant chain fern, and white root. There are other examples as well.

On the east side, seed, root, and bulb gathering occurred, and in some cases, irrigation was used to encourage desirable species (Slaton and Stone 2013a, 2013b). Activity in sagebrush was concentrated near meadows. Fire was conducted in the spring and fall. The Paiute, Shoshone and Washoe used pinyon pine extensively and still collect products from the trees, including pine nuts, pitch, and wood products. Native Americans pruned the trees, raked away the litter, weeded around them, and burned to increase productivity and protect them from wildfire. Elder interviews attest to the fact that fire was used to foster growth of particular food groups such as wild onions, elderberries, and caterpillars. Fire was used to eliminate excess fuels that threatened favorite pinyon pine stands.

The condition of plants, animals, and insects that tribes use, as well as the ecosystems they occur in is low for low- and mid-elevation areas (foothill, montane, eastside pine, and sagebrush vegetation types) and moderate for higher elevation areas (upper montane, subalpine, and alpine vegetation types). This is related to the condition of vegetation and fire regimes relative to the natural range of variation. Dense vegetation, and limited low- and moderate-intensity fire are primary factors. Current vegetation conditions are denser and less diverse in the understory, and many important plants such as black oak, shrubs used for basketry, and other plants used for traditional foods or medicines are in poor condition. Traditional travel routes are covered in dense vegetation, impeding ease of travel, particularly for elders and young tribal members. Management for biodiversity, particularly through the use of beneficial fire, would help to maintain viable populations of the diverse plants and animals that are necessary for Native American traditionalists to continue their cultural practices.

Integrated Terrestrial Ecosystem Sustainability

The integrated terrestrial sustainability condition varies by the ecological and elevational zone. For details by each zone and major vegetation type, see the "Fire Trends," "Terrestrial Vegetation Ecology," and "Insects and Pathogens" sections. Here a synthesis of the overall findings from each of these sections is presented.

In most lower and mid-elevation areas, indicators of terrestrial ecosystem sustainability point to a low and moderate condition as shown in Table 57 for the west side and Table 58 for the east side

(USDA FS 2004, USDA FS 2011). The greatest contributors are vegetation and fire conditions that are outside of the natural range. On the east side, invasive plants are widespread, although still scattered in many locations. The ecosystems are still functioning but may be at a tipping point for large change. This would include a higher susceptibility to widespread drought and insect- and pathogen-related plant and tree mortality. It includes a susceptibility to widespread changes in connectivity, forest cover, and mature forest area from increasingly large, high-intensity fires.

Table 57. Overall ecosystem sustainability conditions by characteristic from National Forest Sustainability Report* by major ecological and elevational zone for the west side

Characteristic	Foothill	Montane	Upper Montane	Subalpine/Alpine
Area affected by insects and pathogens beyond natural range	Current, low to susceptibility high	Current moderate, susceptibility high	Current moderate, susceptibility moderate	Low
Area affected by air pollutants that may cause negative effects	High	High	Moderate	Moderate to low
Area affected by invasive species	High	Moderate	Moderate	Low
Area with fire condition class outside of natural range	Moderate	High	Moderate	Low
Area with vegetation condition outside of natural range	Moderate	High	Moderate	Low

* USDA FS 2004, USDA FS 2011

Table 58. Overall ecosystem sustainability conditions by characteristic from National Forest Sustainability Report* by major vegetation types for the eastside

Characteristic	Sagebrush/ pinyon-juniper	Jeffrey pine	Red fir	Desert xeric shrub
Area affected by insects and pathogens beyond natural range	Current, low to susceptibility moderate	Current moderate, susceptibility high	Current moderate, susceptibility moderate	low
Area affected by air pollutants that may cause negative effects	Low, but some transport of ozone east of the San Joaquin River drainage	Low, but some transport of ozone east of the San Joaquin River drainage	Low, but some transport of ozone east of the San Joaquin River drainage	low
Area affected by invasive species	Moderate, extensive areas of non-native grasses	moderate	low	moderate
Area with fire condition class outside of natural range	moderate	high	moderate	moderate
Area with vegetation condition outside of natural range	moderate	high	moderate	Low

* USDA FS 2004, USDA FS 2011

Environmental Consequences to Terrestrial Ecosystem Processes and Functions

Consequences Common to All Alternatives

Fire Regimes and Fire as an Ecological Process

Fire regimes would continue to be departed from the natural range of variation for much of the mid- and lower elevation areas in the analysis area, except where moderate to high levels of restoration occur across broader areas. Because fire operates at large scales, landscapes (areas greater than 10,000 acres) with at least 40 to 60 percent restoration are necessary to effect changes in large fire patterns (the amount of high-intensity or crown fire; see the "Fire Trends" section). The alternatives vary in the amount of the landscape that would have restoration of varied types (such as mechanical treatments, prescribed fire, or wildfire managed to meet resource objectives). The alternatives also vary in the intensity of the treatments, or degree of change in vegetation that affects fire type. Finally, the alternatives vary in the amount of fire that would be applied or managed on the landscape at intensities within the desired condition that would have beneficial effects to the vegetation, and would reduce fire regime interval departure.

In this section, the broader characterizations of the alternatives are described by the vegetation type actions would most likely occur in. The majority of the mechanical and prescribed fire restoration treatments are most likely to occur in the upper foothill ponderosa pine and montane mixed conifer forest types on the west side and in the pinyon-juniper and Jeffrey pine woodlands on the east side. Wildfire managed to meet resource objectives is most likely to occur in the upper montane and subalpine forests, particularly on the west side and in the Kern River drainage. Large areas of montane, mixed conifer forests and chaparral are highly likely to have fire managed to meet resource objectives. The greater amounts of mechanical treatments in alternatives B and D in strategic locations would increase the likelihood of larger prescribed fires and managed fires to meet resource objectives in montane areas. These characterizations by vegetation type are used to analyze the expected consequences of the alternatives below.

Table 59 and Table 60 below summarize the expected consequences of the alternatives by major vegetation type.

Table 59. Fire regime integrity for westside vegetation types by alternative

Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D
Chaparral	Low to moderate	Moderate	Low to moderate	Moderate
Oak woodland	Moderate	Moderate	Moderate	Moderate
Ponderosa pine-black oak	Low	Moderate	Low to moderate	Moderate
Dry mixed conifer	Low	Moderate	Low to moderate	Moderate
Moist mixed conifer	Low	Moderate	Low to moderate	Moderate
Red fir	Moderate	Moderate to high	Moderate	Moderate to high
Jeffrey Pine	Very low to low	Moderate	Low	Moderate
Kern Plateau forests	Moderate	Moderate to high	Moderate	Moderate to high
Subalpine and Alpine	High	High	High	High

Table 60. Fire regime integrity for eastside vegetation types by alternative

Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D
sagebrush	Moderate	Moderate to high	Moderate to high	Moderate to high
Pinyon-juniper	Moderate	Moderate to high	Moderate to high	Moderate to high
Eastside Jeffrey pine	Very low	Low to moderate	Low	Moderate
Dry mixed conifer	Low	Low	Low	Moderate
Mountain mahogany	Moderate	Moderate to high	Moderate to high	Moderate to high
Desert shrub/black brush	Moderate	Moderate to high	Moderate to high	Moderate to high

In all alternatives, there is little difference among the alternatives in consequences to the subalpine and alpine areas. Limited vegetation and harsh growing conditions result in slow changes in vegetation there. The majority of these areas are in wilderness or inaccessible locations.

Westside Upper Montane Forests

In all alternatives, red fir and lodgepole pine forests have at least moderate integrity owing to the relatively longer fire return intervals in these forest types (median fire return interval of approximately 30 to 50 years). However, most red fir and lodgepole pine forests have missed one or two fire return intervals, resulting in a variety of ecological impacts associated with fire exclusion (such as increased fuel loading and tree densities). The upper montane areas are among the most vulnerable to climate change (North 2014, Meyer 2013a). This is because they are experiencing and will continue to experience the greatest relative change in type of precipitation and temperatures. Fires may become more frequent in these areas and disrupt the current moderate levels of fire regime integrity and resilience.

Current Jeffrey pine forests in the Sierra Nevada are moderately to highly departed from their historic fire regime, because of decades of fire exclusion in these frequent fire-regime forests. Under all alternatives, fire regimes in Jeffrey pine forests would be relatively intact on the Kern Plateau and neighboring upper montane landscapes (like the Golden Trout Wilderness), owing to the many wildfires that are managed to meet resource objectives in this portion of the Sequoia National Forest.

Westside Subalpine and Alpine Vegetation

Alpine vegetation and many subalpine forests at higher elevations would have high fire regime integrity under all alternatives, because of the very long historic fire return intervals in these vegetation types that often exceed 150 to 200 years. This is greater than the current fire exclusion period of the 20th and early 21st centuries. As a result, they are within the natural range of variation with respect to fuel loading and fire regimes. All alternatives support at least moderately high resilience to fire.

Eastside Vegetation

Some eastside vegetation has fire regimes similar to the westside vegetation. This includes the upper montane, subalpine, and alpine vegetation types. The fire regimes for eastside Jeffrey pine and eastside mixed conifer are similar to that described for westside ponderosa pine and dry mixed conifer.

Eastside Sagebrush, Pinyon-Juniper, Arid Shrublands

Although highly variable, the historic fire return intervals were relatively long in sagebrush (40 to 450 years), pinyon-juniper woodlands (90 to 150 years), curl-leaf mountain mahogany (60 to 70 years), and xeric shrub and blackbrush (more than 600 years). Under all alternatives, arid shrublands and woodlands would have at least moderate fire regime integrity, owing to the relatively long fire return intervals in these arid vegetation types. However, increasing and excessive wildfire activity in these vegetation types that exceed the natural range of variation (that is, too frequent fire compared to the historic fire regime) would result in reduced fire regime integrity. This reduced integrity is often associated with vegetation type conversion favoring non-native annual grasses such as cheatgrass and red brome.

Ecological restoration treatments in some arid shrublands and woodlands (like sagebrush invaded by pinyon pine), could increase the resilience of these ecosystems to wildfires and reduce the probability of excessively frequent fire that exceeds the natural range of variation. However, all alternatives would support at least moderate fire regime integrity in many arid shrublands and woodlands (such as xeric shrub and blackbrush), because of the long historic fire return intervals in these vegetation types that often exceed 100 to 200 years. This is greater than the current fire exclusion period of the 20th and early 21st centuries.

Carbon Stocks, Sequestration, and Stability

Under all alternatives, there would be several conditions and trends that greatly influence current carbon stocks, sequestration, and especially stability. First, dense forests would continue to occur across much of the area, because there are no alternatives that restore more than 50 percent of most landscapes. This means that carbon storage and sequestration will continue in those areas. There may be increases in carbon sequestration in thinned forests, since individual trees would be less stressed and may have faster growth. At the same time, under all alternatives, there would continue to be large, high-intensity fires, especially within dense forests lacking restoration. When these fires occur, there will be large conversions of carbon stored in forests and soil litter, into carbon dioxide in the air. Climate change will also limit carbon sequestration and carbon stocks following these fires through increased evaporative demand that limits tree growth rates and regeneration.

Tribal Uses and Biocultural Diversity

There would be continued use of forest lands, vegetation, insect, and animal materials by tribes in all alternatives, similar to what occurs now. More information on how these are determined and negotiated is covered in the later section on “Tribal Relations and Uses.” The condition of ecosystems, plants, insects, and animals used by tribes varies by alternatives. In addition, all but alternative A contains specific direction that would improve the condition and use by tribal members. The rate and type of ecological restoration that would result in improvements varies by alternative.

Consequences Specific to Alternative A

Fire Regimes and Fire as an Ecological Process

Westside Foothills Vegetation

Fire regime integrity would continue to be low in alternative A in most areas. There would continue to be some restoration treatments in areas around communities, but the width of the defense zone and threat zone, is limited. The restoration may also increase the amount of non-

native, annual grasses that can decrease resilience. Native plants can become crowded out and fires can burn more frequently than the natural fire regime. There would be some restoration aimed at non-native plant invasions and removals but it would be limited.

Montane Forests

Fire regime integrity would continue to be low in montane forests in alternative A. This analysis assumes that a low amount of any type of treatment would occur in alternative A. It also assumes that most of the restoration treatments would result in limited to moderate changes in vegetation structure and composition that would influence fire type, fire severity, and effects. Most of the treatments would occur in montane mixed conifer and ponderosa pine vegetation. Fire regime integrity would continue to be low across most areas, with high proportions of crown fire and fire severity expected during peak fire season fires. The trend of increased fire severity would continue or worsen due to increased burned area and fire size (see the "Climate Change" and "Fire Trends" section).

There is expected to be some restoration of wildfires used primarily to meet resource objectives but little to none of this would occur in montane forests except for in the Kern River drainage on the Sequoia National Forest. Large areas in the Kern River drainage have already had managed fire (greater than 30 percent) and would continue to in alternative A. Fire regime integrity would continue as moderate or shift to high in some of this area.

Beneficial effects of fire to understory flora would be limited because prescribed fires would be limited. Some plants and birds would benefit from large, higher severity fires, but overall, a deficit of low- and moderate-severity, frequent fire would have the most beneficial effects. This latter type of fire would be limited in alternative A.

Upper Montane Forests

As described above under all alternatives, upper montane forests would continue to have moderate fire regime integrity. There would be limited restoration treatments in this area. There would continue to be some ecologically beneficial fires where low and mixed severity fires occur. It is uncertain how many such fires will happen. The greatest likelihood is in the Kern River drainage, where remote areas have had extensive areas of wildfires managed to meet resource objectives.

Subalpine and Alpine Vegetation

Alternative A would support continued moderate to high fire regime integrity in subalpine forests as described under all alternatives. There would be limited restoration treatments in these areas. Similar to upper montane forests, there would continue to be some ecologically beneficial fires, especially in wilderness and in the Kern River drainage.

Eastside Arid Shrubs and Woodlands

The least amount of restoration treatment would occur in alternative A in arid shrubs and woodlands. There would be less restoration of sagebrush areas with conifer invasion, and in pinyon-juniper and Jeffrey pine forests. There would be less restoration of fire as an ecosystem process using prescribed fire. Invasive plant treatments would continue to minimize introductions of invasive species when possible, but invasive species would continue to expand and potentially alter fire regimes.

Carbon Stocks, Sequestration, and Stability

Low levels of vegetation restoration would continue in alternative A, while the likelihood of large, high-intensity fires would increase (see "Fire Trends" section, Westerling et al. 2015). This would result in increased emissions of carbon to the atmosphere and decreases in carbon stocks and sequestration. Most of the carbon stocks and fires both occur in the montane and upper montane zones. Therefore, an individual very large fire can have large impacts on carbon stocks and emissions. There would be a negative impact of alternative A on carbon stability, carbon stocks, and sequestration rates.

Landscape Connectivity

Alternative A would result in few indirect effects to landscape connectivity because treatment levels would be low. The primary consequence would be the effect of treatments in reducing the likelihood of large high-intensity fires that can disrupt connectivity for many species, except those using early seral habitat. The extent of restoration treatments is very low (less than 10 to 15 percent of the low and mid-elevation landscape area) and thus the likelihood of large, high-intensity fires would increase in alternative A (See "Fire Trends" section, Westerling et al. 2015) and cause fragmentation of forested areas and areas of older and mid-aged chaparral. These fires can also fragment sagebrush habitat.

Special Habitats

Old Forest

The treatments in alternative A would have little to no impact on large trees and the proportion of area in old forest. There are diameter limits restricting the harvest of any trees greater than 30 inches in diameter under almost all conditions. Treatment area is limited in alternative A and there are also limitations on the forest canopy cover changes that can occur in montane forests or other areas where the California spotted owl, northern goshawk, Pacific fisher, or Sierra marten occur. This would result in a continuation of large areas of high forest density that are susceptible to high-intensity fires (see "Fire Trends" section and Fire Ecology supplemental report). There is an increased likelihood of large, high-intensity fires under current treatment levels (see "Fire Trends" section; Westerling et al. 2015). Therefore, this analysis assumes there would be an increased likelihood of large, high-intensity fires in areas with old forests.

It is unknown what proportion of areas burned in future fires would be high severity and result in large tree mortality. Recent fires have ranged widely in large tree mortality levels and extent. Given the limited levels of current old forest and the long time it takes to redevelop (several hundred years), the impact of single, large, high-intensity fires may have negative impacts on old forests. The likelihood of very large "mega fires" (greater than 50,000 acres like the King Fire that had extensive areas burned in old forest in Rubicon River Canyon at extremely high intensity) is thought to be increasing because of climate warming, longer fire seasons, and drier fuel conditions (Millar and Stephenson 2015). It is unknown when or where these types of fires may occur, but the likelihood exists in the analysis area and the likelihood is increasing.

Complex Early Seral Forest

The impacts of alternative A on complex early seral forest are related to the consequences described above for old forest as well as likely salvage, reforestation, and other post-fire restoration treatments. The amount and distribution of complex early seral habitat would likely increase under alternative A because the amount of high-intensity fire is likely to increase. The spatial pattern of the complex early seral forest would likely continue to be mostly in large

patches from large high-intensity fires. The exception would be in the Kern River drainage, where extensive fire restoration in the last decade has resulted in a wide variety of small and medium size high-severity fire patches (Meyer 2015). Fires are starting to burn into previously burned areas, limiting the potential in this area especially on the Kern Plateau to develop large high-severity fire patches (Vaillant 2009, Ewell et al. 2012).

There is no specific management direction under alternative A directed at desired conditions, guidelines, or standards for complex early seral forest. There is direction to leave at least 10 percent of burned areas unsalvaged. There is uncertainty how much of burned areas would be restored in ways that would decrease the ecological character of complex early seral forest habitat. However, at the project level, recent fires have had a wide range in the amounts proposed to be left unsalvaged or without reforestation. In the analysis area, between 76 and 90 percent of the burned forest areas have been left unsalvaged for a variety of reasons, including purposeful retention of areas to provide for complex early seral forests, excluding areas that are too steep or inaccessible, and excluding areas that would have little commercial value by the time projects are implemented (for example, the Aspen and French Fires on the Sierra National Forest). Only 9 to 20 percent have had or are planned for reforestation. Therefore, while there is a high uncertainty level on the amount of complex early seral forest that would retain its ecological character after fires, currently the majority of burned areas are not treated and are left to provide these habitats.

Limited Special Habitats

There is no specific direction for special habitats with limited distribution in the current forest plans. There is species-specific direction for some species, such as bats, that use caves. There is direction to conduct surveys for sensitive species and for rare plants. In general, as a result of the surveys, there is protection of rare and sensitive plants. There are impacts that occur as a result of other activities such as recreational climbing on cliffs and rock outcrops or in caves that are not tracked directly. There are unknown consequences to these activities but there have been observations that in some areas it is concentrated.

Keystone Species Groups

Pollinators – Pollinators are positively impacted by restoration treatments that result in sunny openings and improve conditions on the forest floor. Many flowering plants benefit from fire, although in large fires where non-native, invasive plants expand, they have an opposing impact. In alternative A, treatments would be very limited that benefit pollinators. There would be limited amounts of treatments that generally retain moderate and high canopy cover, and limited amounts of prescribed fire. Overall, alternative A would continue to maintain dense forest conditions, with limited fire restoration, that retains poor flowering plant conditions that pollinators depend on.

Primary Cavity Excavators – There would be increases in primary cavity exactor habitat because limited restoration would perpetuate dense forest conditions, which would continue to have trees dying and increasing snag levels. However, there is the potential that they can be harvested outside of wildland-urban intermix areas for fuel or hazard.

Tribal Uses and Biocultural Diversity

Alternative A has the least change in conditions of ecosystems, plants, insects and animals of interest to and used by tribes than any of the other alternatives. Conditions would continue to be poor in most areas, with only limited areas where restoration improves them. There would be limited projects that specifically address tribal member concerns and incorporate some traditional ecological practices, but in a limited way.

Integrated Terrestrial Ecosystem Sustainability

With limited restoration levels, vegetation would continue to remain dense overall and outside the natural range of variation in most low and mid-elevation areas (see "Terrestrial Vegetation Ecology" section). There would continue to be a high susceptibility to insects, pathogens, and air pollution stress (on the west side especially).

Consequences Specific to Alternative B

Fire Regimes and Fire as an Ecosystem Process

Westside Vegetation

Three types of restoration treatments would occur in alternative B that would move the landscape toward desired conditions for fire regimes and restoration of fire as an ecosystem process (TERR-FW-DC-06). The first are the vegetation restoration treatments (TERR-FW-OBJ-01 to 02), especially in focus landscapes or other large landscape areas as described in the management approaches below.

> Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.
>
> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed primarily for resource objectives.
>
> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.

Mechanical treatments and prescribed fire in patches throughout the focus landscapes would result in restoration of fire as a process in these areas and increase the likelihood that when large wildfires move through these areas, fire severity would be mixed or lower than adjacent unrestored areas (FIRE-FW-DC-03). Vegetation restoration along ridges and some roads (MA-GWPZ-GDL-01) would increase the likelihood that large prescribed fires could be used to restore fire to landscape areas, especially where there is steep and inaccessible terrain. In alternative B, the focus landscapes and restoration along ridges and roads would occur mostly in the montane and foothill zones.

At higher elevations in the upper montane and subalpine areas or in the Kern River drainage (Sequoia National Forest, TERR-FW-OBJ-03), there would be additional restoration emphasizing wildfire managed to meet resource objectives (MA-WRZ-GOAL-01; MA-WRZ-DC-01 to 03; Standards MA-WMZ-STD-01 to 02). There would be less restoration along ridges and roads because there are more natural features (like rock outcrops along ridges) and recent fires to use as fire management boundaries (MA-WRZ-STD-01). There would also be localized restoration of fire as part of restoring areas of tribal importance (TERR-FW-DC-09).

Additional specific management direction to restore fire as an ecological process is specific to individual vegetation types with associated consequences as described below.

Westside Foothills Vegetation

There would be an increase in fire regime integrity in alternative B because of restoration treatments that would reduce effects of wildfires and restore fire as an ecosystem process in some areas. There would be an increase in restoration toward desired condition for vegetation and restoration of fire in alternative B as compared to alternative A. In the community wildfire protection zone, the treatments would emphasize restoration along ridges and roads and may have some (but less) ecological benefits for chaparral vegetation and fire ecology. Desired conditions and guidelines for chaparral areas are based on the natural range of variation for chaparral fire regimes and associated vegetation (TERR-CHAP-DC-01 to 02; TERR-CHAP-GDL-01 to 02) but along roads, ridges, and especially in community buffers, there would be a greater emphasis on larger areas of younger chaparral (MA-CWPZ-DC-01; MA-CWPZ-GDL-01 to 02).

Desired conditions for blue oak woodlands include periodic fire to maintain lower dead grass and litter levels and low-severity fire effects (TERR-BLU-DC-02). There would be restoration treatments more oriented toward the ecological desired conditions for chaparral and blue oak woodland associated with restoration of areas of tribal interest (Sequoia National Forest, TERR-FW-OBJ-04). Many foothill areas have vegetation and plants of importance to tribes. Much of this restoration would include prescribed fire and restoration of native plants. This would include reduction in non-native annual grasses, which would increase fire regime integrity and resilience. In blue oak woodlands, it is nearly impossible to replace all non-native annual grasses, but even a modest shift in some locations toward native perennial grasses would be an improvement in restoring favorable fire effects. These treatments would have beneficial fire effects to plants and animals and improve fire regime integrity.

Montane Forests

Similar to the foothill zone, there would be an increase in fire regime integrity in alternative B, but the increase would be greater because more treatments are focused in the ponderosa pine and mixed conifer forests of the montane zone. This is because there is an emphasis on restoration objectives of montane and other ecosystems that historically had frequent fire (Sequoia and Sierra National Forests: TERR-FW-OBJ-01) and on management approaches prioritizing restoration in these areas (see below).

> Areas that historically supported more frequent fire, like ponderosa pine and Jeffrey pine-dominated forests, and areas with high existing levels of understory fuels are prioritized for treatment.

There would be a moderate movement toward the desired fire regime in alternative B, primarily in the focus landscapes and in the Kern drainage (Sequoia and Sierra National Forests: TERR-FW-OBJ-01 to 03).

Restoration of up to 40 percent of the area to a lower forest density and fuel condition would increase the likelihood that fires would be less severe (see “Terrestrial Vegetation Ecology” section). There would be fewer large areas of high-intensity fire, and instead fire effects would be more mixed severity (see “Fire Trends” section). There is a moderate level of uncertainty that these beneficial effects would occur because of restrictions on spring burning from limited operating periods for California spotted owl, and air quality limitations. Where there is prescribed burning, there would be considerable beneficial effects on the plants and animals that benefit from fire. This would especially occur when there is restoration of sunny openings and heterogeneity coinciding with the burned areas. Many of the plants that are adapted to fire are also adapted to sunlight. In alternative B, similar to the consequences described above for the

foothill zone, there would be additional beneficial fire effects to plants and animals through increased emphasis on projects related to tribal interest.

Upper Montane Forests

The greater use of wildfire fire used to meet resource objectives in alternative B would substantially increase the integrity of fire regimes in red fir and lodgepole pine forests. Upper montane red fir, Jeffrey pine, lodgepole pine, and chaparral are departed from historic fire return intervals, but only moderately, compared to the high departure in montane forests. Recent wildfires and wildfires managed to meet resource objectives have resulted in fire severity levels in upper montane areas that are mostly mixed and increased fire regime integrity. There have been some larger patches of high-severity fire but overall there has been low and moderate severity fires that have decreased vegetation density, increased heterogeneity, and decreased surface fuels. This trend of increased fire regime integrity is expected to continue in upper montane forests.

Subalpine and Alpine Vegetation

The greater use of wildfire to meet resource objectives in alternative B, would increase the integrity of fire regimes in some subalpine forests. This is especially true in subalpine landscapes with relatively short fire return intervals (such as forests with spatially contiguous fuel loading, south-facing aspects, and at lower elevations).

Eastside Arid Shrubs and Woodlands

Alternative B would have increased levels of restoration in sagebrush and pinyon-juniper areas (Inyo National Forest: TERR-FW-OBJ-01 to 03; SPEC-SG-OBJ-01). The restoration would include removal of conifers in sagebrush areas and treatment aimed at reducing non-native annual grasses (INV-FW-OBJ-01). There would be some increases in prescribed fire. These restoration treatments would increase fire regime integrity and would improve habitat for greater sage-grouse. The fire-climate scenarios showed that restoration of 30 percent of the sagebrush and pinyon-juniper landscape was sufficient to decrease the likelihood of large fires and burned areas (Westerling et al. 2015). The combined effect of the ecological restoration and increased likelihood of large fires will be increased fire regime integrity.

There would be an increased emphasis on cooperation with tribes and restoration of areas of tribal interest in alternative B. This would include some use of prescribed fire and also some restoration of areas of tribal interest that are at risk of high-intensity fire. These types of restoration would benefit plants, insects, and animals that are associated with natural fire regimes.

Carbon Stocks, Sequestration, and Stability

Under alternative B, there would be restoration treatments across substantial landscape areas (up to 30 percent or more). These treatments would move vegetation toward the desired conditions, increasing heterogeneity and reducing forest density. This would increase fire resilience and as a result carbon stability (TERR-FW-DC-02, -05). There may be short-term decreases in carbon storage where trees are removed by thinning, but a long-term increase through increased carbon stability. There would be short-term increases in carbon emissions where there are prescribed fires or wildfires managed to meet resource objectives but these would be offset by reductions in potential high-intensity wildfire emissions (see “Air Quality” section). The impact of restoration on carbon sequestration is more uncertain. There may be increases because vegetation in the

thinned areas may have more optimal growing conditions. There may be decreases because trees are removed.

Landscape Connectivity

The impacts of alternative B on connectivity would be similar to alternative A, but with a lower likelihood of fragmentation of forested areas from large high-intensity fires. There is management direction specifically directed at connectivity for wide-ranging species and climate-related migrations (TERR-FW-DC-04; TERR-MONT-DC-02; SPEC-CSO-DC-01, SPEC-PF-DC-01; SPEC-PF-DC-08 to 10; SPEC-PF-STD-01, -03 to 04; Sequoia National Forest: TERR-FW-GDL-01). This includes management approaches to prioritize ecological restoration in areas providing connectivity in areas where it is limited for forest species. This would provide connectivity for other species needing overhead cover. For example:

> **Pacific Fisher**
>
> Prioritize ecological restoration in landscapes around key linkage areas and areas with suitable habitat at highest fire risk.

There would be lower likelihood of large high-intensity fires because of the increased area with restoration, especially at the low and mid-elevation areas (see “Fire Trends” section). The likelihood of large high-intensity fires would still increase because of climate warming, and these fires could result in fragmentation of forested areas. These fires could also increase connectivity of complex early seral habitat (see section in the following pages) but these habitats tend to be more dynamic in space and time limiting the need for true connectedness. There would be an increased emphasis in alternative B in restoration treatments in key forested linkage areas for fisher that would decrease the likelihood of fragmentation of key north-south forest connecting areas. There would be an increase in connectivity of open forest habitat because the restoration treatments would be directed toward desired conditions for forest heterogeneity and reduced overall forest density.

Special Habitats

Old Forest

Consequences to old forests varies between westside and eastside areas in the analysis area. This is because management direction for the California spotted owl and Pacific fisher apply to the westside portions and affects old forest direction. The consequences are discussed separately as a result.

Westside Old Forests: Alternative B would result in increased restoration and resilience of old forest, especially in montane ponderosa pine, mixed conifer, and black oak forests. The approach to restoration in old forest would vary widely depending upon location, as shown in Table 61. The differences in approaches would affect potential large tree losses from wildfire, drought, insects, pathogens, safety issues, and excesses in densities over desired conditions.

Across all areas, management approaches to perpetuate, increase, and restore old forests would be applied including:

> To perpetuate old forest components, encourage the development of old forest conditions in areas where old forest is lacking. Restore patchiness within stands and sustain large black oak trees, pine tree regeneration and snags, over time.
>
> To protect old forest components from uncharacteristic fire, prioritize restoration in key old forest areas. Methods of protecting existing old forest components on the landscape

may include thinning, selective harvest, prescribed fire and wildfires managed to meet resource objectives.

Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.

Table 61. Plan direction and effects on large tree densities by location in alternative B

Plan Direction	Inside fire protection zones, outside focus landscapes	Inside fire protection zones and focus landscapes	Outside fire protection zones, inside focus landscapes	Outside fire protection zones, outside focus landscapes
Large tree direction and consequences	Manage for desired densities	Manage for desired densities	30-inch tree diameter limit, operational exception	30-inch tree diameter limit, operational exception
Wildlife-related large tree direction	Retain and recruit den and nest trees, especially old and with decadence	same	same	same
Wildlife-related canopy cover direction	Limited reduction of canopy cover in fisher and owl habitat	Manage primarily for desired conditions; some limitations in protected activity centers	Manage primarily for desired conditions; some limitations in protected activity centers	Limited reduction of canopy cover in fisher and owl habitat
Potential harvest of large trees, (safety issues, excess of desired conditions)	Limited, amount uncertain (similar to D)	Limited amount, uncertain (similar to D)	Little to none (similar to A)	Little to none (similar to A)
Potential loss of large trees to drought, insects, pathogens and fire	Low resilience (limited by canopy retention restrictions)	Moderate to high resilience	Low to moderate resilience (less in stands originating from railroad logging)	Low resilience, similar to A

Outside of the fire protection zones, there would be a strict 30-inch diameter limit (TERR-FW-STD-01) as in alternative A. There would be little to no reductions in large trees associated with restoration treatments within this area. Within the fire protection zones, there would be no diameter limit and instead there would be management of large trees using desired conditions for large tree densities and old forest area (TERR-OLD-DC-03 to 04). Across all areas, there would be old forest and wildlife-related desired conditions and guidelines to retain and restore large, and old trees that are important for nesting and denning (TERR-OLD-DC-02, -05; SPEC-CSO-STD-01c; TERR-FW-GDL-01).

The primary purposes for removing large trees within the fire protection zones would be to move stands toward desired conditions for heterogeneity, restore species composition, and improve forest resilience by reducing forest density. The removal of older and very large trees (greater than 35 inches diameter at breast height) would not occur, except in rare instances where human safety is imminently threatened (FIRE-FW-GDL 09; SPEC-FW-GDL-01).The consequences of wildlife related management direction on canopy cover and forest density on large tree densities would also vary by location. Where there is little to no restoration around large trees, there would

be a continued vulnerability to mortality from drought, insects, disease, and high-intensity wildfire. This would occur outside of restored areas that are dissimilar to desired conditions (TERR-POND-DC-02 to 04; TERR-DMC-DC 03 to 06; TERR-MMC-DC 02 to 06; TERR-RFIR-DC 01, -03, -05 to 07; TERR-LDGP-DC-01, -04 to 11; TERR-UMJF-DC-01, -03 to 07). There may be some decrease in large tree densities as trees die where they are overcrowded. Some large trees may die during prescribed fires or wildfires managed to meet resource objectives. There is management direction to limit this mortality with best practices (FIRE-FW-GDL-09), but some is likely to occur because of the buildup of fuels around large and especially old trees.

These impacts of increased likelihood of reductions in large tree densities from drought, insects, pathogens, and fire would occur most outside of the focus landscapes where California spotted owl and Pacific fisher habitat management direction limit opportunities to reduce forest densities (see "Montane Forests" section on page 230). Within the focus landscapes in areas outside of the fire protection zones that overlap with stands originating from railroad logging, there would also be continued vulnerability to mortality from drought, insects, disease, and wildfire. This is because these areas have a high proportion of younger, large trees (greater than 30 inches in diameter) that cannot be removed (TERR-FW-STD-01). Otherwise, in focus landscapes there would be more substantial reductions in tree density in the stands around the large trees because more California spotted owl and Pacific fisher habitat can be restored toward the vegetation desired conditions.

Inside the focus landscapes, there is greater ability to restore forest heterogeneity and tree density to desired conditions. Treatments here would increase the resilience of large and old trees to drought, insects and pathogens, ozone, and fire. This would make it more likely (Fry et al. 2015) that the amount of large tree mortality (Mantgem et al. 2009) reverts to historic levels. The treatments would make it more likely that medium-sized trees will grow into larger trees, although they may not be old. Restoration of heterogeneity and fire as an ecological process would increase associated biodiversity and processes.

The amount of large, high-intensity fire would most likely have the greatest negative impact on the amount of old forests and large trees, except possibly in the focus landscapes. Similar to alternative A, there would continue to be an increased likelihood of large, high-intensity fires (see the "Fire Trends" section; Westerling et al. 2015). Within the focus landscapes, near the end of the analysis period (10 to 15 years) there may be large areas (greater than 10,000 acres) that have enough restoration treatments (greater than 40 to 60 percent) of sufficient intensity to reduce fire intensity and severity across most of the individual focus landscapes. There would be beneficial impact to old forest in these areas, reducing the likelihood of high-severity fire patches and large tree mortality during large, high-intensity fires. The remaining area would continue to have an increased likelihood of high-intensity fire.

Where restoration occurs outside of the focus landscapes, the treatments would be lower intensity because of the restrictions on wildlife management direction limiting canopy cover removal and the amount of treatment allowed. As a result, outside of the focus landscapes, the consequences for old forest would be similar to alternative A. Additionally, areas within the focus landscapes but outside of the fire protection zones will also have similar consequences for old forest as alternative A, where those areas overlap with stands originating from railroad logging. These areas may comprise up to one-half to two-thirds of the potential focus landscape areas, especially on the Sierra National Forest.

The consequences of wildfires managed to meet resource objectives on old forest are difficult to analyze. This is because they are difficult to predict. In the Kern River drainage, there would

continue to be positive impacts on old forests from these types of fires. Fires in the last 15 years in this area have killed some large and old trees but have substantially reduced the likelihood and extent of large, high-intensity fires (Meyer 2015), which have the greatest negative impact on old forests.

Overall, alternative B may have positive but limited impact on large trees and old forests, particularly in the focus landscapes, but this could be outweighed by continued increases in large, high-intensity fires outside of the focus landscapes and Kern Drainage to an unknown degree.

Eastside Old Forests: The consequences for eastside old forests would be based on management toward the desired conditions for large tree densities and landscape proportions of old forests. It is assumed that there would be very limited if any removal of large trees during restoration. The same restrictions on removing trees greater than 30 inches in diameter in westside forests applies to eastside forests (TERR-FW-STD-01). Because of the drier conditions, it is more likely that medium-diameter trees (greater than 20 inches diameter) are old and these could be removed, but it is unlikely. Most thinning that does occur during restoration is used as fuelwood or for community protection. Restoration would result in increased resilience of old forests where it decreases forest density and increases heterogeneity. There would be limited amounts of restoration in alternative B but an increase over current levels (alternative A). There would be a slight increase in resilience. There would continue to be losses of large and old trees from drought, insects, pathogens, and climate change in unrestored areas.

Complex Early Seral Forests

There is specific management direction for complex early seral forests in alternative B including: desired conditions (TERR-CES-DC-01 to 03), standards (SPEC-CSO-STD-06), and guidelines (TERR-CES-GDL-01, -03). This includes retaining at least 10 percent of large contiguous blocks (1,000 acres or more) of areas burned at moderate and high severity with high snag densities for complex early seral habitat that is unsalvaged (TERR-CES-GDL-06). Management approaches include:

> During post-fire restoration projects, consider the availability of complex early-seral forests across the forest and region to provide for ecological conditions needed by complex early seral wildlife species. This includes retaining areas of: dense and connected patches of snags across a range of snag sizes; naturally regenerating vegetation, and adjacent or intermixed burned and unburned areas or areas with moderate to high tree survival.
>
> Promote native vegetation (e.g., conifers, hardwoods, shrubs) in complex early-seral habitat that supports long term ecosystem integrity considering climate change, drought, insects, disease and fire.

Alternative B would result in some changes in the spatial pattern of complex early seral forest and some changes in the amount. There would be some shift toward a fine-grained, mosaic of complex early seral forest, especially in focus landscapes and in upper montane areas that have had wildfires in the last 15 years. Restoration aimed at increased forest heterogeneity would increase the likelihood of increased heterogeneity during fires of all kinds. Prescribed fires and wildfires managed to meet resource objectives, and desired conditions for fire severity mosaics (TERR-MONT-DC-05) would result in increased area with very small (less than 1 acre), small (1 to 10 acres) and medium to large (10 to 200 acre) patches of mixed- and moderate-severity fires that would contribute to complex early seral habitat. Wildfires managed for resource objectives typically have high spatial complexity (Vaillant 2009; Meyer 2015). The guideline to retain at least 10 percent of areas burned at moderate and high severity unsalvaged would provide for

complex early seral habitats. In the past 5 years, salvage of dead trees has typically occurred on less than one-third of the burned area and is avoided in California spotted owl protected activity centers that are mostly unburned. Artificial reforestation would occur in some areas, but it is often limited in scope and area to locations where salvage occurs first to make it safe for workers and to prepare mineral soil seedbeds for planting trees. There would be increased consideration of natural regeneration in some areas burned in extensive large patches of high-severity fire, where there are insufficient living seed trees to ensure enough seedlings will regenerate a forest. These changes, compared to current management, would result in an increased proportion of large fires contributing to complex early seral forest habitat. There would be a continued increase in the likelihood of large, high-intensity wildfires because the majority of the landscape outside of focus landscapes would have limited restoration. These high-intensity fires would provide large areas of complex early seral forest.

Limited Special Habitats

In alternative B, there is specific direction aimed at management and conservation of special habitats where federally-listed species and species of conservation concern occur (SPEC-FW-GDL-03 to 05; SPEC-FW-DC-03), including those related to particular rock types and substrates (like marble or limestone). This direction would increase the consideration of special habitats in all projects and management of all sites (TERR-SH-STD-01) where activities including restoration, special uses, and dispersed recreation may occur. There would be a beneficial impact to edaphic habitats under alternative B.

Keystone Species Groups

Pollinators – In alternative B, there would be increased levels of restoration toward vegetation desired conditions, including increased heterogeneity that would benefit pollinator plants (TERR-MONT-DC-06). There would be an emphasis on restoration toward desired conditions of vegetation that are based primarily on the natural range of variation. Restoration of native plants would support restoration of dependent pollinators. This would provide more openings and sunlight to the forest floor that would improve pollinator habitat. There would be more prescribed fire and wildfire managed to meet resource objectives that would improve conditions for fire-associated flowering plants (see “Fire Management” section).

In eastside shrublands and woodlands, restoration activities under alternative B would also improve pollinator habitat. Increased levels of restoration in sagebrush and pinyon-juniper are expected to generally favor annual flowering plants over perennials. This would potentially benefit some pollinators during spring blooms, but provide less benefit to pollinators dependent on greater canopy cover or on late-seral, summer perennials such as penstemons or mule ears. Benefits to pollinators would be highly dependent upon effective control of invasive species. Invasive, non-native annual grasses and other non-native plants displace native plants and their associated pollinators. Restoration treatments in these vegetation types would be especially effective at enhancing pollinator habitat when treatments also minimize invasive plant spread.

Cavity Excavators – There may be an increase in the amount of snags because snag retention levels are higher than currently (alternative A) in most areas (TERR-POND-DC-05; TERR-DMC-DC-06; TERR-MMC-DC-05; TERR-RFIR-DC-07; TERR-LDGP-DC-06, 11; TERR-UMJF-DC-07) except in the community buffers (MA-CWPZ-GDL-01c) in the community fire protection zone. There would be an increase in the diversity of plant communities or habitats that snags occur in because of increased restoration of vegetation into more heterogeneous conditions and retention of large trees with deformities and cavities for wildlife habitat (TERR-FW-GDL-01;

TERR-OLD-GDL-01). This would result in an increase in the diversity of cavity excavator habitat (TERR-FW-GDL-02). There would be an increase in the amount of open and moderately open forests in the pine and mixed conifer forests. There would be an increase in the amount of snags in small patches of burned forest because of the increase in prescribed fire and wildfire managed to meet resource objectives. This would increase habitat for cavity excavators and other species that rely upon intermixed or adjacent burned and green habitat. There would be increased snag retention levels and direction for complex early seral habitat that would provide more snag habitat in forests burned at high severity, including in owl nest habitat or in areas of large stand-replacing bark beetle mortality events (SPEC-CSO-STD-06; TERR-CES-GDL-01d; see "Complex Early Seral Forests" section above).

Tribal Uses and Biocultural Diversity

In alternative B there is specific direction to improve conditions for plants and vegetation of tribal interest (TERR-FW-DC-09; TERR-BLCK-DC-04; Inyo: TERR-OAK-DC-01) and restore areas of tribal importance (Inyo National Forest: TERR-FW-OBJ-03; Sequoia National Forest: TERR-FW-OBJ-04). There also would be a moderate level of restoration of ecosystem, plant, insect, and animal conditions (see "Terrestrial Vegetation Ecology" section). Areas restored with mechanical thinning and prescribed fire together would result in improved conditions for plants and animals of tribal interest (Lake and Long 2014). This includes overcrowded black oaks, and shaded understory shrubs and plants currently growing in dense conifer forests (Merriam 2013, Safford 2013).

Areas with prescribed fire and fire managed to meet resource objectives would improve conditions for all understory plants (TERR-MONT-DC-04; TERR-DMC-DC-02; TERR-RFIR-DC-02) including those used for food, basketry, and medicine (Anderson and Donatto 1996, Anderson 2006). Large landscape areas treated would improve conditions for bear, deer, and other important wide-ranging species (TERR-FW-DC-04). Alternative B would have an increase in fire managed to meet resource objectives, particularly at middle and higher elevations that would have benefits to large ecosystem areas. The ecological restoration projects specifically planned and coordinated with tribes would incorporate traditional ecological knowledge and practices and be focused on sites selected by tribal members (TERR-FW-GOA L-01; TRIB-FW-DC-01).

Integrated Terrestrial Ecosystem Sustainability

Alternative B would result in increased integrated sustainability. The greater amount of the landscape area that would be restored under this alternative would increase the resilience of terrestrial ecosystems to uncharacteristic fire, insects, diseases, air pollution, or climate change. Sustainability would be most improved in terrestrial ecosystems targeted by restoration efforts, including lower montane forests, upper montane forests, eastside pine forests, and sagebrush ecosystems.

Consequences Specific to Alternative C

Fire Regimes and Fire as an Ecosystem Process

Overall, there is an emphasis on fire as a restoration tool in Alternative C that would increase the use of fire as an ecosystem process. However, there is a higher level of uncertainty about how much prescribed fire would occur because there would be fewer associated mechanical treatments along ridges and roads that would prepare areas for conducting large prescribed fires. Similarly, although there is the intent to manage more wildfires to meet resource objectives, there may be

fewer opportunities because there would be fewer areas treated mechanically and with prescribed fire that could assist with better management of those fires.

Westside Foothills Vegetation

Lower levels of restoration treatments are proposed for alternative C, similar to alternative A. However, there is more emphasis on restoration of native plants in areas with non-native plant invasions and prescribed fire. There is a similar emphasis on cooperation with tribes and restoration of areas of tribal interest as in alternatives B and D. Overall, there would be limited opportunities to increase fire regime integrity and beneficial fire effects.

Montane Forests

Overall, lower levels of treatments are proposed for alternative C in montane forests. Alternative C would have lower levels of prescribed fire on the Sequoia National Forest than in alternative A. On the Sierra National Forest, there would be more prescribed fire than in alternative A, but not much more. There are higher levels of wildfires used primarily to meet resource objectives but these would occur mostly in upper montane and subalpine areas. Overall, there would be a slight increase fire regime integrity compared to alternative A. The higher levels of prescribed fire and emphasis on cooperation with tribes and restoration of areas of tribal interest would result in increased beneficial fire effects to plants and animals in treated areas.

Upper Montane Forests

Overall, there would be less proposed treatment in alternative C in upper montane forests. However, there is direction that supports the use of wildfire used to meet resource objectives. This is most likely to occur in upper montane and subalpine areas. As a result, there would be an increase in fire regime integrity and beneficial fire effects in alternative C.

Subalpine and Alpine Vegetation

The consequences to subalpine and alpine vegetation would be the same as described for alternative A.

Eastside Sagebrush and Pinyon-Juniper

In eastside sagebrush and pinyon-juniper there would be slightly increased fire regime integrity and beneficial fire effects from restoration proposed in alternative C compared to alternative A.

Carbon Stocks, Sequestration, and Stability

Impacts of alternative C on carbon would be similar to alternative A, except that there may be more prescribed fire and wildfire managed to meet resource objectives. There is a high level of uncertainty on how much more fire may occur, because with fewer thinning projects, prescribed fires and wildfires managed to meet resource objectives may be more difficult to implement and could be less likely to occur. Therefore there is a high level of uncertainty on the impacts of alternative C on carbon. If more beneficial prescribed and managed fires occurred, then there would be short-term increases in carbon emissions but a long-term increase in carbon stability. Burned areas would have lower surface fuels, lower vegetation densities, and higher fire resilience, making the likelihood of large, high-intensity fires lower.

Landscape Connectivity

Alternative C would result in similar impacts to connectivity as alternative B but with more recommended wilderness and an increased likelihood of large, high-intensity wildfires. There would be a similar emphasis on restoration of fire resilience of key fisher linkage areas. Restoration in the remaining area would be uncertain. There will be lower amounts of thinning, similar to alternative A, and the thinning will be lower intensity. The plan objectives for prescribed fire and fire managed primarily to meet resource objectives is greater than the proposed action, but there is moderate to high uncertainty how much would occur over the plan period, because there would be less associated thinning in strategic areas. This could make it more difficult to implement prescribed burning because burns would be more risky to manage with higher fuel levels and would be more costly to implement.

There are more recommended wilderness areas in alternative C than the other alternatives. This may provide for increased landscape connectivity of species that are impacted by more intensive management (like mechanical treatment) or uses (such as developed recreation). See the "At-risk Terrestrial Wildlife Species" section for more information.

Special Habitats

Old Forest

Management under alternative C in old forests would be similar to alternative A, but would include greater limitations on restoration from additional management direction in the fisher conservation strategy and the California spotted owl interim recommendations. There would be diameter limits restricting large tree harvest in all areas. There would be substantially more limits in the amount of mechanical restoration treatments in the fisher and owl habit areas. There would be no mechanical restoration allowed in owl foraging or nesting areas. Overall, there would be the least amount of area proposed for restoration treatment in old forest of all the alternatives. There would be an increased emphasis on prescribed fire and the use of wildfires managed to meet resource objectives, but it is uncertain how much of this would occur because dense forest conditions would continue that make burning difficult.

Alternative C would retain all large-diameter trees, with limited exceptions. There would be retention of old forest with denser trees and canopy cover. There would be an increased likelihood that large, old tree would die from drought, insects, pathogens, and warming climate (Van Mangtem et al. 2009). There would continue to be an increasing and high likelihood of large, high-intensity fires, similar to alternative A. This would have a negative impact on old forests in some areas, although there is uncertainty about the resulting fire severities and how they overlap with old forests. Although there would be an increased emphasis on restoration of fire, it is unlikely that this would occur across large areas because it is more difficult to accomplish in dense forest conditions.

Overall, there would be little to no change in large tree density from the restoration treatments, because there would be restrictions on harvest of large trees. There could be a positive impact on old forest structure, increased heterogeneity, and increased resilience from restoration treatments, including thinning, prescribed burning, and wildfires managed to meet resource objectives. There may be some low levels of large tree mortality from the fire treatments. The area that is proposed for restoration is lower than other alternatives and because of this there would continue to be an increased likelihood of large high-intensity wildfires. It is uncertain when and where large, high-intensity fires might occur, but if they did there could be negative impacts if they burn large areas of old forest at high intensity and result in killing a lot of large trees.

Complex Early Seral Forest

In alternative C there would be more complex early seral forest than under all other alternatives. There would be very limited salvage, only associated with safety hazards and limited strategic fuel treatment areas. There would be little to no reforestation or herbicide use; instead natural regeneration would be emphasized to minimize disruption of natural processes. There would be the greatest increased likelihood of large, high-intensity wildfires, and overall burned area (see Fire-Climate supplemental report, Westerling et al. 2015). The spatial pattern of complex early seral forest is difficult to predict but there is a higher likelihood of large (100 to 1,000 acres), and very large (greater than 1,000 acre) patches of mixed- and especially high-severity (greater than 75 percent basal area mortality) fires. There would also be an increased likelihood of very large (greater than 10,000 acre), very high-severity (greater than 90 percent basal area mortality) fire patches, based upon increases in fire-atmospheric interactions (from fire created weather, see the "Fire Trends" section).

Limited Special Habitats

There would be similar impacts to limited special habitats in alternative C as in alternative B.

Keystone Species Groups

Pollinators – There would be similar impacts to pollinators in alternative C as in alternative A. There would be some increased emphasis on restoration of vegetation heterogeneity and fire restoration that could create sunny openings and improve pollinator habitat. However, canopy cover retention in montane forests would limit these areas. In shrublands, there would be similar impacts to pollinators in alternative C as in alternative B, with some benefits to pollinators resulting from increased annual cover in restoration areas, and some benefits to diversity maintained by the structural diversity of tree cover.

Cavity Excavators – There would be an increase in the amount of habitat for primary cavity excavators because there would be an emphasis on snag retention. This would occur mostly in denser canopied forests and complex early seral forest because there is less restoration proposed. Denser stands would have greater live tree mortality, creating more snags. There may be more habitat in areas burned at mixed severity since there would be more prescribed fire and fire managed to meet resource objectives. However, there is uncertainty how much fire restoration would occur because there would be fewer areas treated mechanically and with prescribed fire that could assist with better management of those fires.

Tribal Uses and Biocultural Diversity

Similar to alternatives B and D, there would be an increased consideration of tribal interests in ecological restoration and coordination of some of the projects. Overall, there would be less ecological restoration across the landscape, providing fewer benefits to ecosystems, plants, insects, and animals of tribal interest.

Integrated Terrestrial Ecosystem Sustainability

There would be limited increases in integrated terrestrial ecosystem sustainability in alternative C, similar to alternative A. This is because there would be limited areas of restoration.

Consequences Specific to Alternative D

Fire Regimes and Fire as an Ecosystem Process

Consequences for alternative D would be similar to alternative B in type but would differ in pace and scale. Therefore, the analysis is focused at larger landscape scale differences and not by specific vegetation types.

There would be double the amount of restoration treatments in alternative D that would have a substantial impact on fire regimes and fire as an ecosystem process in the landscapes where these treatments occur. This would occur most in large areas in the westside montane ponderosa pine, black oak, and mixed conifer vegetation types and in the eastside Jeffrey pine and sagebrush, the latter of which has been invaded by pinyon-juniper and Jeffrey pine. Since there would be double the amount of focus landscapes, there would be up to 40 percent or more of these areas that have landscape areas with reduced fire intensity and severity. There would be increased beneficial effects of restoring fire as an ecological process because there would be more prescribed fire and opportunities to manage wildfires to meet resource objectives. Alternatives D would have the greatest levels of restoration in sagebrush habitat for the greater sage-grouse.

The consequences for subalpine and desert vegetation types would be similar to alternative B. There would be some additional restoration in westside foothill and upper montane red fir and lodgepole pine forests (both eastside and westside) that would reduce fire intensity and severity.

Carbon Stocks, Sequestration, and Stability

The impacts of alternative D on carbon would be similar to alternative B but with beneficial impacts over a larger area. Under alternative D, the area proposed for thinning is the greatest. There would also be the greatest amount of prescribed fire and wildfire managed to meet resource objectives. The combined effect of these restoration treatments would be between 30 and 60 percent of the low and mid-elevation areas with lower forest and vegetation densities and fuel loadings. This would substantially decrease the likelihood of large, high-intensity fires. This means that carbon stability would be substantially higher and large carbon emissions the lowest (see the “Air Quality” section).

Landscape Connectivity

Alternative D would result in similar impacts to landscape connectivity as alternative B but with less likelihood of large, high-intensity wildfires that could potentially interrupt habitat connectivity for forest-associated species. This is due to the increased restoration treatment rates under alternative D compared to other alternatives. There would be more prescribed fire and fire managed to meet resource objectives under alternative D, which could enhance overall long-term ecosystem resilience of fisher linkage areas and other critical habitat connections. However, there would be higher levels of mechanical thinning in alternative D than alternative B, including within fisher linkage areas. Consequently, alternative D would likely result in greater long-term connectivity but significantly lower near-future (next 10 to 20 years) habitat connectivity for fisher and other forest-associated species than other alternatives.

Special Habitats

Old Forest

Alternative D would have similar environmental consequences to alternative B, but with more area restored there would be greater positive impacts of increased heterogeneity, decreased forest

density, and increased old forest resilience. Instead of restrictions on harvesting large trees of a certain diameter, alternative D emphasizes managing toward the desired conditions for large trees. This is the only alternative to result in a reversal of the trend in large, high-intensity fires.

Increased mechanical restoration treatments would result in lower levels of large and old tree mortality from both water stress and large, high-intensity fires. The higher levels of mechanical restoration would increase the likelihood that more prescribed fire and wildfire managed to meet resource objectives would occur and these would have a positive impact on old forests. The impact to large trees in alternative D across the entire analysis area (outside of wilderness or other areas with no or highly restricted mechanical treatment) would be the same as described for alternative B within the fire protection zones.

The direction in alternative D for large trees focuses on desired conditions for large tree densities and guidelines to meet those desired conditions in vegetation management activities (such as restoration thinning or timber harvest) instead of the current diameter limits in alternative A. This may result in some removal of individual large trees, but it is expected to be very limited because large tree densities are lower than desired conditions in most landscape areas. The exception to this situation would be the same as that described under alternative C, consistent with the fisher conservation strategy, primarily to thin dense, uniform, young but large white fir to make them more resilient. The harvests of some large trees, even though limited, may result in a small reduction in large tree densities, greater than in alternatives A, B, or C. These reductions may be offset and lower than losses of large trees in alternatives A, B or C from mortality due to water stress and large, high-intensity fires. It is unknown how much of an offset would occur.

The proposed levels of restoration in all forests in alternative D would result in numerous large landscape (greater than 10,000 acres) areas exceeding 40 percent and up to 60 percent or more of the area restored. The fire-climate scenarios show a substantially decreased likelihood of large, high-intensity fires with this level of restoration (see the “Fire Trends” section). Therefore, the likelihood of large, high-intensity fire that could result in killing a lot of large trees and converting large areas to early seral vegetation is decreased compared to current trends. This is the only alternative to result in a reversal of the trend in large, high-intensity fires. This would not likely be achieved until the middle and later parts of the planning analysis period (10 to 15 years) because of the time it takes to plan and implement projects. There may be large, high-intensity fires that occur in the early part of the analysis period. If large stewardship projects occur across very large landscapes (greater than 100,000 acres), then it is possible that the projects may occur more rapidly because there would be fewer limitations on the internal capacity to plan and implement the projects.

Complex Early Seral Forest

There would be mixed impacts of alternative D on complex early seral forest. There would be more restoration treatments that would increase the likelihood that fires that would occur would have low or mixed fire-severity effects. This would include more prescribed fires and wildfires managed to meet resource objectives, which would increase the amount of distributed, fine and medium grained, or patches of complex early seral forest. There would be a reduction in the likelihood of large, high-intensity fires that would also reduce the potential for very large patches of complex early seral forest. There would be the greatest amount of salvage and reforestation. This would decrease the proportion of large, high-intensity fires that have high levels of complex early seral forest.

Limited Special Habitats

There would be similar environmental consequences to limited special habits in alternative D as in alternative B.

Keystone Species Groups

Pollinators – Alternative D would have similar environmental consequences as alternative B but across more area.

Primary Cavity Excavators – Alternative D would have similar environmental consequences as alternative B for cavity excavators.

Tribal Uses and Biocultural Diversity

Alternative D would have similar environmental consequences as alternative B for tribal uses and biocultural diversity, but across more area.

Integrated Terrestrial Ecosystem Sustainability

Alternative D would have similar environmental consequences as alternative B for integrated terrestrial ecosystem sustainability but for considerably more area. The amount of landscape area that would be restored would provide for a higher level of overall integrated sustainability since many of the benefits increase with larger areas treated. For example, the "Fire Trends" section notes how the difference between restoring 60 percent of a landscape area results in a reduction in the increase in large fire size and area.

Cumulative Effects

Fire Regimes and Fire as an Ecosystem Process

Overall, climate change may accentuate the differences among alternatives. This is because fire frequency and intensity are projected to increase in many landscapes with rising temperatures, increasing fuel loading, and decreasing fuel moistures. In general, the cumulative effects described in the "Fire Trends" and "Climate Change" sections apply to fire ecology as well.

Carbon Stocks, Sequestration, and Stability

Cumulative effects for carbon are a complex topic, because of the interactions involved between vegetation in the forests, and carbon dioxide in the atmosphere that comes from many diverse sources outside of the national forests. Here the cumulative effects emphasize those aspects of carbon that are vegetation related, namely carbon stability, storage and sequestration. There is some reference to carbon release from vegetation but more detail can be found in the "Air Quality" section.

Restoration treatments and wildfires on adjacent lands that can burn onto the national forests are the two primary influences on the cumulative effects on carbon and vegetation. Restoration treatments on adjacent national parks (Yosemite and Sequoia and Kings Canyon), and Bureau of Land Management-managed lands can result in areas of increased fire resilience and carbon stability. These areas of increased fire resilience would make it less likely for large, high-intensity fires to move from these lands onto national forest lands. However, in the Lake Isabella area, the lower elevation lands bordering the Sequoia National Forest are dominated by annual grasses and chaparral. These areas burn frequently because of the high human presence and source of fire starts.

Landscape Connectivity

The cumulative effects of the alternatives combined with climate change, uncharacteristic fire, insects, and other stressors on landscape connectivity are complex and difficult to disentangle. However, it is anticipated that these stressors, irrespective of the alternatives, will likely have synergistic interactions that amplify their impact on habitat connectivity in the southern Sierra Nevada. Based on fire and climate model projections, it is anticipated that these synergistic interactions would have the greatest negative impact on habitat connectivity under alternative A, which promotes the fewest measures that protect or build adaptive capacity in habitat corridors or linkage areas. Alternatives B, C, and D would result in similar levels of cumulative impacts to connectivity, with greater reliance on minimizing short-term impacts in alternative C followed by alternative B.

Special Habitats

Old Forest

The cumulative effects of the alternatives on old forest are influenced by management on adjacent lands, factors that influence fire and status, and conservation plans for old forest-associated species (such as California spotted owl and Pacific fisher).

The combined effects of increased restoration of old forests and restoration on adjacent national park lands combine to move more total area in old forest toward desired conditions and the natural range of variation. There are extensive areas of old forest in the two national parks that share borders and are intermixed with the national forests in the analysis area. Yosemite National Park is to the north, bordering the Sierra National Forest and a small portion of the Inyo National Forest. Sequoia-Kings Canyon National Park lies in between the Sierra and Sequoia National Forests. The western third of Sequoia-Kings Canyon National Park has oak woodlands and chaparral at the lowest elevations and giant sequoia forests above. The very old giant sequoia forests in the national park and adjacent national forests were analyzed in the Giant Sequoia National Monument Plan Environmental Impact Statement and that information is not repeated here.

At higher elevations, there are extensive areas of upper montane and subalpine old forests in Sequoia-Kings Canyon National Park that occur adjacent to similar areas on the Inyo, Sequoia, and Sierra National Forests. This forms a large continuous block of old forest, most of it in wilderness. The large continuous area is the largest in the Sierra Nevada and the ecological value is great because of this. The National Park Service and Forest Service have coordinated multiple times on wildfires managed to meet resource objectives in these areas and would continue to do so under all alternatives. The fires cross boundaries often. The cumulative effect is that there are large areas in Sequoia-Kings Canyon National Park that have been restored adjacent to the large areas that have been restored in the Kern River drainage. This restoration has improved the resilience of old forests to large, high-intensity fires and increased heterogeneity and restored species composition. All of the alternatives would continue this cooperative, beneficial management of fire across the boundaries.

There has been similar cooperation between the Sierra National Forest and Yosemite National Park, but there have been fewer opportunities for large prescribed fires or wildfires managed to meet resource objectives.

Complex Early Seral Forest

Management of large fires and post-fire restoration in adjacent national parks, monuments and national forests to the north are the primary contributors to cumulative effects on complex early seral forest. Yosemite and Sequoia and Kings Canyon National Parks do little post-fire restoration that is likely to reduce the amount of complex early seral forest. There is no post-fire salvage in national parks, except along major roads. Future projected trends in large, high-intensity fires from climate warming in national parks are similar to likely trends in national forests (Westerling et al. 2015). With increased likelihood of large, high-intensity fires and limited post-fire restoration, the cumulative effect would be to have an overall increased amount of complex early seral forest across the analysis area. The southern portion of the Stanislaus National Forest to the north has had repeated, large, high-intensity fires, most recently the very large Rim Fire. This resulted in several very large patches of complex early seral forest habitat and many moderate and small patches. There has been extensive roadside hazard salvage and planned salvage across large areas, but because of the very large burn perimeter, there still was a large cumulative increase in complex early seral forest habitat. Overall, with increased fire trends throughout and varying levels of salvage, the cumulative effect of all alternatives would have an increase in the amount of complex early seral forest.

Limited Special Habitats

The cumulative effects of the alternatives on specialized edaphic habitats would likely be influenced by stressors in some cases. Plant species limited primarily to limestone and other specific substrates may be impacted by the combined effects of climate change, uncharacteristic fire, and invasive species, potentially resulting in population declines within these specialized habitats. Species dependent on caves and cliffs (such as bats) may also experience these cumulative impacts but possibly to a lesser degree due to their greater mobility and ability to use existing variability in thermal features and other refugia within these environments. Soil biotic crusts in eastside arid shrublands and woodlands are also likely to be impacted by the cumulative effects of the alternatives with increasing stressors, especially invasive plant species and uncharacteristically frequent fire.

Keystone Species Groups

The cumulative effects of the alternatives and various stressors on keystone species groups are varied. In the near future (next 10 to 15 years), the synergistic effects of climate change, uncharacteristic fire, air pollution, invasive species, and insect and pathogen activity would likely benefit cavity excavators and pollinators under all alternatives, because these stressors would increase the amount and proportion of early successional habitat and tree mortality that benefits cavity excavators and pollinators (by providing increased foraging habitat). However, greater loss of “green forest” may have unknown impacts to other cavity excavators and pollinators that also depend on this habitat for nesting or foraging during some stage in their life cycle (like pileated woodpeckers, hairy woodpeckers, or Williamson’s sapsuckers). In the long-term (decades) the loss of forests due to increasing stressors (especially climate change) would reduce the habitat extent for these keystone species regardless of episodic increases in early seral habitats following fire and other ecological processes.

Tribal Uses and Biocultural Diversity

Cumulative effects for tribal uses are a combination of what is described in the sections discussing tribal interests, vegetation ecology, fire ecology, economic and social conditions, and fire and climate trends. Overall, the trends in ecosystem conditions that support tribal uses would

be improved from the restoration treatments and greater tribal cooperation and involvement. But the economic and social conditions for tribes outside of the national forests where they live can influence their ability to access and use the ecosystems. Better economic and social opportunities would provide a greater ability to use these ecosystems.

Integrated Terrestrial Ecosystem Sustainability

The varied aspects of integrated terrestrial ecosystem sustainability are complex when considered individually, as well as when considered together. However, the cumulative effects for each are similar. The effects of climate are the dominant overarching outside influence that affects all aspects, especially fire and non-native invasive plants.

Analytical Conclusions

Fire Regimes and Fire as an Ecological Process

Westside Vegetation

The alternatives vary in restoration of fire regime integrity and fire as an ecological process by ecological zone and location. Alternatives B, C, and D would increase fire regime integrity and fire as an ecological process in the upper montane, subalpine, and alpine vegetation types, and in the Kern River drainage areas because of an increased potential to have wildfire managed to meet resource objectives. In the montane and foothill zones, both alternatives B and D would create increased fire regime integrity in the focus landscapes. Large, high-intensity fires are likely to have moderate behavior in these restored landscapes and would result in reduced fire severity and effects. Alternative D would have the greatest positive benefit to fire regime integrity across the national forests because at least half of the entire forest area would be restored. Alternative B would only have half of this area restored at most. Alternatives A and C would have little restoration.

The alternatives differ in proposed restoration of fire as an ecosystem process, especially in the montane zone. Alternative B has prescribed fire objectives that would substantially increase the prescribed burning levels over alternative A, but there is a moderate uncertainty that this amount of prescribed fire would occur because of limited operating periods for California spotted owl and Pacific fisher. With warming climate, drought, and longer and drier fire seasons, spring burning is increasingly important to achieving prescribed fire objectives. There are fewer limited operating periods in alternative D and a higher likelihood that prescribed fire would occur, although there is uncertainty whether air quality conflicts would prevent burning at any time of the year.

Eastside Vegetation

The increased restoration treatment rates in arid shrublands and woodland landscapes are greatest under alternatives D and B, and lowest under alternatives C and A. However, all alternatives would support at least moderate fire regime integrity in many arid shrublands and woodlands (such as xeric shrub and blackbrush), because of the long historic fire return intervals in these vegetation types that often exceed 100 to 200 years (greater than the current fire exclusion period of the 20th and early 21st centuries). These vegetation types are less departed from the desired conditions than other more productive vegetation types in the analysis area. Alternatives B and D would have the greatest levels of restoration in sagebrush habitat for the greater sage-grouse and the least amount of undesirable fire in landscapes where these treatments exceed 30 percent of the area.

Carbon Stocks, Sequestration, and Stability

Alternative D followed by B would have the greatest positive impact on carbon stability, and as a result, on carbon storage and sequestration. They have the greatest proportions of vegetation restoration that would decrease the likelihood of large, high-intensity fires and increase the resilience of vegetation to fires. This would result in less tree mortality maintenance of carbon storage. Carbon sequestration would be more stable and would likely increase because of less competition between trees for water, light, and openings that would improve understory shrub and plant vigor. Alternative D would have the greatest positive impact, because there is enough of the low and mid-elevation areas restored that could reduce the amount of large, high-intensity fires (see the "Fire Trends" section).

Alternatives A and C would likely result in a continued condition of high instability of carbon. There would be a continued increase in the likelihood of large, high-intensity fires and low climate adaptive capacity. There would continue to be large areas of the landscape with low ecological fire resilience and resilience to insects and pathogens (see "Insects and Pathogens" section). This means that there would likely be large areas burned as crown fires in large, high-intensity fires or areas with widespread tree mortality due to moisture stress and insect and pathogen activity. While dead trees can store much of their carbon in the stems and branches, this is short term carbon storage, because decay and other ecological processes (like fire) release carbon to the atmosphere (North and Hurteau 2011). Carbon sequestration could increase because of more young vegetation actively growing after large fires. This increase in sequestration would likely be short term in both alternatives. In alternative C, there would be little to no reforestation and therefore, lower levels of sequestration in post-fire landscapes characterized by large high-severity fire patches with increased tree regeneration failure (Ritchie and Knapp 2014, Collins and Roller 2013). In alternative A, while there might be more reforestation, if it is extensive and densely planted, there is a moderate to high likelihood that the plantations would not survive additional large, high-intensity fires and climate change. There is often, but not always, a pattern of repeated fires in the same vicinity, that burn intensely through plantations. The most notable examples are on the Stanislaus National Forest, near and in the Rim Fire area, which were often established following earlier uncharacteristically severe wildfire events (like the 1987 Stanislaus Complex).

Landscape Connectivity

Alternative B potentially provides for short- and long-term habitat connectivity, especially for forest-associated species such as Pacific fisher. Key linkage areas for fisher are prioritized for restoration but recent fires (the Aspen Fire in 2013 and Rough Fire in 2015) burned through key linkage areas before they could be restored. Alternative C provides the greatest short-term connectivity but at the cost of elevated exposure or sensitivity to uncharacteristically severe fire, climate change, and other stressors that reduce long-term habitat connectivity. Alternative D may support the greatest long-term habitat connectivity, but at the cost of significantly reduced short-term habitat connectivity resulting from elevated mechanical and prescribed fire treatment rates in the next 10 to 20 years. Alternative A provides the lowest connectivity for forest-associated and other wildlife species under both short- and long-term horizons. Alternative A provides the lowest restoration treatment rates and lacks management approaches that are specifically focused on habitat linkage and dispersal corridor areas otherwise promoted under alternatives B, C, and D for wildlife species such as fisher. Consequently, alternative D would result in the greatest habitat connectivity for forest-associated and other species.

Special Habitats

Old Forest

Alternative D followed by B would result in the greatest restoration of old forests. There would be more old forests that have restoration of desired tree density, heterogeneity, tree canopy cover, fire regime integrity, and fire as an ecosystem process in these alternatives. This would restore old forests toward conditions reflecting the natural range of variation. There would be substantially increased resilience of large, old trees to moisture stress, drought, insects and pathogens, ozone, and large, high-intensity fires. There is potential for harvest of some large trees in alternative D and within the fire protection zones in alternative B because the direction to limit the size of trees removed is provided by desired conditions for old forests compared to fixed harvest diameter limits. It is unknown how much harvest of large trees would occur, but it is assumed that it would be low because many areas are below desired conditions levels for large trees.

The greatest impact to old forests, aside from direct harvest of large trees, is trees dying from large, high-intensity fires and the combined effects of drought, insects and pathogens. Large, high-intensity fires can kill many large trees, across large areas at one time. The fire-climate research by UC Merced (Westerling et al. 2015) supports that there has been and will continue to be an increase in the size, number and area burned in large fires due in part to warming climate. In restoration scenarios, the trend did not change or reverse until 60 percent of the foothill and montane landscape was restored. Restoration levels of 15 and 30 percent showed less increase of large fires compared to no treatment but there would still be increases in large, high-intensity fires compared to today.

In all alternatives, the Kern River drainage would reach the 60 percent restoration level rapidly, because it is already near or exceeding 30 percent in many areas. For all other areas, alternative D is the only alternative that comes close to the 60 percent restoration level. This alternative is most likely to have the least loss of old forest from large, high-intensity fire. Alternative B would have a similar impact in some areas but not all. In all alternatives, there is uncertainty as to what proportion of large fires would be dominated by high severity, mixed severity or low severity effects, even though relative qualitative comparisons could be made among alternatives. Larger proportions of high-severity fire is likely under alternatives A and C and higher proportions of low and moderate severity fire are more likely under alternatives B and D. Even with the very large Rim and King Fires, there were significant portions of the fires that burned at moderate, mixed or low severity, especially within the upper montane zone. Similar patterns occurred with the Aspen and French Fires. These areas of low and moderate fire severity may result in some large trees dying, but overall would provide benefits of increased heterogeneity, desirable habitat features (such as snags), and resilience on some parts of fires but would have very severe effects for old forest in other parts of the fires that burn at high severity.

Old forests can also be greatly impacted by drought, insects, and pathogen-related mortality. Where forest density is high, all trees are vulnerable to mortality, including the large trees. Current levels of mortality in ponderosa pine and some mixed conifer forests are very elevated. Mortality of younger and medium-sized trees from surrounding younger forests increases the likelihood that large trees will die because the elevated insect levels increase the extent and rate of infection. Alternative D would have the greatest reduction in vulnerability to future drought, insect, and pathogen-related large tree mortality because the greatest intensity of forest thinning across large areas would occur. Alternative B would have some increases in resilience in the focus landscapes, except for areas outside of the fire protection zones that overlap with railroad logging-originated stands. This could be half of the potential focus landscapes. The net result is

that only a small portion of remnant large old trees would benefit from restoration treatments of intensity needed to increase resilience. This may be less than 10 percent of the areas with large, old trees. Alternatives A and C would have even lower levels of benefit from restoration because treatments would be less intense and less extensive.

Complex Early Seral Forest

The increase in complex early seral forest would be the most in alternatives C followed by alternative B and the least in alternatives A and D. There is a high level of uncertainty about the amount and spatial scale of the complex early seral forest patches that would occur because of the high uncertainties associated with fire. However, there is a high likelihood of increased fires under all four climate scenarios used to project large fires (Westerling et al. 2015).

Edaphic Habitats

Alternatives B, C, and D all provide similar increases in protection for special habitats because there would be the same management direction for them. Alternative A would provide the least protection because it emphasizes management of individual species and not the habitat where multiple federally-listed or species of conservation concern occur. There is also increased emphasis and management direction in alternatives B, C, and D on sustainable recreation that can decrease trampling and disturbance impacts to these sensitive habitats.

Keystone Species Groups

Pollinators – Alternatives B and D would provide the greatest restoration of habitat to support improved pollinator habitat in forested ecosystems. There would be the greatest amount of restoration, including prescribed fire, mechanical thinning, and wildfire managed to meet resource objectives, at an intensity and spatial pattern to create openings, more open canopy, and sunlight on the forest floor. Alternative C proposes increased prescribed fire compared to alternative A, but it is uncertain how much would occur and mechanical restoration would retain more canopy cover. Alternative A would provide the least restoration of habitat conditions supporting pollinators. In woodlands and shrublands, alternatives B and D would provide greater benefit to pollinators dependent on annual plants, in areas where invasive species are not dominant. All alternatives would have very similar impacts for pollinators dependent on perennial flowers.

Primary Cavity Excavators – Alternative C would provide the most snag habitat because of the lower levels of mechanical restoration, increased levels of prescribed fire, and higher snag retention levels. Alternative B would provide slightly higher levels than alternatives A and D. Alternative D would provide the lowest levels of snags. It is uncertain for all alternatives what the distribution of snags would be on the landscape among different habitat types (for example young versus old, burned versus unburned forests). As described above in the complex early seral forest discussion, alternatives C followed by alternative B would have the most snag habitat in burned forests.

Tribal Uses and Biocultural Diversity

Alternative D, followed by alternative B would provide the greatest increase in ecosystem condition for tribal uses. More restoration would occur in these alternatives that would improve plant, animal, and insect habitat. Alternatives B, C, and D, all provide for increased tribal coordination and restoration of areas of tribal interest. These would all increase the amount and quality of restoration benefitting tribes.

Integrated Terrestrial Ecosystem Sustainability

Table 62 provides an overall summary of conditions for characteristics of integrated sustainability by alternative. Out of all of the alternatives, alternative A provides the least likelihood of sustainability. Alternative D followed by alternative B are the most likely to improve the likelihood of sustainability. Alternative C could improve sustainability but there is greater uncertainty because there is more reliance on fire restoration treatments with less ability to treat the areas prior to burning.

Sustainability of old forest condition and extent is most influenced by the amount of restoration of the entire landscape it occurs within as well as the old forests themselves. Alternatives D followed by alternative B would have the greatest overall levels of restoration and would increase resilience to large fires. Alternative D would have the greatest amount of restoration in old forests outside of the forest protection zones. This would increase the resilience of old forests to drought, insects, pathogens, air pollution and high-intensity fire. However, some large trees might be harvested. Alternatives A and C would have the most restrictions on restoration of old forest and vegetation overall. This might provide short-term protection for old forests but also increase the susceptibility of mortality from drought, air pollution, insects and pathogens and high-intensity fire.

Table 62. Summary of conditions for characteristics of integrated sustainability by alternative

Characteristic	Alternative A	Alternative B	Alternative C	Alternative D
Terrestrial Ecosystem Condition	Low	Low to moderate (restored areas)	Low	Moderate
Area outside of the natural range of variation (low and mid-elevations)	Very high	Moderate (restored areas) to high	High	Moderate
Area and percent of forest affected by processes or agents beyond the range of historic variation (by insects, disease)	High vulnerability	Moderate to high vulnerability	High vulnerability	Moderate vulnerability
Area and percent of forest land subjected to levels of specific air pollutants (sulfates, nitrate, ozone) or ultraviolet that may cause negative impacts on the forest ecosystem	Moderate, pine and mixed conifer vulnerable	Moderate, pine and mixed conifer less vulnerable than A	Moderate, pine and mixed conifer vulnerable	Moderate, pine and mixed conifer less vulnerable than A or B
Special Habitats	Low	Moderate	Low	Moderate
Old Forest Condition and Extent	Low, high vulnerability	Low, moderate to high vulnerable	Low, high vulnerability	Low, moderate vulnerability
Complex Early Seral Habitat Amount and Extent	Moderate, more large patches	Moderate, more small patches	High, more large patches	Similar to B but less extensive
Limited Plant Community Condition	Mixed, low to high	Moderate to high	Moderate to high	Moderate to high

Climate, Ecological Vulnerability and Adaptation

Background

This section summarizes ecological vulnerabilities to climate changes and effects of adaptation strategies and plan direction addressing ecological impacts of climate change. This section examines the overarching effects of climate change on terrestrial and aquatic ecosystems. It adds detail to the general discussions in the vegetation ecology section above on individual vegetation types.

Analysis and Methods

This section summarizes the more detailed analysis of climate, ecological vulnerability and adaptation found in the bio-regional and forest assessments (USDA FS 2013a, 2013b, 2013c, 2013d) and the snapshots of the "Living Assessment" used to develop the final assessments (USDA FS 2013e, 2013f, 2013g, 2013h). Additional information from several recent climate change vulnerability and adaptation assessments is also incorporated (Schwartz et al. 2013, Kershner 2014).

Indicators and Measures

Ecological vulnerability indicators include tree mortality, distribution of species (elevational distribution of plants and animals), presence of non-native invasive species, and changes in fire regime (that is, changes to frequency, size, and severity).

Adaptation strategies can increase the resilience of ecosystems and resources to climate change impacts (IPCC 2013). Short-term adaptations build resistance and resilience, so that ecosystems are better able to withstand undesirable effects of climate changes such as diminished ecosystem integrity and function. In Table 65, the alternatives are compared by their relative capacity to support various climate adaptation approaches that are recommended by climate vulnerability assessments and other best available science information sources. These approaches include: (1) increase adaptive capacity of ecosystems through ecological restoration and climate adaptation, (2) develop and use collaborative partnerships, (3) apply climate vulnerability assessments in planning and prioritization, and (4) use monitoring and adaptation. Collaborative partnerships are addressed in the "Benefits to People" section.

The primary adaptation strategies are listed below. These are based upon several recent climate adaptation workshops (Southern Sierra Partnership 2010, Nydick and Sydoriak 2011a, Kershner 2014) as well as scientific literature on climate change (North et al. 2009, Finch 2012, Lawler et al. 2012, Safford et al. 2012a, 2012b; Millar et al. 2007, Hanberry et al. 2015).

- Manage for vegetation heterogeneity and diversity;
- Restore or maintain key ecological processes, including fire in fire-adapted forest ecosystems;
- Reduce the density of smaller diameter, shade-tolerant trees in fire-adapted forests to levels more consistent with the natural range of variation;
- Reduce the chance of uncharacteristically large and severe wildfire and other climate-related stressors using ecologically appropriate treatments, including prescribed fire, mechanical thinning, and wildfires managed for resource objectives within the natural range of variation;
- Implement rapid detection of and response to invasive species;

- Restore ecosystem function to degraded meadows, aquatic and riparian ecosystems;
- Identify and protect future climate refugia for other areas of native species persistence;
- Maintain and restore habitat connectivity across the ecoregion to facilitate species movements under rapidly changing conditions; and
- Enhance recruitment and expansion in species that are ecologically underrepresented (aspen), functionally important (whitebark pine), or climate resilient (oaks and pines).

Assumptions

- Ecological response models assess the response of ecosystems (vegetation, wildlife habitat) to climate change. These models include additional assumptions that increase the level of uncertainty (Glick et al. 2011).
- The outcomes of management actions with climate change are also highly uncertain. However, best strategies for adapting to future change will be based on adaptive land management strategies that consider historic, current, and future projected changes in climate and climate-related processes (Wiens et al. 2012). This provides a more comprehensive evaluation of the effects of climate change in the absence of robust projections of future climate and climate-related processes (Safford et al. 2012b).
- Plan components that specifically address climate change, including desired conditions and management approaches, will result in improved climate adaptation.
- Plan components that result in increased pace and scale of restoring vegetation to a more resilient condition (desired conditions that reflect the natural range of variation) will substantially improve the capacity for climate response of major vegetation types. Thus, the increased pace and scale of restoration treatments will provide greater support of climate adaptation strategies focused on enhancing ecosystem resilience.
- Increased pace and scale of restoring vegetation will include proportionate measures to prevent or control non-native invasive plant species to the extent possible.

It is assumed that the different adaptation strategies are equally important. However, depending upon the vegetation type, species or ecosystem process, that some strategies may be more important than others in a particular situation. Differences in the importance of adaptation strategies by vegetation type, species or ecosystem processes are analyzed in the “terrestrial Ecosystems,” “Aquatic and Riparian Ecosystems,” and “Species of Conservation Concern” sections.

Affected Environment

Studies of terrestrial mammals, birds, and butterflies show that ranges of many species have been shifting to higher elevations and shrinking in high elevation zones, probably in response to warming temperatures and changing precipitation patterns (Safford et al. 2012a). Similar sensitivities are suggested for aquatic and riparian species (Hauptfeld and Kershner 2014).

As described in the “Agents of Change,” “Terrestrial Vegetation Ecology,” and “Terrestrial Ecosystem Processes and Function” sections above, there have been changes in wildfires, tree mortality, and insect populations related in part to climate changes that affect species habitat and distribution. Wildfire frequency, size, total area burned, and fire severity have all been increasing in the Sierra Nevada over the last two to three decades. Larger trees are also dying from factors other than fire throughout many parts of the Sierra Nevada (Dolanc et al. 2014, van Mantgem et

al. 2009). This pattern is frequently associated with increasing moisture stress and bark beetle activity related to increasing temperatures across western North America (Logan et al. 2003, van Mantgem et al. 2009). More recently, especially in the last several years, extensive tree mortality has occurred. In some areas, more than half of the ponderosa pine forests are dead (see "Insects and Pathogens" section). How much of this mortality is directly related to climate change is not known, but it is likely an important contributing factor. Higher winter temperatures allow more insect survival and buildup over winter. There may be a combination of increased drought stress as well as increased respiration of trees (absorb water and release water vapor) in the warmer weather (van Mantgem et al. 2009).

Projected Future Trends in Ecological Indicators

Climate vulnerability assessments for the planning area anticipate broad-scale changes in ecosystem conditions, such as fire regimes, vegetation, insect activity, and species distribution patterns. Table 63 shows the climate vulnerability of different major vegetation types based on the degree of climate exposure, sensitivity to climate change, and capacity to adapt to changing conditions, which is ranked from high to low based on relative vulnerability among types. Models suggest the area of conifer-dominated forest in the southern Sierra Nevada will decrease substantially, especially for high elevation forests (like subalpine areas). In contrast, hardwoods are expected to respond positively to warmer nighttime temperatures and shifting disturbance regimes (such as increased fire intensity and bark beetle activity) that favor oaks over conifers. This will result in some of the ponderosa pine and lower mixed conifer forests shifting to black oak and/or live oak types. Many scenarios also show an increase in grassland area at lower and middle elevations, as woody vegetation retracts in the face of increased fire frequency and invasion by non-native annual grasses. This is expected to occur especially at the lower elevations, where blue oak woodlands will shrink or move upward.

Table 63. Climate vulnerability of major vegetation types in the planning area

Vegetation type	Climate vulnerability
Subalpine forest and alpine	High
Red fir forest	High
Wet meadow	High
Riparian	Moderate–High
Mixed conifer and yellow pine forest	Moderate–High
Xeric shrubland	Moderate
Sagebrush	Moderate
Pinyon-juniper woodland	Low–Moderate
Montane and foothill chaparral	Low–Moderate
Oak woodland	Low–Moderate
Grassland	Low

Current trends of increasing fire activity (such as longer fire seasons, and changes to fire frequency) and larger burned areas are expected to continue in most vegetation types under almost all future climate scenarios (see "Fire Trends" section). Moisture stress and the frequency and severity of bark beetle outbreaks are projected to increase dramatically with increasing temperatures in the Sierra Nevada, resulting in widespread tree mortality (Bentz et al. 2010, Hicke et al. 2006). This is currently happening on much of the Sierra and Sequoia National Forests in ponderosa pine and lower elevation mixed conifer forests, where the amount of dying

conifers is moderate to very high in many areas as shown in Figure 39 and discussed in the "Insects and Pathogens" section. Note in the photo that over half of the ponderosa pine trees are recently dead, as evident by the red needles.

Figure 39. High levels of dead and dying trees in ponderosa pine and black oak-ponderosa pine forests on the Sequoia National Forest

Regional climate trend assessments (Safford et al. 2012a), climate vulnerability assessments (Kirshner ed. 2014), and natural range of variation assessments suggest that climate change will have impacts to species that vary by individual plant and animal species. Table 64 shows the climate vulnerability of selected species or species groups in the plan area. This is not an exhaustive list but instead rather representative species that are vulnerable in the different ecosystems in the Sierra Nevada.

Table 64. Climate vulnerability of select species or species groups in the planning area

Species or Species Group	Climate Vulnerability
High-elevation white pines[1]	High
Alpine chipmunk	High
Greater sage-grouse	High
Fisher and marten	High
Mountain and Sierra yellow-legged frogs	High
Giant sequoia[2]	Moderate to high
Great gray owl	Moderate to high
Aspen	Moderate
Clark's nutcracker	Moderate
Swainson's thrush	Moderate
Canyon and interior live oak	Low
Stellar's Jay	Low

1. Includes whitebark pine, foxtail pine, bristlecone pine, and limber pine
2. Overall climate vulnerability is moderate but mature and old trees may be highly vulnerable

There will likely be increasing vulnerability of species resulting from direct and indirect effects of climate change. Direct effects will include increasing evaporative demand for plants with warming temperatures and resultant increased water stress. Indirect effects will include habitat loss from vegetation changes. For example, Clark's nutcracker is dependent on whitebark pine in subalpine and alpine areas for food. If whitebark pine and these forests are heavily impacted by climate change, then Clark's nutcracker will be heavily impacted.

Many models project significant range contractions in some species distributions, those with high climate sensitivity and low adaptive capacity. For example, alpine plants and animals that live at the highest elevations will have few if any other places to go to stay in the colder environments they are adapted to. Species with low adaptive capacity include those that have small and isolated populations, low genetic variation, and limited ability to move widely and low reproductive rates. Vulnerable species also include those with habitat tied to vulnerable vegetation types. For example, it is predicted that the conditions that support marten presence in California are likely to change greatly over the next century, potentially causing a pronounced loss of suitable habitat (Lawler et al. 2012). Marten are closely associated with red fir forests, which are dependent upon snowpack. Lawler et al. (2012) suggest that marten will be highly sensitive to climate change, with the largest impacts in the southern Sierra Nevada (Lawler et al. 2012).

Environmental Consequences to Climate, Ecological Vulnerability and Adaptation

The alternatives were contrasted qualitatively in the opportunity, likelihood and rate of application of adaptation strategies focused on building adaptive capacity of ecosystems from restoration actions (Table 65). A rating of high means that there were likely to be numerous opportunities and a high likelihood of applying adaption strategies in multiple locations. A rating of low meant that there were few opportunities and a low likelihood of applying adaptation strategies on few to no locations. Moderate would be in between, either with a lower likelihood and/or fewer locations where adaptation strategies would be applied.

The climate adaptation strategies were assumed to be equally weighted. There may be different ways to weight them, emphasizing the importance of some (such as reducing vegetation density or protecting future climate refugia) over others. Because this analysis is general and not specific to individual species, it would be difficult to provide ecological justification for a specific weighting scheme, since it would likely vary by individual species. For analysis specific to individual vegetation types or specific species of conservation concern see the Vegetation Ecology, Wildlife and Plants sections.

Consequences Common to All Alternatives

Decades of fire exclusion coupled with intensive logging in forest ecosystems of the southern Sierra Nevada have resulted in uncharacteristically high fuel loads and homogenous forest structure (Kilgore and Sando 1975, McKelvey and Johnston 1992). These conditions increase the susceptibility of fire-adapted forest ecosystems to climate change and related influences on ecosystems including uncharacteristically severe wildfire, insect or disease outbreaks, and drought-triggered mortality (North et al. 2009, Stephens et al. 2010). All alternatives include the reduction of small-diameter, shade-tolerant trees to increase forest resilience, although the amount varies considerably by alternative. The desired conditions for vegetation are shared across alternatives B, C, and D and they include reduced forest densities and a shift from dominance of smaller to larger trees (TERR-POND-DC-02 to 03; TERR-DMC-DC-03 to 04; -MMC-DC-02,

04; TERR-RFIR-DC-03, 05; TERR-LDGP-DC-05, 08, 09; TERR-UMJF-DC-03, 05; TERR-MJF-DC-01).

Table 65. Rating of the amount of application climate adaptation strategies by alternatives

Climate Adaptation Strategy	Alternative A	Alternative B	Alternative C	Alternative D
Manage for vegetation heterogeneity and diversity	Low	Low to moderate (in 15 to 25% of area)	Low	Moderate to high (in 30 to 60% of area)
Restore or maintain key ecological processes (like fire)	Low	Low (moderate in Kern Drainage)	Low	Moderate
Reduce density of small-diameter trees, reduce tree density in sagebrush	Low	low to moderate (in 15 to 25% of area)	Low	Moderate to high (in 30 to 60% of area)
Reduce impacts of climate-related stressors	Low	Low to moderate	Low	Low to moderate
Rapid detection and rapid response to invasive species	Low to moderate	Low to moderate	Low to moderate	Low to moderate
Restore and maintain watershed function	Low	Low to moderate	Low	Moderate
Restore function of non-meadow riparian vegetation	Low	Low to moderate	Low	Moderate
Restore function of meadow ecosystems	Low	Low to moderate	Moderate	Low to moderate
Improve resilience of aquatic ecosystems	Low	Low to moderate	Low	Moderate
Protect future climate refugia	Low	Low	Low	Low
Post-disturbance climate adaptation response strategies	Low	Low moderate	Low	Low to moderate
Enhance ecologically important species	Low	Moderate	Low to moderate	Moderate
Maintain and restore dynamic habitat connectivity	Low	Moderate to high	Low to Moderate	Low to high
Overall	Low	Low to moderate (some high)	Low (some moderate)	Low to moderate (some high, some low)

All alternatives would continue to have opportunities to maintain and restore vegetation in the Kern Drainage using wildfire managed for resource objectives. These areas currently have greater resilience to climate change and related trends in increased fire because extensive areas have had restoration of wildfire managed for resource objectives over the least 15 years (Fites-Kaufman et al. 2003, Vaillant 2009, Meyer 2015). This area has large landscapes that have reduced forest density and fuel conditions. Fires are limited in size when they reach numerous recent fires in the area (Ewell et al. 2012, Reiner et al. 2016).

Aggressive eradication and containment of established invasive species will be an important component of ecosystem management under a changing climate. This is especially true considering that while fire plays an essential role in vegetation restoration, these same activities can result in invasive plant species introductions and spread (Keeley 2006). Projections are for an

increase in burned area with climate change (see "Fire Trends" section). All alternatives include taking an approach to controlling invasive species and preventing their introduction. Similar plan direction from the existing plans has been incorporated into the proposed new plans and would be similar under alternatives B, C, and D. This includes desired conditions limiting invasive plant invasion and spread (INV-FW-DC-01 to 02; MA-RCA-DC-01), and management approaches, standards, and guidelines to reduce invasion and spread during management activities using an early detection and rapid response strategy (INV-FW-STD-01; INV-FW-GDL-01 to 06).

No alternatives have identified future climate refugia for native species persistence, except for a desired condition for special habitats that would apply to alternatives B, C, and D (SPEC-FW-DC-03). However, vulnerability assessments for the southern Sierra Nevada have the potential to identify future climate refugia that can be prioritized for restoration or monitoring. Alternatives B, C, and D would share desired conditions that address connectivity and the ability of species to move and persist across larger areas (MA-RCA-DC-04; RCA-RIV-DC-01; TERR-FW-DC-04; TERR-SAGE-DC-04; TERR-OLD-DC-02; TERR-MONT-DC-02).

No alternatives have addressed prioritization of restoration to address vulnerabilities to climate change. However, alternatives B, C, and D provide climate adaptation response strategies by emphasizing vegetation restoration to reduce climate-related stressors including large and severe wildfires, insect outbreaks, invasive species, and drought (chapter 2, Table 6 through Table 8).

Monitoring and adaptive management approaches are fundamental to understanding how to respond to the impacts of climate change. All alternatives include monitoring and adaptive management as a component of their plan management strategies, approaches, and tools. Alternatives B, C, and D apply the new 2012 planning rule that was developed in part to use a more flexible and adaptive planning process that allows for more frequent and streamlined plan amendments and revisions. This adaptive process, provides greater potential for alternatives B, C, and D to monitor, learn, and adapt to rapidly changing climate.

Consequences Specific to Alternative A

Alternative A has no management direction specific to climate adaptation or resilience. There is some ecological restoration aimed at reducing forest density but it is limited in intensity and extent. Alternative A has the lowest potential to reduce the risk of undesirable wildfires because of the reduced fuel treatment rates under this alternative that have resulted in a significant fuel treatment "backlog" and fuel buildup in Sierra Nevada forest ecosystems Alternative A would not emphasize forest heterogeneity approaches to promote resilience to the same degree as the other alternatives. Although there is an ability to restore heterogeneity, the limits on allowed changes to forest canopy cover in California spotted owl habitat limit the degree to which heterogeneity can be restored. Compared to the other alternatives, alternative A has the lowest rate of watershed restoration (less focus on priority watersheds) and has an increased potential for wildfires burning at increased severity outside the historic range of variation that may impair watershed function (such as increased soil erosion and sedimentation). Fewer fuel reduction treatments, less watershed restoration, and less emphasis on heterogeneity restoration would likely result in less prescribed burning and fewer wildfires managed primarily for resource objectives than other alternatives. Although alternative A has the least potential to reduce the risk of large wildfires which would be vulnerable to weed invasion, it also has the fewest restoration activities such as prescribed fire and mechanical treatments that would be vulnerable to being invaded by non-native plants.

Alternative A provides the least benefit to certain ecologically important species, such as aspen and whitebark pine, because it has the lowest treatment rates in special habitats and whitebark pine stands, and the lowest potential use of wildfire managed primarily to meet resource objectives. Alternative A may incorporate some of these recommendations, but they are not part of the plan direction and there is uncertainty that the recommendations would be implemented. Consequently, alternative A would do the least to integrate climate vulnerability assessments in planning and prioritizing of all the alternatives. Alternative A does not address vulnerabilities to climate change for riparian and aquatic ecosystems. Alternative A does not have plan monitoring components focused specifically on climate change and there are no direct and indirect indicators of changing climate conditions.

Consequences Specific to Alternative B

Alternative B emphasizes plan direction that would increase the resilience of vegetation directly to climate change and indirectly through increased vegetation and watershed resilience to fire, drought, insects, and pathogens. This includes desired conditions on resilience to climate change and sustainability in the face of climate change for watershed and terrestrial ecosystems (WTR-FW-DC-01, -03 to 04; TERR-FW-DC-02, -05, -08) and riparian and aquatic ecosystems (MA-RCA-DC-12; RCA-MEAD-DC-02; RCA-RIV-DC-01; RCA-SPR-DC-02-03). There is a goal to integrate landscape or watershed approaches to restoration that integrates recreation, fuels, partnerships, and vegetation management to effectively address climate change (WTR-FW-GOAL-01).

Alternative B would manage for forest and shrubland vegetation heterogeneity and diversity and restore or maintain key ecological processes (such as fire in frequent fire systems), and key approaches for resilience to climate change through guidelines and desired conditions (TERR-FW-GDL-01; TERR-FW-DC-01; TERR-BLU-DC-01; TERR-CHAP-DC-01; TERR-MONT-DC-01, -04, -06; TERR-UPPR-DC-01 to 02; TERR-ALPN-DC-01; TERR-SAGE-DC-01 to 02; TERR-PINY-DC001 to 02; TERR-XER-DC-01 to 03). This includes restoration of vegetation density and composition to vegetation types and specific desired conditions that are based primarily on the natural range of variation for those types (see “Terrestrial Vegetation Ecosystem” section for more detail). In alternative B the assumption is that fire, and low resilience to drought, insects, and pathogens are the greatest risk to all ecosystems. Therefore, the emphasis is on restoring the resilience of terrestrial ecosystems. Alternative B would likely increase structural heterogeneity based on the emphasis of mechanical thinning and prescribed fire treatments to implement concepts of ecological restoration in westside forests (North et al. 2009-1, North 2012) and vegetation diversity in eastside sagebrush and pinyon-juniper woodlands. This would occur on 15 to 25 percent of the landscape, primarily in the montane and foothill areas on the west side, and in the Jeffrey pine, pinyon-juniper and sagebrush vegetation types in the east side (TERR-FW-OBJ-01 to 04).

Alternative B would have a moderate likelihood of reducing the chance of uncharacteristically large and severe wildfire and other climate-related stressors in portions of the planning area based on the combined rates of mechanical and prescribed fire treatments and use of wildfire managed to meet resource objectives (see the “Fire Trends” section). Alternative B has greater treatment rates of mechanical treatments, prescribed fire, and wildfires managed for resource objectives (TERR-FW-OBJ-01 to 04) than alternatives A and C. The greater use of mechanical treatment and prescribed fire in the foothill, montane, Jeffrey pine, pinyon-juniper, and sagebrush vegetation types would provide greater resilience to climate change, since these vegetation types are most departed from the natural range of variation. The greater use of wildfires managed for resource objectives (Sequoia: TERR-FW-OBJ-03; MA-WRZ-GOAL-01; MA-WRZ-DC-03; MA-

WMZ-STD-01; MA-WMZ-GOAL-01) would be critical to reduce fuel loading and the vulnerability of forest ecosystems across large spatial scales in the southern Sierra Nevada (Meyer 2015), especially considering the high level of mechanical constraints in the steep and inaccessible areas that occur in many parts of the analysis area (North et al. 2015). Use of wildfires managed for resource objectives would occur primarily at higher elevations in the upper montane and subalpine and alpine vegetation types and in the Kern River Drainage where landscape fuel conditions are moderate to low overall. Since red fir, subalpine and alpine ecosystems have a high vulnerability to climate change, continued restoration of fire in these areas would provide increased resilience to climate change.

Alternatives B would restore watershed function at a slightly higher rate by increasing the emphasis on priority watersheds for management actions (WTR-FW-OBJ-01) and objectives for water quality improvement projects (RCA-RIV-OBJ-01 to 02). Vegetation treatment rates in riparian ecosystems and meadows would also likely be higher in alternative B (MA-RCA-OBJ-01; RCA-MEAD-OBJ-01) compared to alternative A, resulting in greater resilience to climate change and in some locations resilience to fire under alternative B. There is less emphasis on direct restoration of aquatic ecosystems. There would be limited improvements to aquatic ecosystem resilience as a result. There would continue to be vulnerability of many aquatic ecosystems to changing hydrographs and temperature thus increasing their vulnerabilities to climate change. There would be improvements to resilience of meadows to climate change that are restored as a result of meadow restoration objectives.

In the long term, greater resilience of forest and shrubland vegetation would improve climate resilience in areas where restoration is emphasized (such as focus landscapes on the west side) and may maintain relatively greater levels of habitat connectivity for forest-dependent species by facilitating species movements into suitable future habitat (higher elevation forests or climate refugia). There would be a management approach on the westside forests that addresses restoration of larger areas:

> Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.

In addition to desired conditions for connectivity for wide-ranging species (MA-RCA-DC-04; RCA-RIV-DC-01;TERR-FW-DC-04; TERR-SAGE-DC-04; TERR-OLD-DC-02; TERR-MONT-DC-02) there are specific standards and guidelines to ensure restoration projects do not result in reduced connectivity for species vulnerable to climate change, such as Pacific fisher (SPEC-CSO-DC-01, SPEC-PF-DC-01; SPEC-PF-DC-01, -08 to 10; SPEC-PF-STD-01).

There would continue to be large, high-intensity fires, especially in unrestored areas in the foothill, montane and eastside pine, pinyon-juniper and sagebrush landscapes that would disrupt connectivity for some species. Only a portion of the landscape would be restored and fire trends would continue in many areas (see “Fire Trends” section). Species associated with mature forest or shrublands, including Pacific fisher, the California spotted owl, and greater sage-grouse, would continue to have disruptions in connected habitat in many areas. For more detail, see the “Old Forest” and “At-risk Terrestrial Wildlife Species” sections. There would be consideration of climate change in post-fire restoration. This is from numerous desired conditions that emphasize resilience to climate change (see above). There would also be a specific guideline to consider climate change adaptations in reforestation related restoration (TIMB-FW-GDL-02) and a management approach that addresses native vegetation:

> Promote native vegetation (e.g., conifers, hardwoods, shrubs) in complex early-seral habitat that supports long term ecosystem integrity considering climate change, drought, insects, disease and fire.

Restoration in alternative B would have some benefits to ecologically important species that have a high vulnerability to climate change, such as aspen and whitebark pine. The restoration of special habitats (like aspen) and whitebark pine stands would increase and there would be specific direction to improve management of whitebark pine and special habitats. The greater use of wildfire managed to meet resource objectives would likely improve conditions for aspen and whitebark pine because they respond positively to mixed-severity fires.

Climate vulnerability assessments provide useful insights in the regional impacts of climate change. In the southern Sierra Nevada, several recent vulnerability assessments are available for assessing climate change effects to terrestrial and aquatic ecosystems in the planning area (Nydick and Sydoriak 2011a, 2011b). Alternatives B incorporates at least some recommendations of these climate vulnerability assessments in planning and prioritization efforts for terrestrial ecosystems (like for whitebark pine restoration,). There is a guideline that addresses consideration of refugia for species associated with small-scale special habitats that are less likely to have connected habitat (MA-RCA-GDL-04). Fewer recommendations from the Climate Vulnerability and Adaptation Strategy (Kershner 2014) to use strategies and standards to address climate change vulnerabilities for aquatic systems were incorporated. Increased meadow restoration is one area where the recommendations were incorporated. Vulnerabilities to climate change for aquatic ecosystems are already being manifested in terms of decreased water flows and increased temperature.

Alternative B would have moderate potential to reduce the risk of large wildfires which would be vulnerable to weed invasion, but it also has more restoration activities such as prescribed fire and mechanical that could make areas more vulnerable to being invaded by non-native plants. There is specific management direction (desired conditions, guidelines, and standards) to limit the invasion and spread of non-native invasive plants that are common to all alternatives (described above). Alternative B also incorporates objectives to restore infested areas (INV-FW-OBJ-01) that would lessen the effects of climate change on increasing invasive plant spread. However, this would not be enough to keep up with the pace of increased invasions. There is a specific management approach directed at improved understanding of effectiveness of different methods to reduce climate related invasive species spread:

> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, non-native species.

Alternatives B uses more flexible plan direction and an adaptive planning process that allows for more streamlined plan amendments and revisions than alternative A, which requires more prescriptive and restrictive plan direction developed under the 1982 Planning Rule. In alternative B, the emphasis is on specific desired conditions at multiple spatial scales (from patches to landscapes) that allow for a wide range of site-specific actions to implement. In alternative B, the greatest flexibility is in the focus landscapes, where there would be more flexibility to evaluate the response of Pacific fisher and California spotted owl to restoration of vegetation to the natural range of variation. This adaptive process that is inherent in the new planning rule provides greater potential for alternative B to monitor, learn, and adapt to rapidly changing climate.

Consequences Specific to Alternative C

Alternative C shares many of the desired conditions for forest structural heterogeneity and diversity and restoration and maintenance of key ecological processes (like fire) as alternative B.

However, additional desired conditions for more forest cover in California spotted owl habitat (interim recommendations) combined with additional restrictions on reducing canopy cover and using mechanical restoration in westside mixed conifer and ponderosa pine forests would limit the amount of restoration of vegetation to the desired conditions. This would result in lower levels of heterogeneity. Much of the landscape would remain in the current condition of high forest density. There would be an increased emphasis on restoration using prescribed fire and wildfires managed primarily for resource benefit but the opportunities for this type of restoration would be low in most areas (except Kern Drainage as mentioned previously) because vegetation would be denser and fires harder to control. However, on the Sequoia National Forest, there is expected to be less prescribed fire (chapter 2, Table 6 through Table 8). Overall there would be lower resilience of mixed conifer and ponderosa pine forests to climate change and associated stressors of drought, insects and pathogens, and high-intensity wildfire.

Because of the denser forest conditions, there would be fewer opportunities to reduce the chance of uncharacteristically large and severe wildfire and other climate-related stressors in the planning area based on the combined rates of mechanical and prescribed fire treatments and use of wildfire managed to meet resource objectives. The greater use of wildfires managed for resource objectives would be critical to reduce fuel loading and the vulnerability of forest ecosystems across large spatial scales in the southern Sierra Nevada (Meyer 2015), especially considering the high level of mechanical constraints in the steep and inaccessible areas that occur in many parts of the analysis area (North et al. 2015). The outcome of such fires in alternative C would be larger patches of high-severity fire because vegetation would remain denser throughout much of the montane landscape.

Alternative C would restore watershed function by increasing the emphasis on priority watersheds for management actions. There would be an increased emphasis on restoration using prescribed fire and wildfires managed primarily for resource benefit; however, whether this is sufficient to reduce risk of large, high-intensity fire and improve resilience to climate change in riparian ecosystems and meadows is unknown. It is unlikely that alternative C would result in improved watershed resilience compared to alternative B.

Alternative C would have varied benefits to ecologically important species (such as keystone species). Although there is an emphasis on species conservation in alternative C, the benefits to some special habitats that are especially at risk (like aspen and whitebark pine) may be fewer than alternative B due to less overall restoration that could include these areas. For those aquatic species without conservation strategies or standards and guidelines, alternative C would not improve habitat conditions or decrease vulnerabilities to climate change.

Like alternative B, alternative C incorporates some of the recommendations of recent climate vulnerability assessments (especially for terrestrial ecosystems) that would increase climate adaptation. Alternative C would similarly apply only limited recommendations for aquatic ecosystems. The objectives for meadow restoration are increased and would provide for increased climate resilience in restored meadows and for associated aquatic ecosystems, especially downstream.

For non-native invasive plant species, alternative C would have a more limited use of mechanical treatment and would reduce risk of invasion. However, this may be outweighed by a likely increase in the amount of burned area predicted from climate change (see “Fire Trends” section).

Consequences Specific to Alternative D

Alternative D would have similar consequences to alternative B but there would be a greater amount of terrestrial, riparian and aquatic ecosystem restoration. The amount of restoration could potentially be double that in alternative B and more than double what currently occurs under alternative A. This would decrease the likelihood of large, high-intensity fires (see "Fire Trends" section) and increase vegetation resilience to climate change and related stressors. There may be increases in the spread of non-native plants because of increased mechanical restoration; however, there would also be plan direction similar to alternative B designed to reduce and limit invasive plant establishment and spread. Nonetheless, non-native plants are likely to increase to a greater degree under alternative D than alternatives A, B, or C.

Alternative D has the greatest potential to reduce the risk of large wildfires which would be vulnerable to weed invasion, but it also has the most restoration activities such as prescribed fire and mechanical restoration that would be vulnerable to being invaded by non-native plants.

Alternative D has the greatest potential for short-term impacts to habitat connectivity due to the increased amount of restoration occurring in a relatively short period of time, but it provides the most reduction of risk of large, high-intensity wildfires that have long-term impacts on connectivity of forest cover. The plan components from alternative B would reduce some of the short-term impacts by incorporating the consideration of maintaining or restoring connectivity in project design.

Cumulative Effects

There are three aspects to cumulative effects from climate change. First, there are the cumulative effects of multiple climate change adaptation strategies. Second, there are cumulative effects of management across different adjacent ownerships. These interact with cumulative effects of climate change over time.

The cumulative effects of climate change and climate-related stressors (such as uncharacteristically large and severe wildfire, insect outbreaks, and non-native invasive species) can be substantial to ecosystems in the planning area. The incorporation of multiple or many climate adaptation strategies may synergistically build greater adaptive capacity than the application of a few approaches. Adaptation strategies that increase climate resilience across larger areas in more vulnerable ecosystems are likely to have the greatest positive effect. This includes restoration of vegetation that reduces the likelihood of large, high-intensity fire.

Reasonably foreseeable management activities on private, State, tribal, or other Federal land would vary in the application of climate adaptation strategies. Some management activities on adjacent tribal lands, national parks, and Bureau of Land Management-managed lands would be similar, including vegetation restoration, aquatic and riparian restoration, and measures to enhance habitat resilience of species and vegetation types vulnerable to climate change. Private land owners may implement some similar actions in conjunction with Natural Resources Conservation Service programs to restore watershed health and function or improve grazing lands. These actions would increase the positive benefits of climate adaptation actions on the national forests. Conversely, a lack of restoration actions on these adjacent lands could increase the vulnerability of terrestrial, riparian and aquatic ecosystems on national forest lands because the likelihood of large, high-intensity fires and limited resilience of widespread vegetation types would persist. Coordinated efforts across all ownerships would provide the greatest cumulative positive impact on climate adaptation.

Lastly, in the foreseeable future, climate will continue the trend of increasing temperature, earlier snowmelt, and increased level of fluctuating precipitation. It is unknown whether the current drought will continue or other more severe ones will occur. The climate record suggests that this is possible although when or how long is uncertain.

Analytical Conclusions

Based on the climate adaptation indicators and measures, alternative D followed closely by alternative B are best for achieving overarching forest management goals and objectives under climate change. Alternatives B, C, and D share most of the same desired conditions that incorporate resilience and adaptation to climate change. They all emphasize an all lands approach to management, encouraging partnerships with a wide variety of public groups, communities, and government agencies. These will increase the likelihood of a successful outcome of the application of climate adaptation strategies.

Alternative D has the greatest flexibility in the amount of vegetation restoration that would reduce the impacts of high-intensity fire, drought, and warmer temperatures on vegetation. Alternative B has increased flexibility to conduct vegetation restoration in owl and fisher habitat in focus landscape areas and has the potential to double current levels of restoration, but alternative D proposes double the amount of restoration in alternative B. Although alternative D results in greater potential to increase current non-climate stressors on ecosystems related to management activities (such as reducing habitat connectivity in the short term compared to the current condition), it moves the most area toward the vegetation natural range of variation over time and provides for the most dynamic habitat connectivity in the long term by increasing the resilience of vegetation to disturbance. In contrast, alternatives B and C contribute less to non-climate stressors on ecosystems in the short term and maintain current habitat connectivity. However, these two alternatives would have more areas at risk to dynamic habitat connectivity because of continuing high risks of large, high-intensity wildfires.

Alternatives A and C have the least flexibility in vegetation management and the least area planned for restoration. Both alternatives emphasize conservation of moderate to high density canopy cover in late seral forest habitat and would result in retention of dense vegetation conditions that have low resilience to large, high-intensity fires, drought and temperature increases. Desired results in terrestrial ecosystems and watersheds would be achieved more rapidly in alternatives B and D, but potentially at greater short-term impacts to habitat for at-risk species than alternative C and possibly alternative A.

Aquatic and Riparian Ecosystems

Aquatic and Riparian Ecosystem Integrity

Background

This section summarizes the current conditions in aquatic and riparian ecosystems on the Inyo, Sequoia, and Sierra National Forests, and the consequences of adopting the revised plan or its alternatives. To address aquatic and riparian ecosystem integrity, the proposed plan includes desired conditions designed to:

- provide resilience to climate change;
- restore or maintain the function of streams, meadows, riparian areas, seeps, and springs, avoid invasive species;

- conserve biodiversity;
- preserve and reestablish ecological connectivity; and
- promote resilience to fire in riparian ecosystems.

The extent the alternatives would move toward the proposed desired conditions are analyzed in this section. The terrestrial, aquatic, and riparian ecosystems are interconnected with watershed conditions, water quality, and water quantity. Watershed condition and function are discussed recognizing these connections. A more detailed analysis can be found in the Aquatic and Riparian Ecosystems supplemental report in the project record.

Ecological integrity is a measure of an aquatic and riparian ecosystem's functional and structural conditions. Functional conditions include the surface flow that sustains riparian and aquatic habitats; shallow groundwater recharge; temperatures; carbon and nitrogen sequestration; and nutrient cycling. Structural conditions include habitat type and availability, migration corridors among habitats, and structure and composition of riparian vegetation. These ecosystem conditions affect suitability of habitat, diversity, connectivity and resilience to climate change. Aquatic and riparian ecosystem conditions in the southern Sierra Nevada vary depending on the amount of past and current land disturbance that has occurred within the area, and the effect of climate changes on the natural integrity of the ecosystems. The severity of effects is influenced in part by the elevation, fire regime, precipitation, and management of these areas.

Analysis and Methods

This qualitative analysis is based primarily on the best available scientific information derived from forest assessments (USDA FS 2013a, 2013b, 2013c), the Bio-Regional Assessment (USDA FS 2013d), the Science Synthesis (Long et al. 2014) and recent reports and publications that assess trends in current conditions, and where available, assessment of effects of management actions. Aquatic habitats and diversity, groundwater-dependent systems, and riparian ecosystem functions that have been assessed at a broad scale are evaluated. Key ecosystem characteristics common to all three forests are used to predict whether future conditions will provide for ecological integrity under the different alternatives. Only key ecosystem characteristics that could be influenced by management following the draft plan direction or by climate change were selected. For this analysis, these indicator measures were assessed at the landscape or southern Sierra Nevada level.

Indicators and Measures

Sustainability of aquatic habitat (including invasive species), ecological connectivity, aquatic species diversity, resilience to climate change, and riparian vegetation were selected because they could be assessed across the landscape, were indicators of the desired conditions, and were important measures of aquatic and riparian ecosystem integrity. All aquatic ecosystems including fens, wet meadows, springs, stream, lakes, ponds and rivers are referred to as aquatic ecosystems in the analysis. Aquatic indicators cover all the various aquatic and semi-aquatic habitats.

Sustainability of Habitat

- Management to maintain or improve habitat for all life stages of aquatic and riparian species.
- Management direction to reduce invasive aquatic species.

Ecological Connectivity

- Management to reduce or improve road crossings and small dams and diversions affecting aquatic at-risk species.
- Management of connectivity among habitats for aquatic or riparian associates.

Aquatic Species Diversity

- Management that improves aquatic species diversity, including rare and common native species.

Resilience to Climate Change

- Rate of restoration to improve resilience to climate change of priority habitats for all life stages of riparian and aquatic rare and common native species.
- Rates of restoration of ecological and hydrologic connectivity to improve resilience to changing timing of flows and changing elevation of rain/snow interface.
- Rates of ecological restoration for native species and effects on riparian species fire resilience.

Riparian Vegetation

- Management of riparian conservation areas to promote native species including understory vegetation, as indicated by management direction.
- Rate of ecological restoration to reduce risk of high-intensity wildfire and promote native shrub diversity in riparian areas.
- Rate of restoration of riparian areas to promote native species, reduce the risk of high-intensity wildfire, and promote wildfires managed to meet resource objectives.

The environmental consequences section provides a qualitative assessment of forecasted trends in indicator measures by alternative based on the effects from potential watershed restoration activities; meeting objectives for meadow, stream, aquatic organism passage, and riparian area restoration; forest vegetation restoration activities; recreation activities; trails and road crossings management; invasive species management, and climate change management on these indicator measures.

Assumptions

There are several key assumptions about why, when, where, and how restoration treatments would occur in aquatic and riparian areas that were used in the analysis.

- Restoration of aquatic passages would occur as resources permit on forest roads where aquatic at-risk species occur, and where appropriate. However, no desired barriers to invasive fish would be opened where they might impact at-risk species. Culverts and road crossings that are associated with roads used to access treatment areas would be examined for restoration opportunities.
- National forest managers would use an integrated restoration approach to designing projects that strive to balance watershed restoration with terrestrial restoration. Stewardship contracting may increase funding for restoration treatments of all types, although the Inyo and Sequoia National Forests would not have as many stewardship contract opportunities to restore aquatic habitats as the Sierra National Forests due to the

difference in forest product markets, values, and area available for mechanical vegetation treatment.

- Within riparian areas, vegetation treatments would occur to move vegetation toward the desired conditions. This would be primarily to restore native species composition and reduce the ingrowth of conifer trees where appropriate. The end result of the treatments would generally be more diversity of hardwood species and sizes, as well as vigorously growing herbaceous vegetation.
- Most riparian vegetation restoration would occur in areas where the adjacent upland areas are being restored.
- Aquatic habitat restoration in streams, meadows, and other special aquatic habitats would be primarily to maintain or improve habitats for at-risk species and to improve downstream beneficial uses. Aquatic habitat restoration would be integrated into landscape treatment designs where appropriate. Partnerships and additional funding opportunities from sources outside the Forest Service would be sought to increase the pace and scale of aquatic habitat restoration.

Affected Environment

Aquatic habitat integrity within the three national forests is generally highest in the higher elevation portions of the analysis area and within existing protected areas due to fewer alterations than lower elevation areas. There are several aspects of aquatic habitat integrity that are outside the natural range of variation across the three national forests including species assemblages and flow regimes altered by diversions and dams.

The current plans developed critical aquatic refuges to preserve, enhance, restore or connect habitats for aquatic species at the local level and to ensure the persistence of aquatic or riparian-dependent species. Critical aquatic refuges provide additional protection to watersheds with high biodiversity of native species or that contain sensitive, threatened, or endangered species. The three national forests have critical aquatic refuges of various sizes tied to a particular native species or a high level of biodiversity. Many critical aquatic refuges are wholly encompassed within areas of high aquatic integrity and inventoried roadless areas or wilderness, especially those delineated for Little Kern golden trout, Kern River rainbow trout, California golden trout, Yosemite toad, and yellow-legged frogs. Table 66 summarizes the current critical aquatic refuges on the three national forests and the overall watershed conditions in the watersheds containing these critical aquatic refuges (see “Water Quality, Water Quantity, and Watershed Condition” section).

Across the Sierra Nevada, aquatic biodiversity is vulnerable, as indicated by declining trends in native fish, amphibians, and other species (Moyle and Randall 1998, Moyle et al. 2011, Purdy et al. 2012, Viers and Rheinheimer 2011, Viers et al. 2013, Vredenburg, et al. 2007, Frissell et al. 2012, USFWS 2015). Depending on the species groups, 40 to 80 percent of all aquatic species in California are now facing extinction, unless current trends are reversed by active management and conservation (Frissell et al. 2012, Howard et al. 2013, Katz et al. 2012, Quinones and Moyle 2015). In 2010, the primary threats to aquatic biodiversity were ranked as follows: alien species were considered the most detrimental threat (34 percent), followed by major dams and associated water diversions (24 percent), agriculture (18 percent), hatcheries (14 percent), and estuarine alteration (12 percent) (Moyle et al. 2011).

Table 66. Summary of critical aquatic refuges and watershed conditions on the Inyo, Sequoia, and Sierra National Forest

National Forest	Number of Critical Aquatic Refuges in Current Plans	Critical Aquatic Refuge Watersheds in Good Condition (Functioning Properly)	Critical Aquatic Refuge Watersheds in Fair Condition (Functioning At Risk)	Critical Aquatic Refuge Watersheds in Poor Condition (Impaired Function)	Type of Species Provided Protection
Inyo	17	11	6	0	Amphibians, birds, fish
Sequoia	6	3	3	0	Amphibians, fish
Sierra	7	2	5	0	Amphibians, birds, fish
Planning Area	30	16	14	0	Amphibians, birds, fish, mollusks

Rivers and Streams

Large river systems on the three national forests drain the highest peaks in the Sierra Nevada. The Inyo National Forest provides the headwaters within the eastern Sierra Nevada, White, Inyo and Glass Mountains. The Owens River drains the east side of the Sierra Nevada and the White Mountains. Because the eastern slope is in a rain shadow and drier, permanent streams, meadows and springs are especially important for wildlife and fisheries. The upper Owens River and smaller permanent streams, including Pine Creek, Bishop Creek, Big Pine Creek, and Rock Creek, are the major sources of water. Historically these waters flowed into Owens Lake but much of the flow is now diverted to Los Angeles for domestic consumption.

The Kern River flows north to south through the Kern Plateau, which is shared by the Inyo and Sequoia National Forests. The Kern Plateau is home to many springs and meadows that maintain perennial streams. One of the few riparian forested areas in the area lies at the confluence of the South and North Forks of the Kern River, upstream of Lake Isabella.

The Kings River drains both the Sequoia and Sierra National Forests. The Kern and Kings Rivers historically flooded the Tulare Lake Basin, but today supply water for agriculture, industry, and residential use in Kern, Tulare, and Kings Counties.

The Kings and San Joaquin Rivers drain the Sierra National Forest. The San Joaquin River and its major tributaries, the Chowchilla, Fresno and Merced Rivers flow north through the San Joaquin Valley to the delta of the Sacramento and San Joaquin Rivers.

The geologic history of the basins (Owens, Tulare, and San Joaquin) determined what types of fish (anadromous or inland) were native to these rivers.

Although the Inyo National Forest is often thought to be dry, there are an estimated 1,640 miles of perennial streams there. About 1,280 miles of perennial streams occur on the Sequoia National Forest. The Sierra National Forest includes about 2,000 miles of perennial streams and rivers.

Common native species found in these systems include a variety of stream-dwelling macro-invertebrates, such as caddis flies, mayflies, and stone flies. Seventy-eight percent of streams were found in good condition on national forest lands in the southern Sierra Nevada based on assessment of macro-invertebrate populations (Furnish 2013).

Prior to stocking of non-native trout, the North and South Forks of Kern River and some of their tributaries provided a much larger range for three golden trout species. Now these native species are confined to small headwater streams. Native rainbow trout in the Kings River were extirpated due to non-native trout introductions (Moyle 2002). Brown trout and rainbow trout were introduced into eastside Sierra streams and rivers as they are prized by anglers, but they have reduced native amphibian population. The California Department of Fish and Wildlife manages the fishery resources in the state and has changed fish stocking policies, using triploid fish that are unable to reproduce, and encourage restoring native fish and managing for native species where possible (Frissell et al. 2012). The Forest Service encourages the return of native species to the landscape.

Non-native fish and bullfrogs are present within the planning area and their presence has been detrimental to native species, especially amphibians (Schwartz et al. 2013). The New Zealand mud snail is established in the Owens River watershed and has found to cause significant disruptions in stream food chains throughout the western states (Moore et al. 2012). It is anticipated that aquatic invasive species will continue to spread throughout streams, rivers and reservoirs in the San Joaquin valley on boats, fishing equipment, and other water sports gear (CDFG 2008). Invasive species are a continual and pervasive threat to native species in rivers and streams as it can be difficult and expensive to control them once they become established.

Dams and water impoundments block movements of fish, amphibians, and aquatic insects resulting in a lack of habitat connectivity. Large dams on the San Joaquin and Merced Rivers and their tributaries block salmon from reaching former habitat on the Sierra National Forest (USDA FS 2013c). Connectivity of aquatic habitat is also an issue at higher elevations due to poorly designed or maintained road culverts that block aquatic species passage. Non-native fish are often predators in aquatic systems and they can disrupt the connectivity of habitat and reduce populations of amphibian species in particular. By contrast, where at-risk fish or amphibian species are present it is often desirable to maintain barriers to aquatic connectivity to keep invasive fish away from at-risk species.

Meadows, Fens, and Springs

The Inyo National Forest has over 25,000 acres of meadows; the Sequoia National Forest has more than 10,000 acres in meadows, and the Sierra National Forest has more than 15,000 acres in meadows. Although the overall area of meadows is a small proportion of the landscape (around 2 percent of national forest lands higher than 6,000 feet elevation), they provide critical ecosystem function. The Kern Plateau on the Sequoia National Forest is an exception to this general pattern where meadows occupy an estimated 10 percent of the landscape.

Meadow condition depends on vegetation, hydrology, stream channel condition, and invasive species (Purdy et al. 2012). Viers et al. (2013) found during drought in the Sierra Nevada that vegetation cover and bare ground cover ranged from natural condition to moderately or heavily impacted, depending on the montane meadow location. Meadows with incised channels are less resilient to water flow changes over time and face increased risk of damage from wildfire. Bank erosion, small streambed materials, and wide and shallow streams within meadows in the Sierra Nevada degrades habitat for aquatic species (Micheli and Kirchner 2002). Habitat quality within meadow habitats for rare aquatic species has been degraded (Frissell et al 2012, Purdy et al. 2012, Henery et al. 2011) due to an ingrowth of conifers, bank trampling by cattle, off-highway vehicle use, and destabilized banks due to roads, culverts, historic ranching, and intensive timber harvest on adjacent uplands on the three national forests (Fryjoff-Hung and Viers-2013). Where meadow conditions are degraded, restoration may be necessary to restore hydrologic functions for

dependent vegetation such as willows to recover in highly degraded meadows (Frissell et al. 2012).

In 1999, the Forest Service Pacific Southwest Region Range Program initiated a regionwide, long-term meadow condition and trend monitoring program. The primary purpose of the program was to (1) document baseline meadow conditions as these new riparian standards and guidelines were coming into use; and (2) examine long-term trends in meadow condition following implementation of these riparian standard and guidelines. The program currently includes 618 permanent meadow vegetation monitoring sites established in key meadows across the region including the three national forests covered in this analysis. Vegetation composition is measured at the time a plot is established and then every 5 years following. There are 496 plots within the 10 national forests covered under the Sierra Nevada Forest Amendment. As of summer 2012, a total of 246 plots have been reevaluated over the past 10 years, across 127 grazing allotments.

In 2012, the Forest Service Pacific Southwest Region and the University of California, Davis Rangeland Watershed Laboratory established a partnership to conduct the first comprehensive analysis of this unique dataset examining (1) meadow conditions and trends; and (2) relationships between meadow conditions and trends, livestock management, weather, and environmental drivers. In this analysis (Roche 2013) the number of plots available with at least 8 years between their earliest measurement (1997 to 2002) and the latest measurement (2007 to 2012) was 42, 23, and 25 on the Inyo, Sierra, and Sequoia National Forests, respectively. The meadow plant community condition metrics analyzed included relative frequency data, Ratliff Vegetation Score and Condition Classification, and species richness and diversity. The comprehensive analysis found a significant increase in mean species richness and species diversity on all three national forests. There was no significant change in Ratliff condition class between the readings.

On the Sierra National Forest, 4 percent of plots were in excellent to good vegetation condition with an upward trend, 43 percent were in excellent to good vegetation condition with stable trend, no plots were in good vegetation condition with downward or fair upward trend, 30 percent were in fair vegetation condition with stable trend, 22 percent were in fair vegetation condition with a downward trend, and no plots were in poor vegetation condition.

On the Sequoia National Forest 16 percent of plots were in excellent to good vegetation condition with an upward trend, 64 percent were in excellent to good vegetation condition with stable trend, 8 percent were in a good vegetation condition with downward trend, no plots were in a fair vegetation condition with upward trend, 4 percent were in fair vegetation condition with a stable trend, 8 percent were in a fair vegetation condition with a downward trend, and no plots were in a poor vegetation condition (USDA FS 2013c).

On the Inyo, 5 percent of plots showed excellent to good vegetation condition with an upward trend, 74 percent were in excellent to good vegetation condition with a stable trend, 14 percent were in good vegetation condition with a downward trend, no plots were in a fair vegetation condition with an upward trend, 2 percent were in fair vegetation condition with a stable trend, 5 percent were in fair vegetation condition with a downward trend, and no plots were in poor vegetation condition (USDA FS 2013a).

Because no systematic assessment of meadows exist on the three national forests, the forest assessments provide information about a subset of meadows overall. Other meadow and stream assessments covering the Kern Plateau, the Breckinridge Mountains, and the Sierra National Forest indicated that a majority of meadows exhibited features such as ingrowth of trees, unstable banks, off-highway vehicle trails, headcuts, and gullies (Fryjoff-Hung and Viers, 2013).

Another study on the Inyo National Forest, which included the Kern Plateau, found that meadow plant species richness, diversity, evenness, and frequency of soil-substrate stabilizing species were not significantly different between grazed and ungrazed sites (Freitas et al. 2013). Modest increases in richness and diversity were observed over the 10-year study period, while evenness and frequency of soil-substrate stabilizing species were constant.

Fens are special sensitive habitat types with deep organic soils found at high elevation on the three national forests (Wolf and Cooper 2015, Kattleman and Embury 1996). While the exact number of fens on each of the three national forests is not known and no consistent assessment exists, fens are estimated to represent about 10 percent of the meadows on the Sequoia National Forest and about 1 percent of the landscape (M. Linton, personal communication). Further north, fens in Sequoia and Kings Canyon National Parks cover approximately 0.2 percent of the landscape (Hopkinson et al. 2013). On the Inyo National Forest proper functioning condition information for fens that have been evaluated indicate that most either are properly functioning, or have an upward trend, or no trend (USDA FS 2013a).

Springs and seeps are a result of both precipitation and geologic structure and are generally found throughout the plan area. From the highest passes and valleys into the lower elevations, springs are found throughout the southern Sierra Nevada and the White Mountains. Fully functioning springs are typically considered “biodiversity hotspots” supporting many species that only occur there, most notably spring snails. Spring habitats are vulnerable to damage from on- or off-site changes of water or land uses and species associated with springs typically have limited mobility; therefore, effective protection of springs is necessary to protect endemic species (Frissell et al. 2012). There is little information about the current trends for springs across the landscape (USDA FS 2013d). However, drought has influenced flow in many springs, so the uncertainty of climate change may influence this habitat.

Lakes

Lakes on the eastern side of the Sierra Nevada Mountains in the Inyo National Forest range in size from one acre to hundreds of acres. No lakes occur in the White, Inyo, or Glass Mountains. Mono Lake is a vast inland saline lake of 44,480 acres. Approximately 478 freshwater lakes that are larger than 2 acres occur on the Inyo National Forest (USDA FS 2013a). Ponds and other small waterbodies, such as tarns and pools, occur throughout the higher elevations within the Sierra Nevada Mountains. The Sequoia National Forest has 96 acres of natural lakes and ponds. Due to lack of glaciation, high-elevation lakes and ponds are rare on the Sequoia National Forest. However, lower elevation reservoirs such as Hume Lake and Lake Isabella provide lake habitat and recreational opportunities for residents and visitors. The Sierra National Forest contains 11 reservoirs covering 17,310 acres (Redinger, Wishon, Florence, Bass, Mammoth Pools, Huntington, Courtright, Edison, Shaver, and Pine Flat). In addition, there are 1,602 lakes larger than 1 acre (totaling 14,273 acres), plus 3,366 lakes, ponds and other waterbodies less than 1 acre (totaling 1,006 acres; USDA FS 2013c).

Historically the lakes of the high Sierra Nevada were fishless and supported native fauna such as amphibians, aquatic insects, abundant zooplankton, and phytoplankton. However, many of the high-elevation lakes now support introduced brook, brown, rainbow and golden trout, which has had an impact on native frog populations (Knapp et al. 2007, Knapp and Matthews 2000a, Knapp and Matthews 2000b). The historic introduction of trout into lakes throughout the Sierra Nevada mountain range has had the effect of eliminating the yellow-legged frog from over 95 percent of its historic range (Vredenburg et al. 2007). The introduction of trout into these lakes has also altered the life-cycle and reduced the population numbers of macro-invertebrates and zooplankton

within lakes (Knapp 2005, Schindler et al. 2001). The loss of these keystone species changes the food web, and changes biodiversity. Aquatic ecosystem biodiversity in many of these lakes is outside the natural range of variation. A few lakes have remained fishless, or have had fish removed to protect amphibians and are being protected from additional fish stocking by changes in stocking rules by the state fish and wildlife agencies. These fishless lakes provide important refuges for some amphibians to support their persistence.

Riparian Ecosystems

Riparian vegetation composition and structure are influenced by the size and type of stream, the amount of flooding, and the surrounding upland ecosystems and vegetation (Kondolf et al. 1996, Kattelmann and Embury 1996). Riparian vegetation across these three national forests is diverse, with plant communities varying widely based on elevation, location, and site history (Harris 1989, Manning and Padget 1995, Potter 2005, Fites-Kaufman et al. 2007). In most of the analysis area, fire is an important influence on riparian vegetation, especially in the foothill, montane, upper montane, sagebrush and pinyon-juniper ecosystems. At lower elevations on the east slope of the Sierra Nevada, often only a few trees such as cottonwoods, willows, and birch are found. These systems are naturally drier and the riparian areas are limited in width. Similarly, at higher elevations throughout the analysis area, riparian vegetation is more limited in width in the subalpine and alpine areas. On both the east and west sides of the Sierra Nevada, in the pine or conifer forest, narrow bands of herbaceous riparian plants and often deciduous shrubs (such as creek dogwood or willow) are interspersed with upland forest trees (mostly conifers) growing next to the streams. Riparian plants can include grasses, sedges, shrubs, and trees, Along larger streams and rivers, willow shrubs are common, with a wide variety of species that vary by elevation.

In the absence of fire within the natural range of variation, conifers have grown into riparian areas and often are taller and now shade riparian hardwood trees, shrubs, and herbaceous plants in many areas. This has occurred especially at low and middle elevations where fire was historically more frequent and trees grow relatively fast. Many riparian areas have become more uniform with dense overstory cover (especially of conifers), and less vigorous and diverse understory deciduous shrubs, grasses, sedges, and herbaceous plants. Many riparian plant species are adapted to disturbances such as floods, and vigorously resprout after disturbance. This makes them resilient to fire as well (Pettit and Naiman 2007). When composition and structure of riparian vegetation becomes dominated by conifers, especially at a high density, it becomes less resilient to fire. Many of the riparian areas in the analysis area are in this condition of low resilience. Fire return intervals are not within the natural range of variation over much of the landscape, and thus not within the range of variation for the interspersed riparian areas.

Climate Change Influences to Aquatic and Riparian Ecosystems

The climate in the southern Sierra Nevada and the White and Glass Mountains is normally variable in nature varying by year, season, elevation and slope and aspect. Average annual precipitation ranges from 39 to 49 inches along the western foothills; 9 to 20 inches along the southern end of the Sierra Nevada, Kern River, and eastern slope; and up to 49 to 59 inches at higher elevations (Wolf and Cooper 2015). Changes in climate have influenced the quantity, quality, or seasonality of water and can have significant impacts on the ecological integrity of aquatic systems. Warming temperatures, particularly when combined with less precipitation, results in loss of stream flows, drying of shallow lakes or ponds, and changes in seasonal availability of aquatic habitat. Resilience of streams to climate change is influenced by sources of water, riparian forest cover, and meadow area (Frissell et al. 2012).

Changes in timing of snowmelt are already influencing stream flow patterns (Hunsaker and Long 2013). Flood potential is predicted to increase, as is the proportion of precipitation falling as rain instead of snow (Overpeck et al. 2012, Safford et al. 2012a). This is likely to continue (Null et al 2010) and will impact aquatic ecosystems through seasonal changes, decreased water flows and increased water temperatures. Stream flows in summer are declining and floods are occurring in winter rather than spring in areas dominated by snowmelt (Luce and Holden 2009; Isaak and Rieman 2013). These changes along with increases in stream temperature are expected to shift distributions of native fishes according to their water temperature requirement (Isaak et al. 2012; Rieman et al. 2007; Wenger et al. 2011a; and Wenger et al. 2011b).

Over the next century, climate change is predicted to alter hydrologic and precipitation patterns, riparian vegetation, and the role of fire in riparian areas. This will have important effects on aquatic and riparian ecosystems, since they are shaped and are dependent on the amount and pattern of water. Riparian areas will also be strongly shaped by climate-related changes in fire (see "Fire Trends" section).

Climate change has the potential to affect surface and groundwater flows. If there are more severe floods that follow severe droughts, erosion of stream channels could increase. The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season. Streambank vegetation could decrease in vigor and extent if summer base flows become much lower or some perennial streams become intermittent. Then, when high flows occur, there would be a greater chance of channel scour and possible widening or gully incision.

Environmental Consequences to Aquatic and Riparian Ecosystems

Consequences Common to all Alternatives

Sustainability of Habitat

Currently, major drivers of change to aquatic ecosystems include climate change and shifting hydrologic patterns and increasingly dense and unhealthy forests. With any of the alternatives, aquatic invasive species would also continue to be a primary issue of concern affecting aquatic ecosystems in the future. While restoring fire to the landscape generally benefits aquatic habitats, the benefit is reduced where invasive species are present and during the recovery period following fire, aquatic habitats can be more susceptible to invasion by aquatic species. Broad guidance for the management and control of invasive species is provided by the Forest Service National Strategic Framework for Invasive Species Management (FS-1017 2013). While non-native fish were mentioned in the context of maintaining genetically pure native trout, aquatic invasive species such as New Zealand mud snail or other aquatic nuisance species are not a focus. Alternatives B, C and D however include specific desired conditions that support rapid detection and control of aquatic invasive species that are absent in the current forest plans.

Resilience to Climate Change

Warming temperatures increase the potential for large, high-intensity wildfires throughout the forest and within riparian areas wildfires can remove all shade that maintains cooler water temperatures (Westerling et al. 2006). Restoring meadows helps regulate downstream flows and water storage under the surface where it maintains cooler temperatures (see "Water Quality, Water Quantity, and Watershed Condition" section). Riparian plants can shade streams and can be restored or protected to cool streams across the landscape to counteract the warming temperatures that are already occurring (see "Fire Trends" section). Because current air temperatures are

getting warmer and changing conditions for native aquatic species, mitigation of these effects to maintain and increase shading of streams, and to help store more water below ground in restored meadows will be increasingly important.

Consequences Specific to Alternative A

Alternative A would continue to follow the current forest plan direction of the Inyo, Sequoia and Sierra National Forests for management of aquatic species and habitats. The aquatic management strategy would continue to provide direction for riparian habitat according to riparian conservation objectives designed to maintain the ecology of riparian areas and reduce the risk of sediment from entering aquatic ecosystems. Standards and guidelines for alternative A emphasize protecting water quality and protecting riparian conservation areas by limiting active management within a variable buffer distance around riparian features. During project planning, the width of riparian conservation areas can be varied through a landscape-level assessement by an interdisciplinary team to best protect riparian resources. A variety of management actions and uses on the three national forests can impact ecological integrity of riparian areas including unmanaged recreation, dams or diversions, high road and trail density, vegetation management, and grazing.

This alternative would continue to implement priority watershed restoration as funding permits. Critical aquatic refuges would remain the same protecting areas around some but not all rare species. Community wildfire safety concerns would be addressed by an emphasis on fire suppression. There would continue to be limited restoration of riparian vegetation. Few areas would have conifers removed to restore hardwood dominance where conifers have grown in and are outside the natural range of variation. Although wildfire is recognized as an essential ecosystem process, wildfire managed to meet resource objectives would generally be limited to select areas of each national forest, such as wilderness and remote areas. Where new roads are needed to conduct restoration activities, best management practices would be used to reduce the risk of sediment entering the watershed and eventually streams.

Sustainability of Habitat

Alternative A focuses on developing resilience to fire with prioritization of areas around communities. This alternative includes the implementation of the aquatic management strategy. Plan direction emphasizes restoration of hydrologic connectivity but does not include specific direction for the restoration of habitat for all life stages of aquatic or riparian species. Restoration of aquatic ecosystems is a regional priority for the three national forests following the “Ecological Restoration Leadership Intent” established by the regional forester (USDA FS 2011a). Improvement of aquatic habitat conditions is primarily related to mitigating the effects of roads and addressing hydrologic connectivity.

Under this alternative, limited implementation of restoration is anticipated, leaving many areas containing native at-risk aquatic species untreated. Direction under this alternative has allowed for improvements to increase ecological integrity of streams by actions such as reducing trail and road density in riparian areas and meadows and removing or mitigating effects of dispersed camping from the edges of meadows and streams. These standards and guidelines have been in place since 2004; and along with best management practices, have worked well to protect most stream habitats from sedimentation.

Ecological Connectivity

Hydrologic connectivity is addressed under this alternative through maintenance of ecological connectivity among habitats for some aquatic species and riparian associates. Restoration of ecological connectivity by improving road crossings or mitigating water diversions would be expected to occur at a slow pace under this alternative.

Aquatic Species Diversity

In the current plans, direction and best management practices reduce the impacts of management actions locally but do not by themselves address the diversity, sustainability, or persistence of aquatic diversity. Plan direction is primarily prescriptive and restrictive to limit management activities that would restore forest vegetation and improve habitats that support the persistence of all life stages of aquatic or riparian species. Similarly, plan direction in alternative A does not emphasize management of invasive species or restoration of ecological connectivity as well as the other alternatives.

Resilience to Climate Change

Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are not explicitly addressed in the current forest plans. Climate changes may alter riparian habitats substantially (Perry et al. 2015), especially those that are outside the natural range of variation. Projects designed under the current plans incorporate actions to increase resilience to the extent they are consistent with other plan direction.

Riparian Vegetation

Resilience of riparian composition and structural heterogeneity to climate change and increased risk of wildfires would not be improved in alternative A except on the occasional basis. Thom and Seidl (2015) investigated the role of natural disturbance (fire, wind, and bark beetles) in riparian areas and found effects on ecosystem services were negative but effects on native riparian species diversity was positive. There is some ability to restore riparian vegetation structure and composition in alternative A but it is limited by restrictions on mechanical treatments within riparian conservation areas. Prescribed fire restrictions in riparian areas limit direct fire ignitions, which reduces the ability of fire managers to create a patchy mosaic within riparian areas to lower the risk of riparian vegetation burning at high intensity during wildfires. There is less control of fire intensity and spatial pattern of fires when they back down into riparian areas compared to when fire managers are allowed to use ignition patterns to more closely control the fire behavior. The limited amounts of restoration would result in most riparian areas continuing to trend toward a decrease in heterogeneity and degraded condition of hardwoods. Less fuel reduction within watersheds under alternative A can lead to future larger fires that burn at high intensity and impact upland and riparian vegetation and cause more intense fire in riparian ecosystems. Alternative A has the most limited area where wildfires are likely to be managed to meet resource objectives, primarily in wilderness areas, leaving most riparian areas with an altered fire regime.

Consequences Specific to Alternative B

Alternative B improves resilience of terrestrial ecosystems to climate change by increasing the pace and scale where vegetation is being restored, decreasing the threat of large, high-intensity wildfires; and increasing the local capacity to restore vegetation and reduce fuels. This alternative manages the same riparian conservation areas as alternative A; but uses the full suite of plan components (desired conditions, standards, guidelines, goals, and potential management approaches) to better move riparian ecosystems toward resilience to fire and climate change. The

focus landscape treatment approach combined with the riparian conservation area direction is designed to reduce the negative effects of wildfire more effectively than the scattered treatment approach of alternative A and the limited treatment approach of alternative C. Treatments to improve fire resilience in riparian ecosystems over the long term would be guided by desired conditions, standards, and guidelines that protect water temperature, riparian vegetation and other conditions that provide quality habitat for dependent wildlife over the short term.

Sustainability of Habitat

Some management activities like vegetation management and maintenance and development of infrastructure, like roads, trails and campgrounds, have the potential to cause both short- and long-term adverse impacts to aquatic and riparian habitat (Frissell et al. 2012). Desired conditions, standards, and guidelines in this alternative are designed to protect aquatic habitats. The integrated restoration emphasis of focus landscapes would consider impacts such as headcuts in streams and meadows, disconnected floodplains, and lack of mature willows, alders, and cottonwoods across the landscape during project planning. This landscape approach is intended to address the restoration needs of all resources, including impacts to aquatic and riparian habitats from forest infrastructure such as roads, trails, and campgrounds within sensitive areas. The reduction of high-intensity wildfire risk, especially within riparian areas, would improve watershed and aquatic habitat conditions over the long term compared to alternative A.

The proposed increase in ecosystem restoration, and change in slope limitations for equipment use in riparian conservation areas on the Sequoia National Forest, would not be expected to result in substantially increased amounts of sediment and other disturbances to streams. All projects would be designed to incorporate best management practices to mitigate soil and sediment impacts and projects would be designed to maintain or improve riparian and aquatic ecosystem desired conditions. Best management practices and standards and guidelines are designed to reduce the risk of sediment from entering aquatic ecosystems. Alternative B, with its landscape approach, would allow for more improvement of watersheds and riparian ecosystems. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative B, compared to alternative A. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to aquatic habitats for alternative B.

Ecological Connectivity

While there is uncertainty about the magnitude of climate change, species can be influenced especially where connectivity issues block species movements. Desired conditions address the maintenance and restoration of ecological connectivity among habitats for aquatic or riparian associates. The increase in the pace of restoration compared to alternative A, especially in concert with an increased use of partnerships, should allow for an increase in the restoration of aquatic connectivity. The increase in vegetation restoration projects would increase the potential to replace and improve road culverts to improve hydrologic and aquatic connectivity. For amphibians associated with streams and meadows, connectivity requires movement between habitat islands and to allow dispersal among subwatersheds.

Riparian conservation areas would provide conditions for species to use stream corridors for movement and foraging habitat. Plan direction would guide projects that occur within riparian conservation areas to consider connectivity of riparian habitats and the needs of at-risk species. Connectivity among streams for aquatic species would improve over the landscape as undesired barriers are removed to reduce fragmentation and desired barriers to separate invasive species

from native species are maintained. A greater emphasis on partnerships may result in increased resources to restore aquatic habitats and provide for persistence of native aquatic species.

Aquatic Species Diversity

Restoration of degraded habitats would lead to increased resilience for native aquatic species. Desired conditions address native aquatic species and encourage aquatic restoration across the landscape to provide for the persistence of species. An increase in terrestrial ecosystem restoration could have localized, short-term negative effects to aquatic species, but would be offset by long-term benefits where actions would restore riparian vegetation or increase fire or climate change resilience.

Increased partnerships to restore aquatic habitats would improve ecological conditions that support the persistence of native species and aquatic diversity. Existing critical aquatic refuges are managed similar to alternative A and one new critical aquatic refuge is added around populations of the black toad on the Inyo National Forest. New critical aquatic refuges are not proposed in areas of high aquatic species diversity in lower elevation habitats; however, desired conditions, standards, and guidelines would guide management of habitat for all aquatic species. Restoration of watersheds that include critical aquatic refuges through focus landscapes and through restoration of priority watersheds would benefit aquatic species diversity more in alterative B compared to alternative A.

This alternative has potential for localized, short-term impacts for slow-moving species concentrated in moist riparian areas due to mechanical treatments and prescribed burning. Timing of prescribed burning and other ground-disturbing activities outside of species' activity periods could minimize these effects and can be determined at the project level for specific at-risk species. Minimizing short-term consequences on aquatic species when restoring aqautic habitat in conjunction with the long-term benefits of more sustainable and resilient landscapes would improve persistence of species. Overall, the goal to increase restoration of aquatic habitats would address species needs and improve aquatic biodiversity more than alternative A.

Resilience to Climate Change

Managing aquatic habitats for resilience to future climate change and improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are adressed in the desired conditions for alternative B. Riparian plants provide shade over streams and can be restored or protected to cool streams across the landscape to counteract the warming temperatures that are already occurring. The risk of large intense fire in riparian areas would be reduced with this alternative (see "Fire Trends" section). Adaptively managing aquatic habitats for resilience to future climate change, and improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are emphasized under alternative B.

Riparian Vegetation

There would be more emphasis on ecosystem restoration, including riparian vegetation restoration in alternative B, than in alternative A. As national forest managers increase the pace and scale of restoration, including mechanical thinning, prescribed fire, and managing wildfire to meet resource objectives, the forests and riparian areas should become more resilient to climate change.

All restoration that results in a reduction of conifer encroachment, and an increase in heterogeneity in riparian areas would move riparian vegetation composition and structure toward

the natural range of variation. This would improve growing conditions for riparian hardwoods and shrubs that are often shaded out by upland trees and shrubs. Prescribed fire and wildfire managed to meet resource objectives would improve the condition, vigor and health of most native riparian plants. Many native riparian plants sprout as an adaptation to flooding and this often allows them to respond positively to fire as well (Fites-Kaufman et al. 2006, van Watendonk and Fites-Kaufman 2006). The trend in composition and structural heterogeneity of native species would increase.

An increased emphasis on wildfire managed to meet resource objectives would continue to provide improved riparian vegetation conditions and reduce the risk of intense fire across large landscape areas, especially those in higher elevations where there are fewer opportunities for more direct restoration. The reduction in risk of severe wildfire can improve the overall resilience of these systems over the life of the plan. Restoration in alternative B in westside foothill, montane, and upper montane areas would be emphasized in focus landscapes. This would result in large landscape and watershed (10,000 to 80,000 acres) areas with a decreased likelihood of large, high-intensity fires (see "Fire Trends" section) and increased opportunities for riparian restoration in these areas. Alternative B would lead to more improvement of riparian ecosystem resilience to fire and climate change compared to alternatives A and C.

Consequences Specific to Alternative C

Alternative C would have the least restoration using mechanical treatment of all alternatives, and an increased emphasis on the use of prescribed fire and managing wildfires to meet resource objectives. Riparian conservation areas would be managed similar to alternative B. Although there is more emphasis on managing wildfire to meet resource objectives proposed for alternative C, there is a high uncertainty about how much would actually occur because of low levels of mechanical restoration used to create strategic areas to "anchor" large prescribed fires and wildfires managed to meet resource objectives. If there is more fire, there could be a greater benefit in alternative C, but it would be in more limited locations compared to the other alternatives and the intensity of prescribed fire might be higher than in the other alternatives due to higher levels of fuels being burned. With lower amounts of fuel reductions, this alternative would continue the trend of larger, high-intensity wildfires in the future.

Sustainability of Habitat

Desired conditions, standards, and guidelines in alternative C would provide for maintenance of aquatic habitat and protections of aquatic habitats. The large scale landscape approach has the potential to address national forest infrastructure such as roads, trails, and dispersed campgrounds within sensitive areas. This should improve watershed and aquatic habitat conditions over the long term compared to alternative A. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative C, when compared to A. Equipment use would be more restricted in riparian conservation areas compared to the alternatives B and D. The potential for short-term effects from the increased pace and scale of restoration under alternatives B and D would be reduced under alternative C. Alternative C would add the most new critical aquatic refuges of all of the alternatives, although most of them are in existing designated wilderness areas or areas recommended for management as wilderness. The goal to restore aquatic habitat could improve the resilience and sustainability of aquatic and riparian habitat under alternative C.

Resilience and sustainability of aquatic habitats and ecological integrity would not necessarily improve by simply setting aside critical aquatic refuges. Proposing new critical aquatic refuges

and having existing critical aquatic refuges at high elevation may not serve to restore large rivers and lower elevation habitats for aquatic species (Frissell et al. 2012). The increase in the number of stream miles restored and meadows restored under this alternative would increase the pace of restoration compared to alternative A, but would not be sufficient to achieve the restoration needed to reverse past legacy land use degradation of habitat. Restoration of aquatic habitat with partners could improve sustainability and resiliency of aquatic ecosystems to climate change.

Ecological Connectivity

Alternative C would provide for ecological connectivity among habitats for aquatic or riparian associates similar to alternative A, but with more emphasis on restoring connectivity associated with critical aquatic refuges. There would be less potential for short-term impacts to connectivity from restoration compared to alternatives B and D, but there would also be less potential to restore aquatic connectivity related to existing roads compared to those alternatives. Goals to address aquatic restoration including restoring connectivity and increasing the involvement of partners and stakeholders would help improve connectivity of habitat similar to alternatives B and D.

Aquatic Species Diversity

Alternative C identifies additional areas as critical aquatic refuges in watersheds that contain at-risk aquatic species. Aquatic restoration could be focused on habitat to maintain biodiversity or at-risk species, especially in conjunction with restoration in priority watersheds. With restoration of aquatic habitats, aquatic diversity is expected to be sustained or increase in the short term. However, the long-term consequences of this alternative would be an increased risk of large, high-intensity fire. Intense wildfire can have a negative effect on aquatic and riparian species. Although these effects are generally short lived, landscape changes in forest vegetation from large wildfires has longer consequences. Like alternatives B and D, the goal to increase restoration of aquatic habitats would address species needs and improve aquatic biodiversity.

Resilience to Climate Change

Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are addressed in this alternative similar to alternatives B and D.

This alternative would reduce the risk of high-intensity wildfire impacts to riparian areas and adjacent uplands as well as other alternatives due to the decreased area with fuel reduction treatments. Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions would be hampered if sustainability and resilience to climate changes in the rest of the watershed and landscape are not restored. Without more active watershed-level restoration as well as restoration of aquatic habitat, no increase in habitat or species resilience to climate change would occur (Moyle et al. 2013, Viers et al. 2013).

Riparian Vegetation

Limited restoration using mechanical treatments and an increased emphasis on fire, both prescribed and wildfire managed to meet resource objectives, would be the basis for managing riparian areas under this alternative. Although there is more managed wildfire proposed for alternative C, there is a high uncertainty how much would occur because of low levels of mechanical restoration used to create strategic areas to “anchor” large prescribed fires and wildfire managed to meet riparian resource objectives. If there is an increase in low- to moderate-

intensity wildfire, there could be a benefit to riparian species and composition in alternative C similar to alternatives B and D. However if the rate of managed wildfire and prescribed fire remains low, then riparian vegetation restoration and improvement in ecological conditions would not be achieved as well as in alternatives B or D.

Consequences Specific to Alternative D

Alternative D would treat more area within individual focus landscapes and more focus landscapes in total than alternatives B and C. The modified approach for riparian conservation areas would be the same as alternative B. Increased use of mechanical equipment in the riparian conservation areas would be designed to improve conditions of riparian areas, especially to restore fire within the landscape and riparian areas. Focus landscapes are designed to reduce risks of wildfire more effectively than the scattered treatment approach of alternative A and limited treatment approach of alternative C. Alternative D plans to improve resilience of terrestrial ecosystems to climate change by increasing the rate and extent of the land area where vegetation is being restored, decreasing the threat of large, high-intensity wildfires; and increasing the local capacity to restore vegetation and reduce fuels. As national forest managers increase the pace and scale of restoration, including the use of mechanical thinning and increased area where wildfires are managed to meet resource objectives, the national forests should become more resilient to the effects of climate change, especially increases in wildfire.

Sustainability of Habitat

The large-scale landscape approach under alternative D has the potential to address national forest infrastructure such as roads, trails, and dispersed campgrounds within sensitive areas to a greater degree than alternative B. This should improve watershed conditions over the long term compared to all other alternatives. Vegetation management activities and maintenance and development of infrastructure, like roads, have the potential to cause both short- and long-term adverse impacts to habitat (Frissell et al. 2012). Desired conditions, standards, and guidelines would provide for maintenance of aquatic habitat and protections of aquatic habitats. The proposed increase in ecosystem restoration, including increased allowance for equipment use in riparian conservation areas would not be expected to result in substantially increased amounts of sediment and other disturbances to streams. All projects would be designed to incorporate best management practices to mitigate soil and sediment impacts and projects would be designed to maintain or improve riparian and aquatic ecosystem desired conditions. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative D, as compared to A. The potential for short-term effects from the increased pace and scale would be balanced against the long-term benefits to aquatic habitats for alternative D.

Addressing the proper scale of restoration of aquatic habitat while increasing the pace and scale of restoration across the landscape is important. Effective protection of aquatic habitat from sedimentation, erosion, and nutrient mobilization; impediments to connectivity, and undesirable vegetation conditions is essential to ensure the resilience of aquatic habitats in the face of climate change, drought, and fire. Existing headcuts in meadows and streams; impaired hydrologic connectivity and ecological connectivity; lack of mature willows, alders, and cottonwoods; sediment impacts from roads; legacy grazing impacts; and impacts from recreation use are all identified as areas in need of restoration.

Under alternative D increased restoration actions within focus landscapes would result in proportional increases in aquatic habitat restoration. Alternative D would reduce the risk of

uncharacteristically large wildfires, thus reducing the risk of undesirable short-term impacts to aquatic ecosystems while still allowing for the historically beneficial role of fire to be expressed. The goal of encouraging restoration of habitats using partnerships could address many legacy restoration needs in areas prioritized for species and is similar to alternatives B and C.

Ecological Connectivity

Desired conditions in alternative D address the maintenance and restoration of ecological connectivity among habitats for aquatic or riparian associates, and an increased pace and scale of restoration compared to alternatives A, B, and C. With an increased use of partnerships, this alternative should allow for the greatest increase in the number of projects designed to protect aquatic connectivity. The increase in vegetation restoration projects would increase the potential to replace and improve road culverts to improve hydrologic and aquatic connectivity more than in the other alternatives.

Riparian conservation areas would provide conditions for species to use these areas close to streams as corridors for movement and foraging habitat. Plan direction would guide projects that occur within riparian conservation areas to consider connectivity of riparian habitats and the needs of at-risk species. Connectivity among streams for aquatic species would improve over the landscape as undesired barriers are removed to reduce fragmentation and desired barriers are maintained to separate invasive species from native species.

Aquatic Species Diversity

An increase in terrestrial ecosystem restoration could have localized, short-term negative consequences to aquatic species, particularly where mechanized treatments are used to restore riparian vegetation, and roads are reopened to accomplish restoration actions. This alternative may have negative short-term consequences for species concentrated in moist riparian areas, but these short-term consequences on riparian species diversity are balanced favorably against the long-term benefits of creating more sustainable landscapes that have more resilience to changes from wildfire, climate change, and other stressors. The goal to support aquatic restoration using partnerships would encourage restoration of aquatic habitat to improve persistence of species and sustain aquatic diversity.

Resilience to Climate Change

As national forest managers increase the pace and scale of restoration, including mechanical thinning and increasing the use of wildfire managed to meet resource objectives, riparian areas should become more resilient to climate change. The risk of large intense fire on riparian areas would be reduced the most with this alternative because of the increased amount of planned restoration in the riparian areas and adjacent upland vegetation and surrounding watersheds. Restoration and protection of aquatic habitat would improve resilience as in alternatives B, and C but on an increased number of acres under alternative D. Increased fire resilience would confer long-term benefits to watersheds and riparian areas more than all other alternatives.

Riparian Vegetation

With the increased pace and scale of restoration in this alternative, riparian areas should become more resilient to fire and the vegetation community would more closely reflect the natural range of variation. There would be similar environmental consequences to alternative B but with more riparian area restored. The greater amount of area proposed for restoration in alternative D would result in a greater amount of riparian area restoration in sagebrush and pinyon-juniper, westside

foothill, and all montane areas. All of these areas would be the focus of both mechanical and prescribed fire restoration treatments in uplands. Both upland and adjacent riparian areas would be incorporated in large landscape projects. Upper montane riparian areas would have more restoration of wildfire primarily to meet resource objectives. In all of these types of restoration, there would be beneficial impacts to composition, structure, and function of riparian vegetation. There would be a decrease in conifer or upland shrub density and cover that is outside the natural range of variation and an increase in heterogeneity. There would be increased light for hardwood shrubs, trees and understory plants. The likelihood of large, high-intensity fires would decrease under this alternative in many areas of the landscape (see "Fire Trends" section) compared to all other alternatives.

Cumulative Effects

The geographic area included in this section is the southern Sierra Nevada, and the White and Inyo Mountains. For aquatic ecosystems, the long-term cumulative effects of future management actions across the landscape would continue to emphasize protection of water quality and riparian ecosystem function while increasing resilience to disturbance. At lower elevations, user-created motorized trails, motorized trails in riparian areas and adjacent to meadows, and dispersed recreations sites on streams and adjacent to meadows can influence aquatic habitat and ecological integrity and would be a focus for restoration when opportunities exist. Dams on major rivers and Los Angeles Department of Water and Power water use from the eastern slope of the Sierra Nevada would continue to have effects on connectivity of habitat within aquatic ecosystems. Recreational fishing is a valued pastime in the Sierra Nevada and is expected to continue, although some changes would occur as State wildlife agencies adjust their policies and practices. Introductions of non-native rainbow, brown, and brook trout for sport fishing will continue to be a management challenge for native trout. Native fish will continue to decline if conditions begin to dry and get too warm and dams prevent species from seeking refuge at higher elevation.

Analytical Conclusions

Desired conditions designed to achieve restoration of aquatic ecosystems on the three national forests would help improve aquatic and riparian habitats within the planning area more under alternatives B, C, and D than under alternative A. Alternative A does not specifically address ecological connectivity of habitat, nor does it specifically address climate change. Alternatives B, C, and D address ecological connectivity, species diversity and resilience to climate change in plan components. All alternatives continue direction that emphasizes desired conditions and management of riparian conservation areas and critical aquatic refuges similar to the current direction. All alternatives have flexibility of management within these areas allowed for reducing fuels, restoring fire, and managing riparian vegetation species composition, structure, and function, while reducing soil disturbance. Alternatives B and D would allow some increased use of mechanized equipment in riparian conservation areas to facilitate prescribed burning and improve riparian desired conditions. Alternative C would have fewer disturbances to the riparian conservation areas than alternatives B and D with more restrictions on mechanical treatments overall.

Since desired conditions for restoration address invasive species, alternatives B, C, and D are more likely to assist the three national forests in meeting desired conditions for aquatic invasive species. Improvement of ecological connectivity (including reduction or improvement of road crossings and water diversions and the accompanying improvement in number of rivers with unimpeded aquatic organism passage) would improve under alternatives B, C, and D because the goal to address aquatic restoration includes restoration of connectivity. Desired conditions address

aquatic biodiversity in alternatives B, C, and D. The goal to improve habitat can help reverse the downward trend in biological diversity and effects of climate change currently found in the Sierra Nevada. Improving sustainability and resilience of aquatic habitat for aquatic at risk species would contribute toward ecological integrity; involvement with partners would help make progress toward achieving these desired conditions more quickly.

Improving resilience to climate change for aquatic habitats and species requires prioritization across the landscape. Increasing the rate of restoration of priority habitats for aquatic species and improving adaptive capacity through ecological restoration and climate adaptation actions is necessary to conserve diversity of aquatic species. Partners can assist with increasing restoration of aquatic ecosystems by increasing the availability of funding and in some cases through use of volunteers to implement restoration projects. Uncertainty in the rates of climate change, funding availability, and the number of national forest staff working on watershed restoration would affect accomplishments under all alternatives.

Improving riparian area resilience to fire would most improve as restoration activities create a fire regime more aligned with historic patterns under alternatives B and D. Riparian vegetation condition, function, composition, and structure would improve under alternatives B and D more than alternatives A and C due to the greater amount of area restored with a combination of mechanical treatments, prescribed fire and wildfires managed to meet resource objectives.

Water Quality, Water Quantity, and Watershed Condition

Background

This section summarizes the current hydrological environment and soil conditions on the Inyo, Sequoia, and Sierra National Forests and the consequences to each of implementing the revised plan or its alternatives. Water originating on the three National Forests supplies municipal and agricultural water to central and southern California. It also provides electricity for local and distant populations. Stream flows provide recreational opportunities for locals and visitors. Water is integral for ecological sustainability. On the three national forests, streams, lakes, springs, and their associated riparian areas are relatively rare and important habitats. These national forests contain the watersheds of the Owens, Kern, Kaweah, Kings, San Joaquin and Merced Rivers. The watersheds of these rivers contain meadows and corridors of riparian vegetation that provide wildlife habitat, recreational opportunities, and function to store and release water year round. The quality and quantity of water is of critical importance because these watersheds provide water for use by millions of agricultural, residential, and industrial users downstream. The waters from the southern Sierra Nevada are essential for population centers ranging from small communities like Lee Vining, east of Yosemite National Park, to metropolitan areas like Fresno, Bakersfield and Los Angeles.

For the purposes of analysis, overall watershed conditions are described in terms of 10,000 to 40,000-acre watersheds called HUC-12 watersheds.[21] Table 67 shows the number of HUC-12 watersheds which lie completely or partially on the Inyo, Sequoia, and Sierra National Forests and the major river basins of each national forest.

[21] HUC-12 refers to “hydrologic unit code” 12, which indicates a very large-scale watershed. As watersheds decrease in size and are nested as subwatersheds, the hydrologic unit code number decreases.

Table 67. HUC-12 watersheds completely or partially located in the Inyo, Sequoia, and Sierra National Forests

National Forest	Number of HUC-12 Watersheds	River Basin Watersheds
Inyo	125	Kern, Mono Lake, Owens
Sequoia	83	Deer, Kaweah, Kern, Kings, Tule, White
Sierra	64	Chowchilla, Fresno, Kings, Merced, San Joaquin

Streams and rivers are used for water supply, irrigation, transportation, hydropower, waste disposal, mining, flood control, timber harvest, and recreation. Many of these uses have a long history on the national forests and have made aquatic and riparian systems the most altered and impaired habitats of the Sierra Nevada. As the population of California has grown, so has the demand for water, leading to a potential for greater diversion and de-watering within Sierra Nevada hydrologic systems.

The Sierra Nevada ecosystem produces approximately $2.2 billion in commodities and services annually and water accounts for more than 60 percent of that total value (Hunsaker et al. 2013). For more detailed information on water conditions see the assessments for the Inyo, Sequoia, and Sierra National Forests (USDS FS 2013a, 2013b, and 2013c).

Analysis and Methods

The analysis evaluates and compares estimated future conditions for each alternative to the desired conditions. The indicators, measures, and assumption described below are used to evaluate how the alternatives move toward desired conditions, and identify potential consequences from management actions across the three national forests. The indicators are used to predict future conditions related to water resources and overall watershed condition under the four alternatives.

The qualitative analysis is based primarily on the best available scientific information derived from the forest assessments (USDA FS 2013a, 2013b, and 2013c), the Bio-Regional Assessment (USDA FS 2013d), the Science Synthesis (Long et al. 2014) and recent reports and publications that assess current conditions and trends in condition. In particular, soil and water best management practices monitoring data were reviewed to evaluate the effectiveness of current constraints on management actions. In addition, watershed condition assessments using the "Forest Service Watershed Condition Framework" were examined for the three national forests to assess the existing watershed condition ratings and identify restoration opportunities. Since the watershed condition framework is composed of various indicators, each alternative was evaluated on how it would likely effect three key indicators (water quality, water quantity, and watershed condition). Stream condition inventory monitoring and assessment data and State 303(d) listing information was also examined where available to evaluate restoration opportunities across the national forests.

Indicators and Measures

This analysis uses three indicators: Water quality, water quantity, and the overall watershed condition. These indicators are evaluated over two general time periods to compare and contrast how the different alternatives would affect the aquatic resources.

- Short-term impacts generally run for 1 to 5 years after an event
- Long-term impacts generally run from 5 years through the life of the plans

Water Quality

Water quality impacts the health of aquatic habitat, as well as other beneficial uses of water as defined by the State Water Resources Control Board (SWRCB 2015). The two most critical parameters with the potential to influence water quality at the landscape scale or be influenced by climate change are sediment loading and water temperature (Neary et al. 2005, Hunsaker and Neary 2012, Young et al. 2009, USDA FS 2013d). Other water quality parameters such as nutrient inputs (like nitrogen and phosphorus), metals, and bacteria (such as *e. coli)* are also a concern to water quality but are best addressed at the project level considering requirements of the Clean Water Act.

Water Quantity

Water quantity refers to the timing, overall distribution, and volume of water produced from forest watersheds, and includes both surface and groundwater resources. Water quantity is largely dependent on the amount, type, and timing of precipitation. Soil conditions and impervious surfaces affect how precipitation is distributed, whether through runoff or ground infiltration. Shallow groundwater recharge and storage redistributes the water not captured by plant roots as streamflow and as springs and seeps.

Watershed Condition

In March 2011, the three national forests assessed the condition of National Forest System lands for 272 HUC-12 watersheds[22] using standardized protocols (Potyondy and Geier 2011). This watershed condition classification system, known as the watershed condition framework uses 12 indicators consisting of attributes related to watershed processes. The indicators and their attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrologic function. The indicators include: water quality, water quantity, aquatic habitat, aquatic biota, riparian and wetland vegetation, roads and trails, soils, fire regime or wildfire, forest cover, rangeland vegetation, terrestrial invasive species, and forest health. Each indicator consists of one or more attributes and is assigned a weighted score. The overall watershed rating is based on amalgamated values of these attributes and indicators.

For the majority of the indicators, the Forest Service can take direct action that can contribute to maintaining or improving watershed condition, integrity and functionality. This provides a direct linkage between the classification system and management or improvement activities the Forest Service conducts on the ground (USDA FS 2011b).

The watershed condition framework and the Forest Service Manual use three classes to describe watershed condition (USDA Forest Service 2004, FSM 2521.1) and the condition is related to geomorphic, hydrologic, and biotic integrity and their functioning relative to their natural potential. Following are three watershed condition class ratings:

- Class 1 watersheds are considered to be functioning properly
- Class 2 watersheds are considering to be functioning at risk
- Class 3 watersheds have impaired function

[22] http://www.fs.fed.us/biology/watershed/condition_framework.html

Assumptions

There are several assumptions about ecological restoration and how different management tools may affect water quality, water quantity, and overall watershed condition that described in the assumptions section in the "Aquatic and Riparian Ecosystem Integrity" section. There are some additional assumptions that inform this analysis as well.

Water Quality

- Projects developed under all alternatives would implement established best management practices to protect soil and water quality (USDA FS 2011b and USDA FS 2012). Based on results of past monitoring, best management practices are expected to reduce both short- and long-term adverse impacts to less than significant levels. The Forest Service would continue to follow agency direction to implement an annual best management practices evaluation and adaptive management program, following established agency monitoring protocols, and report these results to local Regional Water Quality Control Boards.
- The Forest Service would continue to work with local Regional Water Quality Control Boards to identify management strategies to address current 303(d) watersheds and develop total maximum daily load (TMDL) listings. Projects would comply with requirements of the Clean Water Act.
- The Forest Service would continue the transportation analysis planning process to systematically identify and address segments of roads that are causing impairment to hydrologic function or causing accelerated erosion.
- The Forest Service would continue to pursue opportunities to retrofit, relocate, or decommission roads and trails to reduce potential sediment transport to rivers and streams, especially within priority watersheds as outlined in watershed restoration action plans. System trails are currently undergoing a similar assessment and retrofit program, but are not considered to present the same degree of water quality threat as the road network because of their relatively small footprint.
- While uncertainty surrounds climate changes, observed warming air temperatures combined with fire suppression and insect outbreaks have changed fire behavior, creating the potential for increased size, intensity and frequency of wildfires, and observed increases in water temperatures during late summer will continue (Null et al. 2013, Knowles and Cayan 2002).
- Some management activities and forest infrastructure such as mechanical vegetation management treatments, roads, campgrounds, and grazing management have the potential to cause both short- and long-term adverse impacts to water quality that are evaluated and mitigated at the site-specific project level when projects are proposed and designed.
- Forest Service restoration activities, such as landslide stabilization, road decommissioning, stream channel, floodplain, and meadow restoration reduce sedimentation, and restore resiliency to watershed processes that affect water quality.
- Groundwater serves as a filtering system for surface water and helps maintain beneficial temperatures for native fish.

Water Quantity

- The quantity of groundwater is reduced under drought conditions and where infiltration is limited by development or hydrophobic soils, which occur in areas of high burn intensity after wildfire.
- The Inyo and Sierra National Forests do not contain a recognized groundwater basin but the Sequoia National Forest contains one groundwater basin. The alternatives considered in detail would not affect use of groundwater in this basin.
- The Forest Service would work with the States regarding regulated water rights, particularly during periods of drought.
- Meadow restoration activities would help regulate and extend the season of water flows, and may help mitigate climate change effects as flows become more erratic and the season for ephemeral flows changes.
- Climate predictions include increased warming, less snowpack, and earlier spring snowmelt. These changes would influence the amount of water supply that can originate from national forest lands and from precipitation.
- Climate changes, especially where rain precipitation replaces snowfall, tend to increase runoff and reduce infiltration and shallow groundwater recharge.
- The amount of impervious surface throughout a watershed affects the timing and flow characteristics because a greater area of impervious surface reduces infiltration into the soil of rain and snowmelt.

Watershed Condition

- Management direction would provide opportunities to improve watershed conditions to protect and restore the high value ecological functions of aquatic and riparian ecosystems. Restoration of terrestrial ecosystems would also improve or maintain watershed condition by increasing fire resilience, and reducing risk of large high-intensity wildfire. Under all alternatives, projects listed in the watershed restoration action plans would continue to be planned and completed within the priority watersheds on each national forest.
- There would continue to be a risk of adverse resource effects associated with wildfire under each of the alternatives, which could result in degradation of overall watershed condition. The relative difference in wildfire risk between alternatives is described in the “Fire Trends” and “Fire Management” sections. It is assumed that the level of risk of adverse effects on soil and water resources can be estimated by the level of risk of catastrophic wildfire.
- Stream channel and floodplain restoration efforts planned and implemented, under all the alternatives would improve resilience to and mitigate some effects of climate change. Geomorphically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity.

Affected Environment

Current Conditions and Trends Common to the Three National Forests

Water Quality

Overall, water quality in the three national forests is good, having benefited from restoration projects to treat legacy impacts and because of protective standards and guidelines in the current forest plans. Specifically, water quality throughout the southern Sierra Nevada is generally high. Water quality is directly influenced by erosion of soils, pollutants, dams, roads, and management activities associated with the national forest. Soils are influenced by erosion, compaction, pollution, and land-disturbing activities and events. Water quality on the three national forests is generally good, due to high elevation sources (USDA FS 2013a, 2013b, 2013c, 2013d). Relatively few areas on the three National Forest have widespread accelerated erosion beyond the natural range of variation. Erosion rates far outside of the natural range of variation have been observed mainly along roads in steep areas, in developed areas such as ski areas, and after high-intensity wildfires. While rilling and gullying are evident at Mammoth and June Mountain Ski Areas on the Inyo National Forest, erosion is generally limited to within the ski area boundary. Both ski areas have extensive ski run drainage systems and revegetation programs to reduce erosion (USDA FS 2013a).

There are an estimated 1,985 miles of National Forest System roads on the Inyo National Forest, 1,646 miles on the Sequoia National Forest, and 1,969 miles on the Sierra National Forest. The estimated sediment yield from these roads is between 0.01 and 0.09 tons per acre per year. This compares to an estimated 0.0004 to 0.004 tons per acre per year from vegetation management activities USDA FS 2013d).

In the southern Sierra Nevada, fires are often observed to cause increased erosion, both from water and wind, and to a lesser extent, from dry ravel (Berg and Azuma 2007). Erosion rates as high as 30 to 44 tons per acre per year have been measured following high-severity wildfire. These high erosion rates seen after a fire typically decline within 3 to 5 years as vegetation recovers. Wildfires and soil erosion are natural processes that help shape forest ecosystems. Prescribed fire has not been shown to increase erosion in most studies, due to low fire severity that often leaves soil structure and organic matter intact (Moghaddas 2013). Prescribed fire has been largely successful in reducing fuels without significantly impairing soil productivity, soil stability, or riparian vegetation, which stabilizes soils (DeBano 2000, Bêche et al. 2005, Pettit and Naiman 2007, Arkle and Pilliod 2010).

The effects of fire can be both negative and positive for water quality and quantity, depending upon the extent and severity of the fire. Reducing large, high-intensity wildfire is extremely important to lower total sediment yields from forests in the Sierra Nevada drainage basins. The primary effect of large, high-severity fires on water quality is increased sediment as a result of loss of soil cover and soil organic matter, soil hydrophobicity (lack of ability for soil to absorb water), and the destabilizing of existing roads, trails, and skid trails (Neary et al. 2005, Hunsaker et al., 2013b). Large, high-intensity fires may also cause erosion and changes to the streambed that can eliminate vulnerable aquatic populations, degrade water quality, reduce capacity of downstream reservoirs, and increase the risk of flood (Long et al. 2013c). Two recent debris flows on the Inyo National Forest occurred in watersheds that had recently burned.

There are also beneficial effects of fire to stream and river ecosystems (such as large wood recruitment into streams) that are described more in the “Terrestrial Ecosystems” and “Aquatic

and Riparian Ecosystems" sections. More information on fire and its effect on hydrologic function may be found in the "Fire Trends" section.

The development of fixed width riparian conservation areas and standards and guidelines in the current forest plans have provided an effective level of protection to water quality throughout the three national forests. The current Sequoia and Sierra forest plans incorporate a default "half-the-width" equipment exclusion zone, which can be adjusted as projects are designed, considering site-specific conditions. The riparian conservation areas have resulted in reduced soil disturbance and erosion in areas of highest risk of sediment entering a stream.

The current plans also have the critical aquatic refuges as described in the "Aquatic and Riparian Ecosystems" section above. Critical aquatic refuges focus restoration needs when projects occur within or near them. Where roads are used for management actions, managers would look for opportunities to maintain, repair, reroute, or improve aquatic organism passages across them through stewardship or partnership opportunities. In some cases, critical aquatic refuges lie within priority watersheds where essential projects would benefit aquatic species and watershed condition overall and critical aquatic refuges would continue to be considered as additional priority watersheds are identified over time.

The three national forests have limited direct measurements of water temperature and sediment from monitoring. The State and Regional Water Quality Control Boards have established lists of impaired waters on or immediately downstream of the national forests using the limited data available. The 303(d) list of impaired waters reports on streams and lakes identified as impaired for one or more pollutants; the term "impaired" means these waterbodies do not meet one or more water quality standards (U.S. EPA 2015). Sometimes these listings result in the establishment of a total maximum daily load (TMDL) water quality threshold and management strategy for bringing these waterbodies back into an unimpaired condition. Total maximum daily load values have not been established yet, but some have been identified as needed for these waterbodies. Impaired waters are identified through assessment and monitoring programs conducted by volunteer networks and other local, State and Federal agencies. Table 68 shows the 303(d) listed waterbodies within or adjacent to the Inyo, Sequoia, and Sierra National Forests and cause of the impairment.

Based on an analysis of best management practice effectiveness data collected over the past 4 years (2011 to 2014) the Sequoia National Forest determined that 92 percent of the best management practices evaluated were rated as implemented and effective in preventing adverse impacts to soil and water quality (Kelley 2015b). The Inyo and Sierra National Forest rated 76 percent and 77 percent of their best management practices as implemented and effective, respectively (Kelley 2015a, 2015c). Data collection and analysis was performed following protocols and procedures established for the Regional Best Management Practice Effectiveness Monitoring Program (USDA FS 2002).

Approximately 465 miles of perennial stream channel on the Sierra National Forest were evaluated to rate channel type and stability. Stream reaches composed of bedrock or boulders had low sensitivity to management activities and made up about 60 percent of the streams evaluated. Fifty-four percent of the moderately sensitive channels had poor channel stability, meaning they are susceptible to bank and bed erosion (USDA FS 2013c). Similar conditions on the Inyo and Sequoia are likely within the same range.

Table 68. 303(d) Listed waterbodies within or adjacent to the Inyo, Sequoia, and Sierra National Forests

National Forest	Water Body	Reason(s) for Listing (Pollutant)	Impairment (For What Use or Benefit?)	Possible Causes / Notes	Year to be Rectified	Total Maximum Daily Load (TMDL) Limited
Inyo	Hilton Creek	Dissolved Oxygen Chlorine (Cl)	Fish Habitat	Unknown / Upstream from Crowley Lake	2021	Yes
Inyo	Mammoth Creek	Dissolved Oxygen Metals (Mn, Hg) Total Dissolved Solids (TDS)	Sport Fishing	Natural sources (metals) / Flows through urbanized Mammoth Lakes	unknown	Yes
Inyo	Mono Lake	Chlorine (Cl) (Hypersalinity)	N/A	Evaporation / Downstream from Inyo / Not 303(d) listed due to special circumstances	Settlement w/Los Angeles Department of Water and Power	Yes
Inyo	Rock Creek	Total Dissolved Solids (TDS)	Fish Habitat	Surface mining / Downstream from Mammoth Lakes	2021	Yes
Sequoia	Deer Creek	Ammonia (pH)	Fish Habitat	Unknown	2021	Yes
Sequoia	Hume Lake	Dissolved Oxygen	Sport Fishing	Unknown / Popular recreation area	2021	Yes
Sequoia	Isabella Lake	Dissolved Oxygen Ammonia (pH)	Sport Fishing	Popular recreation area	2021	Yes
Sequoia	Kaweah Lake	Mercury (Hg) Ammonia (pH)	Sport Fishing	Hardrock mining / Downstream from Sequoia National Forest	2019	Yes
Sequoia and Sierra	Pine Flat Reservoir	Mercury (Hg)	Sport Fishing	Unknown / Popular recreation area	2021	Yes
Sierra	Willow Creek	Temperature	Fish Habitat	Unknown / Downstream from priority watershed	2019	Yes

Water Quantity

The effects of climate change in the Sierra Nevada range are apparent in rising minimum temperatures, earlier snowpack melting, changing stream hydrology, and increased frequency of large, severe wildfires (Safford et al. 2012). Climate changes are also expected to change the pattern, frequency, and intensity of disturbances (Safford et al. 2012). The result will be increased wildfires, doubling the area burned annually by the middle of the 21st century.

Based on patterns of large flood described previously, the frequency of large floods may be increasing. Climate predictions indicate that changes in flow patterns will stress meadows, streams, and rivers in several ways. In areas where snow is replaced by rain, the opportunity to infiltrate and recharge shallow groundwater is reduced as more precipitation immediately runs off the land. Peak flows will be earlier and more intense, possibly increasing erosion and leaving less water later in the summer (Hunsaker et al. 2013). Pulses of soil erosion and flooding caused by higher rainfall intensity will increase, but the pattern will be highly variable.

Because severe wildfire often leads to high erosion rates from hill slopes and stream channels, as climate change leads to more intense and larger wildfires, the planning area as a whole will have greater erosion rates. If streams tend to dry out earlier in the summer, or formerly perennial streams become intermittent, it is likely that there will be less riparian vegetation over time. This could lead to increased streambank erosion. Potential climate change effects to nutrient cycling and organic matter in soils has not been well studied outside of agricultural systems.

Watershed Condition

The watershed condition framework, completed in 2011, provides a means to evaluate, prioritize, and measure progress of restoration across the three national forests and to evaluate alternatives (USDA FS 2011b). The three national forests use the watershed condition framework to assess and classify the condition of 272 HUC-12 watersheds in the planning area. Most drain to the San Joaquin Valley or terminal Great Basin lakes and desert valleys. These waters have been diverted in large quantities for agricultural, municipal, commercial, and industrial uses. For example, the majority of flows into the Owens River Basin are diverted to Los Angeles via the Los Angeles Aqueduct, greatly affecting downstream flows below the Inyo National Forest boundary.

Properly functioning watershed conditions create and sustain functional terrestrial, riparian, aquatic, and wetland habitats capable of supporting diverse populations of species. As noted above, assessment of watershed condition is conducted at the HUC-12 watershed level (typically 10,000 to 40,000 acres). Watershed condition integrates the entire ecological function of a land area contained within a given hydrologic boundary. For the three national forests, existing assessments describe watershed condition within their administrative boundaries that are subject to management by the Forest Service and not lower watersheds and intervening areas that may be impacted by agricultural or urban development.

Management activities that affect watershed condition class ratings are not limited to soil and water improvement activities, but include a broad array of resource program areas from hazardous fuel treatments, invasive species eradication, abandoned mine restoration, riparian area treatments, aquatic organism passage improvement, road maintenance and obliteration, and others. To achieve a change in watershed condition class will in most cases require changes within a watershed that are significant in scope and include treatments from multiple resource areas.

The discussion and analysis of watershed conditions and consequences of selecting forest plan alternatives is focused on individual or aggregated effects on HUC-12 watersheds. Some adjacent HUC-12 watersheds are hydrologically connected to each other and others are not. Therefore it is possible to have one or more HUC-12 watersheds that exhibit poor ecological integrity, adjacent to highly functioning watersheds.

The condition of the HUC-12 watersheds on the Inyo, Sequoia, and Sierra National Forests is summarized in Table 69. The condition class area is based on National Forest System lands contained within the HUC-12 watersheds. Private lands cover approximately 37 percent of the area within the listed HUC-12 watersheds. Class 1 represents watersheds that are considered to be functioning properly. Class 2 represents watersheds considered to be functioning at risk. Class 3 represents watersheds that are considered to have impaired function.

Table 69. Number of and percent of HUC 12 watersheds by condition class on the Inyo, Sequoia, and Sierra National Forests

Condition Class	Inyo (number)	Inyo (percent)	Sequoia (number)	Sequoia (percent)	Sierra (number)	Sierra (percent)
Condition Class 1	95	76%	20	24%	23	36%
Condition Class 2	30	24%	59	71%	40	63%
Condition Class 3	0	0%	4	5%	1	1%
Total	125	100%	83	100%	64	100%

High fuel loads, road density, and road proximity to water, invasive species, and aquatic habitat fragmentation due to dams, were the most common stressors affecting watersheds that were not properly functioning, or functioning at risk.

The Inyo National Forest is focusing restoration activities within its priority watersheds to minimize past impacts of high road density, high fire risk due to bark beetle infestation, and channel destabilization caused by high-intensity wildfires. About 7 percent, or 117 miles of the 1,640 miles of perennial streams on the national forest are downstream of a dam, where flows are determined by both natural precipitation and runoff, and the operations of these dams. As noted in Table 69, the Inyo National Forest does not have any watersheds assessed as impaired but 30 are considered at-risk watersheds.

The Sequoia National Forest has four impaired watersheds. The causes of impairment are habitat fragmentation, flow alteration, exotic species, road density, and road proximity to water. Most properly functioning watersheds occur at higher elevations, in inventoried roadless areas, and away from dams on the Sequoia National Forest. The watersheds in fair or poor condition are associated with dams on the Kern and Kings Rivers. The Sequoia National Forest is managing its current priority watersheds under the Giant Sequoia National Monument Plan because these watersheds lie within the boundaries of the Monument (USDA FS 2012).

The at-risk and impaired watersheds on the Sierra National Forest are predominately at lower elevations associated with dams, high-intensity wildfires, past logging, and high road densities. The 50 dams and diversions on the Sierra limit connectivity of aquatic habitat and affect flow over approximately 220 miles of streams on the national forest (USDA FS 2010). Many

watersheds on the Sierra National Forest have been degraded due to historic wildfire and historic salvage logging, high road density, and road drainage issues that have created unstable channels.

Environmental Consequences to Water Quality and Quantity, and Watershed Condition

This section evaluates how the four alternatives considered in detail affect water quality, water quantity, and watershed condition based on the pace and scale of ecological restoration and plan components. The first part describes consequences that are common to all alternatives followed by a table that summarizes different consequences by alternative and a description of those differences.

Consequences Common to All Alternatives

Water Quality

The key water quality indicators are temperature and sediment loading since these factors are critically important to aquatic species and the overall health of the aquatic system (see "Aquatic and Riparian Ecosystem Integrity" section). Climate change will alter the overall hydrologic regime in the Sierra Nevada. The higher ambient air temperatures will cause earlier peak flows and lower base flows in the summer and fall throughout the southern Sierra Nevada. All alternatives seek to mitigate these effects through restoration to maintain or reduce water temperatures and prevent erosion for the benefit of native fish and other species.

The three national forests and their partners are actively implementing restoration actions to reduce erosion on roads, trails, dispersed camping areas, grazed areas, and other developed and dispersed recreation sites. These efforts are expected to continue, further reducing erosion on the national forests. Water quality would be improved where the Forest Service and partners actively restore watersheds.

Water quality in 303(d)-listed streams, shown in Table 68, is likely to be unchanged except where restoration has occurred and the contaminant is within control of Forest Service management. Most of the 303(d)-listed streams on or adjacent to the three national forests are impaired by operations of the various hydropower and other dams on the national forests. These dams have undergone relicensing from the Federal Energy Regulatory Commission and have changed some operating procedures including maintaining downstream baseline flows. Higher flows from these dams, especially where the stored water is cooler than the ambient stream water can help maintain cool water temperatures for the benefit of native fish habitat. Other sources of contaminants, such as mercury and copper that have caused 303(d) impairment to streams are from geologic or legacy sources that are not a result of Forest Service management.

Water Quantity

Climate change will alter timing and distribution of runoff and infiltration to recharge shallow groundwater, which affect stream flow and downstream agricultural, municipal, and industrial users of both surface water and groundwater. Warming air temperatures will bring about less snowfall, more intermittent snowpack at all but the highest elevations, more rain-on-snow events, reduced spring snowmelt, earlier and likely lower peak spring runoff, and higher evapotranspiration rates for vegetation (Podolak et al, 2015). These impacts reduce the effectiveness of precipitation, since snow is stored on the landscape for later release to infiltrate to refresh shallow groundwater or runoff to provide stream flow over many months, and higher evapotranspiration returns the water to the atmosphere.

Climate change will tend to reduce the overall quantity of water produced by the Sierra Nevada affecting both on-forest and downstream beneficial uses. The higher evapotranspiration rates over large landscapes will reduce percolation into shallow groundwater storage and reduce baseflow in streams that are groundwater dependent (Bales et al, 2011).

All alternatives would work toward ecological restoration and attempt to mitigate effects of climate change at varying scales across the three national forests. All alternatives include both removal of vegetation through hand thinning, mechanical treatments, prescribed fire, and wildfire managed to meet resource objectives. The use of fire to restore landscapes in the Sierra Nevada is a key part of all alternatives and has been used for centuries by Sierran tribes to maintain flow from springs and streams among other benefits (Parrotta and Troscar 2011, Anderson 2006).

Taking action to improve or maintain watershed condition will make the forest more resilient to climate change (reducing fuel loading in high fire risk areas, restoring meadows and stream channel function). As the three national forests in the bio-region increase the pace and scale of restoration, including mechanical tree thinning and managed fire, the forests should become more resilient to climate change.

Watershed Conditions

The Inyo, Sequoia, and Sierra National Forests have identified priority watersheds to focus work in a way that results in overall benefits to a watershed, rather than restoring disparate locations through the three national forests. For all priority watersheds, each national forest has developed water restoration action plans, which identify essential projects to restore sites with legacy erosion and degraded aquatic and riparian habitats, such as streams and meadows. The watershed restoration action plans provide each national forest with a list and schedule of projects to be completed and are designed to improve the condition class rating of priority watersheds. As each national forest completes these essential projects, they evaluate the watersheds to determine whether the projects achieved their goals and track and report projects through national agency databases such as the Watershed Improvement Tracking and Watershed Condition and Assessment Tracking Tool. The national forests develop funding strategies, focus resources, and develop appropriate partnerships to complete the identified projects to maintain or enhance the watershed.

The forest plans do not determine the development of new priority watersheds. Instead, watershed managers use the watershed condition framework process to select new priority watersheds after assessing their need to restore degraded aquatic and riparian habitats based on national forest inventory and monitoring data and factors such as interest and availability of partners, the presence of a listed or species of conservation concern, and the risk of large high-intensity wildfire. Managers will also consider watersheds already identified for fuel reduction and other ecological restoration. As new priority watersheds are selected, essential projects are identified in watershed restoration action plans.

Although Forest Service budgets are expected to stay relatively static, with limited funding available to meet all the restoration needs currently identified on the three national forests, there are increasing opportunities for projects to restore watersheds through State water bond grants and other funding. There are a variety of partners interested in applying for grants to accomplish work on National Forest System lands. The three national forests have a substantial list of potential projects that are either ready to begin or being planned for implementation once funding is available. These projects are currently listed in the Watershed Improvement Tracking database, and can easily be incorporated into watershed restoration action plans as new priority watersheds

are selected. The Forest Service anticipates that such partnerships would compete well for these and other State funding for potential projects that benefit watershed condition on the three national forests. The Sierra National Forest has more additional opportunities to generate funding for watershed restoration, through timber harvest receipts and stewardship contracts than the other forests.

Consequences Specific to Alternative A

Alternative A continues the current objectives for reducing fuel loading covering approximately 10 to 15 percent of the lands needing this treatment to substantially reduce the risk of large high-intensity wildfires. The priority for treatment is within the wildland-urban intermix defense and threat zones and upland areas with road access and on low to moderate slopes where mechanical equipment can operate safely and with minimum ground disturbance. The amount of fuel reduction work completed under the existing forest plans is not sufficient to reduce the threat of large high-intensity wildfire, so the potential to maintain or enhance watershed condition remains low (see "Terrestrial Ecosystems" section). Alternative A does not change the pace and scale of terrestrial restoration and retains the restrictive and prescriptive standards and guidelines in the current forest plans. While these standards and guidelines serve to protect water quality and watershed function in areas where projects occur over the short term, the pace and scale is not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, the overall impact on water quality and watershed function would decline under alternative A.

Water Quality

Alternative A maintains current riparian conservation areas and standards and guidelines from the current forest plans. Short-term sediment impacts from continuing at the current pace and scale of restoration would remain nearly the same. However, long-term indirect impacts would be greater from trends of increasing wildfire frequency and fires that burn with higher intensity (see "Terrestrial Ecosystems" section). Ecological restoration reduces fuel loading and tends to have a dampening effect on wildfire intensity. Wildfire behavior would be less constrained by fewer treated acres and be expected to grow larger and burn at higher intensity and may affect multiple watersheds. Within the burned areas, these fires destabilize hillslopes and stream channels, consume surface litter that protects the soil, and creates hydrophobic soils that can significantly limit infiltration and increase runoff. These effects can cause accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Water Quantity

Alternative A would continue to contribute to reduced flows due to higher evapotranspiration rates of dense forests over broad landscapes, exacerbated by lower precipitation and higher temperatures from climate change. The decrease of winter snowpack and increased proportion of rain verses snow reduces the infiltration and increases runoff compared to the past. This would potentially cause earlier peak flows, lower late spring and early summer runoff, and lower baseflows during the dry season. After high-intensity wildfires greatly reduce vegetation, ground cover, and evapotranspiration, runoff spikes are further amplified by the reduction of infiltration by hydrophobic soils, for the short term. This runoff carries a high potential for downstream flooding, soil erosion, and sediment loading of streams. The overall annual yield of surface water is likely to be lower and more difficult to manage and store for beneficial downstream uses (Bales et al. 2011).

Shallow groundwater would also potentially be reduced due to maintaining the current pace and scale of terrestrial and meadow restoration combined with climate change effects. Deep percolation through the soils would be reduced by evapotranspiration in unburned and untreated areas and infiltration would be reduced where high-intensity wildfire causes hydrophobic soils.

Water quantity reductions may be mitigated where forest managers actively restore the watersheds. Since the current forest plans do not limit watershed restoration, the pace and scale may increase as new opportunities and funding sources evolve and partnerships are enhanced to complete watershed restoration projects. Shallow groundwater recharge would increase only where meadows have been restored, but generally would decline overall across the three national forests due to the relatively low pace of restoration.

Watershed Conditions

Alternative A emphasizes restoration activities within priority watersheds to maintain or improve watershed conditions. Under the current forest plans, additional watershed restoration occurs in areas where mechanical thinning occurs and stewardship opportunities exist. Additional sources of funding and assistance through partnerships could be used to improve watershed conditions throughout the three national forests. Riparian and aquatic habitat restoration help offset effects of climate change on stream temperatures, better maintain baseflows, and can enhance riparian condition. However, overall watershed conditions would continue to be at risk from high-intensity wildfire and legacy impacts.

The existing forest plans contain specific standards and guidelines and implement best management practices to protect soils on steep slopes, especially within the riparian conservation area. The critical factors to maintain and enhance soils productivity are to minimize soil disturbance and compaction. Alternative A maintains the current pace and scale of ecological restoration and all riparian conservation area protections in the current plans.

The existing critical aquatic refuges were created to protect and enhance habitat for aquatic species. Alternative A would not add new critical aquatic refuges and would continue to minimize ground-disturbing activities within them.

Alternative A is not likely to adequately address watershed condition indicators such as water quantity, fire regime, forest cover, and forest health issues such as tree mortality and insect infestation over the long term, because these require an increase in pace and scale of terrestrial restoration to moderate the risk of large high-intensity fire at a landscape scale. Riparian area conditions may also decline over time due to increased risk of high-intensity wildfire within the riparian conservation areas.

Consequences Specific to Alternative B

Alternative B proposes to double ecological restoration across the three national forests compared to alternative A and would treat 15 to 30 percent of areas identified as needing this treatment to substantially reduce the risk of high-intensity fire. These treatments are expected to reduce the likelihood of large high-intensity fire compared to current conditions under alternative A but there would still be an increasing trend in large high-intensity wildfires due to climate change (see “Fire Trends” section).

Water Quality

Alternative B requires the use of best management practices in project design and implementation that are effective in reducing soil erosion and sediment delivery to streams in order to protect watersheds. The southern Sierra Nevada has large areas where steep slopes and unconsolidated granitic and pumice soils are common. However, alternative B maintains the riparian conservation areas of generally fixed widths with a default half-the-width equipment exclusion zone, which can be adjusted on a project-by-project basis. These riparian conservation areas have proven effective at reducing soil disturbance and erosion in critical areas near streams, lakes, wetlands, fens and springs.

The proposed use of best management practices, standards, and guidelines in project design and implementation would be effective in reducing soil compaction, erosion, and sediment delivery to streams to protect watersheds. Short-term sediment impacts from increasing the pace and scale of restoration would likely be slightly higher than alternative A but project implementation of best management practices, standards, and guidelines should minimize impacts to water quality.

Although alternative B emphasizes fire's role in restoring ecological integrity to the landscape and would moderate the upward trend of wildfire frequency and intensity, the effects of climate change and insect and disease outbreaks over the long term increase the risk of high-intensity wildfire over current conditions. The emphasis on restoring low- and medium-intensity fires across the landscape (including within riparian areas) would limit the accumulation of fuels, restore understory plants of cultural importance to Sierra tribes, and encourage vigorous riparian habitats. The long-term potential for indirect impacts of sediment flows to streams is lower than alternative A but will still likely increase in the future. High-intensity fires are trending larger and may affect entire or multiple watersheds. Within the affected areas, these fires destabilize hillslopes and stream channels, consume surface litter that protects the soil, and create hydrophobic soils that can significantly limit infiltration and increase runoff. It is these effects that contribute to accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Water quality in 303(d)-listed streams impaired due to temperature may be improved due to slightly higher base flows caused by lower evapotranspiration on the restored uplands adjacent and upstream from affected stream reaches. Restoring meadows would help regulate downstream flows and store water under the surface where it maintains cooler temperatures. Riparian plants shade streams and would be restored or protected to cool streams. Fuel reduction treatments would reduce the potential for high-intensity wildfires. Reducing the risk that high-intensity wildfires would kill vegetation, particularly within riparian areas, would maintain cooler water temperatures by providing more stream shade (Westerling et al. 2006). This is more important considering the expected higher air temperatures (see "Fire Trends" section). Restoration of riparian areas and meadows, combined with upland reintegration of fire into the landscape, would likely enhance greater infiltration and recharge shallow groundwater. Greater groundwater recharge and storage increases baseflow of surface water across the landscape and tends to lower water temperatures during the dry season, which provides habitat for aquatic species and water sources for terrestrial species (see "Aquatic and Riparian Ecosystems" section).

Water Quantity

Climate change is likely to reduce effective precipitation. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils. Overall, shallow groundwater recharge and

storage is likely to be slightly reduced compared to current conditions due to climate change. Alternative B would help somewhat to maintain shallow groundwater recharge and storage under warming climate conditions.

Mechanical thinning of trees and low-intensity underburning of vegetation would reduce evapotranspiration and maintain, slightly increase, or extend the timing of stream flows (Hunsaker et al. 2014). Alternative B would treat more area than alternative A, and combined with more meadow restoration could increase infiltration on a landscape scale, thereby providing more groundwater recharge and storage. Increased shallow groundwater storage potentially mitigates some of the impacts from climate change and increases aquatic system resilience, stabilizes stream flows, and benefits wildlife dependent on springs.

Watershed Conditions

Alternative B would address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues because of the increased pace and scale of terrestrial restoration at a landscape scale. Riparian conditions may improve due to less risk of high-intensity wildfire within riparian conservation areas, but not as much as alternative D.

Alternative B proposes a new critical aquatic refuge for the benefit of the black toad on the Inyo National Forest and several new critical aquatic refuges within existing wilderness on the Sierra National Forest. The opportunity to focus restoration within existing critical aquatic refuges to benefit species would be the same as alternative A. The additional critical aquatic refuges in alternative B are outside of areas to be actively managed so impacts would be similar to alternative A except where new opportunities may present themselves to maintain and enhance amphibian habitat on the Inyo and Sierra National Forests.

Riparian areas are likely to be maintained as restoration activities proceed within riparian conservation areas in the short term and improve over the long term compared to alternative A from the ecological restoration of adjacent uplands and where restoration of riparian structure and native species occurs. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to riparian areas for alternative B.

Soils may be impacted more in the short term due to ground disturbance during restoration activities when compared to alternative A, but would improve over the long term where restoration has reduced the risk of high-intensity wildfire. The critical factors to maintain and enhance soil productivity are to reduce soil disturbance and compaction. The increased pace and scale of ecological restoration, especially using ground-based mechanical equipment, causes soil disturbance and compaction. Infiltration is reduced on compacted soils and tends to run off and increase erosion. The riparian conservation areas and equipment exclusion zones are designed to limit soil disturbance adjacent to streams and to provide filter strips to capture erosion from adjacent uplands. These filter strips have proven effective in preventing sediment delivery to streams and protecting aquatic species such as salamanders (Olson 2015). Alternative B would maintain similar riparian conservation area protections and requires the use of best management practices to reduce soil compaction and erosion. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to soil sustainability for alternative B.

The likelihood of large high-intensity fires would continue to increase but at a lower rate than in alternative A. As a result, alternative B fuel reduction work would provide benefits to maintaining water and soil quality, and watershed condition over the long term. As the pace and scale of

restoration is increased, including mechanical tree thinning and managed fire, the forests should become more resilient to climate change than alternative A.

Consequences Specific to Alternative C

Alternative C proposes to reduce high-intensity fire risk by increasing the use of prescribed fire and actively managing wildfire to meet resource objectives. However, because there would be less opportunity to pre-treat fuels in this alternative, there is uncertainty in how much area would have wildfires managed to meet resource objectives; this in turn leads to a high degree of uncertainty regarding how alternative C would affect the landscape condition (see "Terrestrial Ecosystems" section). Although alternative C proposes to reduce fuel loading more than alternative A using fire as the primary treatment method, the challenges of actively managing fire without mechanical treatment to lower fuels in the landscape may not result in treating more acres than alternative A. For this analysis, it is assumed that alternative C would result in approximately the same treatment area as alternative A, but treatment would be achieved through different means.

Water Quality

Alternative C requires the use of best management practices, standards, and guidelines in project design and implementation that are effective in reducing soil compaction, erosion, and sediment delivery to streams to protect watersheds. Short-term sediment impacts from emphasizing prescribed fire and managed wildfire to achieve restoration goals would be similar to alternative A. Alternative C proposes to reduce ground disturbance from mechanical thinning, but would likely increase the risk of large high-intensity wildfire (see "Terrestrial Ecosystems" section.) Prescribed fire under these conditions is likely to burn at greater intensity than other alternatives because of greater fuel loading on the landscape due to less mechanical treatment.

Indirect impacts from high-intensity wildfire is greater than alternative B and similar to alternative A over the long term. High-intensity fires are trending larger and may affect entire or multiple watersheds causing adverse effects to hillslopes, stream channels, infiltration, and runoff. It is these effects that contribute to accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Alternative C would treat only a small proportion of the lands needing treatment to substantially reduce the risk of high-intensity wildfire. The staff at each national forest identified lands in need of treatment, including all wildland-urban intermix zones and upland areas of low to moderate slopes. The pace and scale is not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, the overall water quality and watershed function would decline under alternative C.

Water Quantity

Alternative C would potentially cause reduced flows due to higher evapotranspiration by vegetation over broad landscapes and across watersheds exacerbated by climate change. The decrease of winter snowpack and increased proportion of rain versus snow reduces the infiltration and increases runoff compared to the past. This will potentially cause earlier peak flows, lower late spring and early summer runoff from snowmelt, and lower baseflows during the dry season. Where high-intensity wildfires occur, evapotranspiration would be greatly reduced for a time, but the runoff increases reflect additional effects from hydrophobic soils. Alternative C would likely reduce annual water yields from surface water.

Shallow groundwater recharge and storage is also potentially reduced due to maintaining a similar pace and scale of terrestrial and meadow restoration as alternative A, exacerbated by climate change effects. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils.

Since alternative C does not limit watershed restoration, the pace and scale may increase as new opportunities and funding sources evolve and partnerships are enhanced to bring such projects to completion. However, where meadow and other aquatic restoration activities would remain at their current pace and scale, shallow groundwater recharge would increase only where the meadows have been restored, but generally decline overall across the three national forests.

Watershed Conditions

Alternative C emphasizes fuel reduction within the wildland-urban intermix defense zone and a greater reliance on prescribed fire and managed wildfire to reduce the threat of large high-intensity wildfires. Alternative C would provide similar direction for protection of riparian conservation areas and would place similar emphasis on watershed restoration as alternative B to maintain or improve watershed conditions. However, overall watershed conditions would continue to be at risk due to large high-intensity wildfire. Alternative C does not limit watershed restoration and could utilize additional sources of funding and assistance through partnerships to address watershed conditions.

Riparian and aquatic restoration work to help offset impacts of climate change on stream temperatures and availability of water would likely be limited to existing and new priority watersheds and completing essential projects within those watersheds. Riparian areas would not likely change in the short term but would decline over the long term due to the limited pace and scale of ecological restoration of adjacent uplands, except where restoration of riparian structure and native species occurs.

Alternative C requires the use of best management practices and maintains riparian conservation areas like alternative B, but would have less mechanical treatment so the effects are almost all fire related. The emphasis on prescribed fire and managed wildfire would result in less soil disturbance and compaction related to equipment use but increased soil impacts from fire. Alternative C would have approximately the same effect on soils as alternative A because the long-term risk of high-intensity wildfire would remain high and the fire intensity of prescribed fire and managed wildfire may be greater than other alternatives. There is more uncertainty in analyzing the potential impact to soil sustainability for alternative C.

Alternative C is not likely to adequately address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues such as widespread tree mortality because these require an increase in the pace and scale of terrestrial restoration to achieve equilibrium at a landscape scale. Although alternative C addresses the need to emphasize managed fire to maintain and enhance riparian areas, the riparian areas overall may decline due to increased risk of high-intensity wildfire within the riparian conservation areas.

Alternative C proposes additional critical aquatic refuges on the three national forests for the benefit of various aquatic species. These critical aquatic refuges are well distributed throughout the national forests both inside and outside wilderness area boundaries. Alternative C presents a wide variety of opportunities to focus restoration to benefit specific aquatic species such as the Yosemite toad and terrestrial species that need moist habitat such as slender salamanders, as well

as aquatic biodiversity in critical aquatic refuges across the landscape. It is assumes that as restoration work is completed, new priority watersheds would be identified considering the restoration needs of these critical aquatic refuges. Since many proposed critical aquatic refuges are within areas to be actively managed, additional opportunities would be available to restore both terrestrial and aquatic habitats within the critical aquatic refuges for the benefit of species and biodiversity.

Consequences Specific to Alternative D

Alternative D proposes to double ecological restoration across the three national forests compared to alternative B and would address 30 to 60 percent of areas identified as needing this treatment to substantially reduce the risk of high-intensity fire. These treatments are expected to reduce the likelihood of large high-intensity fire compared to current conditions more than the other alternatives (see “Fire Management” and “Air Quality” sections).

Water Quality

Alternative D would require the use of best management practices, standards, and guidelines in project design and implementation, and would maintain riparian conservation areas similar to alternative B. These would be effective at reducing soil compaction, erosion and sediment delivery to streams to protect watersheds. Short-term sediment impacts from increasing the pace and scale of restoration would likely be higher than the other alternatives because of the increase in treated acres. However, project implementation of best management practices, standards, and guidelines should minimize reduction to water quality.

Alternative D emphasizes restoring ecological integrity to the landscape at an overall pace and scale that would reduce the current upward trend of wildfire frequency and intensity. The long-term potential for indirect impacts of sediment flows to streams is lower than all other alternatives considered in detail because alternative D would be most effective across more areas at reducing high-intensity wildfire. The emphasis on low- and medium-intensity fires across the landscape (including within the riparian areas) would limit the accumulation of fuels, restore understory plants of cultural importance to Sierra tribes, and encourage vigorous riparian habitats. The long-term benefits of an increased pace and scale of restoration would be reduced impacts to watersheds, soils, riparian areas, streams, and aquatic habitats from large high-intensity wildfires (Neary et al 2005).

Water quality would be improved where restoration of watersheds occurs, especially in areas where restoration of meadows and riparian areas provide greater shallow groundwater storage, baseflow, and shading of streams.

Water quality in 303(d)-listed streams affected by temperature may be improved due to slightly higher base flows caused by lower evapotranspiration on the treated adjacent upland areas. Groundwater recharge of surface water should be greater due to slightly higher infiltration rates across the landscape and restoration of meadows, resulting in higher baseflows and lower water temperatures during the dry season.

Water Quantity

Like alternative B, mechanical thinning of trees and low-intensity underburning of vegetation would reduce evapotranspiration and slightly increase or extend the timing of stream flows (Hunsaker et al. 2013b). However, alternative D would increase the amount of treated area more than other alternatives considered in detail. Combined with potentially more meadow restorations, alternative D could increase infiltration on a landscape level and encourage more

groundwater storage. Encouraging shallow groundwater storage potentially mitigates some of the impacts from climate change by increasing aquatic ecosystem resilience, providing more stable stream flows, and benefitting wildlife dependent on springs.

Climate change is likely to reduce effective precipitation. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils. Overall, alternative D would likely maintain current shallow groundwater recharge and storage under conditions of warming climate better than the other alternatives.

Water quantity may be increased slightly where managers actively restore the watersheds. Since alternative D does not limit watershed restoration, the pace and scale may increase as new opportunities and funding sources evolve and partnerships are enhanced to bring such projects to completion.

Watershed Conditions

Alternative D would address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues through an increased pace and scale of terrestrial restoration.

Like alternative B, alternative D proposes a new critical aquatic refuge for the benefit of the black toad on the Inyo National Forest and several new critical aquatic refuges within existing wilderness on the Sierra National Forest. The opportunity to focus restoration within existing critical aquatic refuges to benefit species is the same as alternative A. The additional critical aquatic refuges in alternative D are outside of areas to be actively managed so impacts would be similar to alternative A except where new opportunities may present themselves to maintain and enhance amphibian habitat on the Inyo and Sierra National Forests.

Models indicate that alternative D is the alternative that best achieves landscape-scale reductions to the risk of high-severity wildfire and provides the greatest resilience to the effects of climate change. Riparian conditions may decline due to increased activity within riparian conservation areas in the short term but they would improve over the long term from the ecological restoration of adjacent uplands and where restoration of riparian structure and native species occurs. The potential for short-term effects from an increased pace and scale of restoration would be balanced against the long-term benefits to riparian areas.

Similar to alternative B, soil conditions may decline slightly in the short term due to ground disturbance by restoration activities but would improve where restoration has reduced the risk of high-intensity wildfire. The critical factors to maintain and enhance soil productivity are to reduce soil disturbance and compaction. The increased pace and scale of ecological restoration, especially using ground-based mechanical equipment, could cause soil disturbance and compaction. The riparian conservation areas and equipment exclusion zones are designed to limit soil disturbance adjacent to streams and to provide filter strips to capture erosion from adjacent uplands. Alternative D maintains similar riparian conservation area protections and requires the use of best management practices similar to alternative B. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to soil sustainability in alternative D.

Alternative D would increase the pace and scale of ecological restoration to reduce likelihood of large high-intensity fires more than the other alternatives. As a result, alternative D restoration treatments would provide benefits to maintaining water and soil quality and watershed condition

over the long term. As forest managers increase the pace and scale of restoration, including mechanical tree thinning and managed fire, the forests should become more resilient to climate change.

Cumulative Effects

The present and foreseeable actions of forest managers and landowners determines cumulative consequences to water quality, water quantity, and watershed condition. The watersheds on the three national forests are part of the greater southern Sierra Nevada ecosystem and are administered or owned by the Forest Service, the National Park Service, the Bureau of Land Management, the State of California, the Los Angeles Department of Water and Power, Southern California Edison, several tribes, and thousands of private landowners. The Forest Service manages most of the headwaters of Sierra Nevada rivers, some watersheds in their entirety, and shares management in parts of many watersheds where ownerships overlap.

Successful management of shared and adjacent watersheds requires a concerted effort of the various landowners and a variety of partners. The Forest Service will continue to work with State agencies in the development of total maximum daily load (TMDL) strategic action plans for 303(d)-listed streams. If sources of impairment are identified related to Forest Service management, the action plans may identify mitigation strategies including implementation of best management practices, maintenance or decommissioning of facilities, roads, and trails, implementation of currently planned restoration projects, and removal of existing stressors. The operators of the various dams on these rivers will adapt their operations to meet Federal Energy Regulatory Commission relicensing requirements and to respond to effects of climate change on runoff and baseflows. The Federal Energy Regulatory Commission and the power companies in conjunction with the Forest Service will need to address issues as they arise in the future. Private landowners and the Forest Service will need to work together to achieve stream and meadow restoration where ownership overlaps these areas.

The effectiveness of Forest Service management under all alternatives may be reduced or enhanced by the cumulative efforts of adjacent landowners. For all alternatives, without concerted efforts by many landowners, especially in the foothill and lower montane zones, the potential for long-term adverse cumulative watershed impacts from high-intensity wildfire remains high.

Analytical Conclusions

The alternatives considered in detail outline different approaches to achieving the same overall set of goals for maintaining and enhancing watershed health. This section and Table 70 summarize how well these alternatives are expected to achieve these goals expressed in terms of the indicators: water quality, water quantity, and watershed condition.

Water Quality

Table 70 shows that the alternatives vary in how they emphasize water quality impacts over the short term or long term. Alternatives A and C emphasize reduction of impacts over the short term through effective filter strips within the riparian conservation areas and less mechanical treatment, while alternatives B and D emphasize a long-term approach through an increased pace and scale of ecological restoration across the landscape. Alternative D best reduces the overall risk of high-intensity wildfire on the three national forests. While short-term impacts of alternatives B and D have a potential for sediment delivery to streams due to the increased amount of treatment, alternatives B and D provide long-term benefits to water quality by reducing the risk of large high-intensity wildfire and resulting sediment more than either alternative A or C.

Table 70. Summary of environmental consequences to water quality and watershed condition by alternative in comparison to current conditions[1]

Indicator	Ecosystem Measure	Alternative A	Alternative B	Alternative C	Alternative D
Water Quality	Risk of short-term sediment impacts	Same or little change from present	Trend slightly to worse condition than present	Same or little change from present	Trend slightly to worse condition than present
Water Quality	Risk of long-term sediment impacts	Trend to worse condition than present	Trend slightly to worse condition than present	Trend to worse condition than present	Trend slightly to better condition than present
Water Quality	Mitigation of air temperature effects caused by climate change on stream temperature	Trend to worse condition than present	Trend slightly to worse condition than present	Trend slightly to worse condition than present	Same or little change from present
Water Quality	Effects to 303(d) listed streams for temperature within or adjacent to National Forest System lands	Same or little change from present	Trend slightly to better condition than present	Same or little change from present	Trend slightly to better condition than present
Water Quantity	Shallow groundwater recharge and storage opportunities (based on static trend precipitation patterns)	Same or little change from present	Trend slightly to better condition than present	Same or little change from present	Trend slightly to better condition than present
Water Quantity	Shallow groundwater recharge and storage potential factored for climate change	Trend to worse condition than present	Trend slightly to worse condition than present	Trend to worse condition than present	Same or little change from present
Watershed Conditions	Opportunities to maintain or enhance watershed conditions Within existing critical aquatic refuges for the benefit of aquatic biodiversity or to protect specific aquatic species	Same or little change from present	Trend slightly to better condition than present	Trend slightly to better condition than present	Trend slightly to better condition than present
Watershed Conditions	Opportunities to maintain or enhance watershed conditions within expanded network of critical aquatic refuges for the benefit of aquatic biodiversity or to protect specific aquatic species	Trend slightly to worse condition than present	Same or little change from present	Trend to better condition than present	Same or little change from present
Watershed Conditions	Fire regime and forest health indicator (Watershed Condition Framework)	Trend to worse condition than present	Trend slightly to worse condition than present	Trend to worse condition than present	Trend slightly to better condition than present
Watershed Conditions	Soils indicator (Watershed Condition Framework)	Same or little change from present	Trend slightly to worse condition than present	Same or little change from present	Trend slightly to worse condition than present
Watershed Conditions	Riparian indicator (Watershed Condition Framework)	Same or little change from present	Same or little change from present	Same or little change from present	Trend slightly to better condition than present
Watershed Conditions	Overall resilience to climate change to maintain or enhance watershed conditions	Trend to worse condition than present	Trend slightly to worse condition than present	Trend to worse condition than present	Trend slightly to better condition than present

Climate change is causing a risk for higher water temperatures throughout the region and requires restoration of meadows and riparian areas to mitigate this effect. Alternative D provides the greatest opportunity to mitigate the effect of higher air temperatures and subsequent changes in precipitation patterns because it treats the greatest amount of acreage.

Water Quantity

The alternatives differ in approach, pace and scale of ecological restoration and may affect shallow groundwater recharge and storage. Alternatives A and C would likely maintain shallow groundwater at current levels if not for the changing climate tending toward warmer and drier conditions in the Sierra Nevada. Even if precipitation remains the same, more rain and less snow would reduce recharge and storage and increase runoff. Combined with greater evapotranspiration, the precipitation provides less soil moisture for healthy forest vegetation, soil infiltration, and recharging the shallow groundwater. Alternatives B and D would reduce evapotranspiration at a landscape scale and would likely increase the opportunities for infiltration across many watersheds.

Watershed Conditions

The watershed condition framework provides a means to evaluate the alternatives considered in detail in how they would affect watershed conditions. Critical aquatic refuges provide additional protection to watersheds that have high biodiversity of native species or contain sensitive, threatened, or endangered species. Since the current priority watersheds and critical aquatic refuges are carried through all alternatives, the projects developed to maintain and enhance these watersheds would continue to move forward. As watershed restoration action plans in priority watershed are completed, new priority watersheds will be identified considering restoration needs of critical aquatic refuges. Alternative C may offer additional opportunities for restoration within these critical aquatic refuges through partnerships and short-term impacts on water quality would be lower due to less use of mechanical treatments. Alternative C also creates the greatest number of new critical aquatic refuges, many outside of wilderness boundaries, which could benefit from watershed restoration activities focused on enhancing habitat.

Since the watershed condition framework is composed of various indicators, each alternative was evaluated on how it would likely effect six key indicators (water quality, water quantity, fire regime, forest health, riparian, and soils). Table 70 shows how each alternative would affect these indicators. For fire regime and forest health, alternatives A and C are insufficient to maintain current conditions when they are influenced by climate change combined with insect and disease outbreaks. Alternative B performs better due to the increased pace and scale of ecological restoration and alternative D would show more long-term improvement of these indicators. The soils indicator would likely be maintained by alternatives A and C, but could decline in the short term under alternatives B and D due to the increased amount of mechanical treatments as described in the Consequences section above.

A key driver for improving watershed condition across the three national forests is restoration of the fire regime and forest health indicators, since long-term water quality and quantity are closely linked to these ecosystem conditions. Alternatives A and C would take longer than alternatives B or D to restore fire regime and forest health at a landscape level. Alternative D would be most likely to maintain watersheds at properly functioning or improve the condition of the greatest number of watersheds. Alternative D would also create the greatest number of watersheds on the three national forests that would be resilient to the impacts of climate change.

Wildlife, Fish and Plants

Background

The diverse landscapes of the Inyo, Sequoia and Sierra National Forests provide a rich array of ecosystems and habitat types that support thousands of wildlife, fish, and plant species. These diverse landscapes include both the east side and west side of the Sierra Nevada, as well as elevations extending from approximately 1,000 feet to 14,494 feet above mean sea level. They include a variety of topography, geology and soils, and are influenced by a wide range of precipitation and temperature regimes. This diversity is also reflected by six major biological provinces present within these three national forests: Sierra Nevada Mountains, San Joaquin Valley, Great Basin Desert, Mohave Desert, Tehachapi Mountains, Great Basin, and the Mojave Desert (Long et al. 2014).

The Inyo, Sequoia and Sierra National Forest contain all or portions of 272 watersheds ranging in size from 10,000 to 40,000 acres (see the "Water Quality, Water Quantity, and Watershed Condition" section on page 282). All of these watersheds drain into the San Joaquin Valley or terminal Great Basin lakes (Mono Lake, Owens Lake Playa). There is an estimated 1,640 miles of permanent streams are on the Inyo National Forest, an estimated 2,000 miles of permanent streams and rivers on the Sierra National Forest, and an estimated 1,280 miles of permanent streams on the Sequoia National Forest. This diversity of habitats supports the following species diversity.

- The Inyo National Forest has approximately 300 terrestrial wildlife species: 160 birds, 100 mammals, 30 reptiles, 10 amphibians, and 4 native fish species. There are also two federally threatened fish species (Paiute and Lahontan cutthroat trout), five introduced fish species, and more than 1,300 plant species (USDA FS 2013a).
- The Sequoia National Forest has approximately 304 species of terrestrial wildlife: 194 birds, 85 mammals, 25 reptiles, 13 amphibians, and 9 native fish species. There are also 24 introduced fish species and more than 2,000 plant species (USDA FS 2013b).
- The Sierra National Forest has approximately 302 terrestrial wildlife species: 198 birds, 82 mammals, 22 reptiles; 15 amphibians, and 9 native fish species. There are also 22 introduced fish species and more than 2,000 plant species (USDA FS 2013c).

The Evaluation of At-risk Species

Forest plans are developed to guide the maintenance or restoration of structure, function, composition, and connectivity of ecosystems to provide ecological conditions that will maintain a diversity of plant and animal communities and support the persistence of most native species in the plan area. This analysis focuses on evaluating the consequences of the plan alternatives on at-risk species.

Forest Service at-risk species include two categories: (1) federally designated species and habitat (species listed as threatened or endangered, species that are proposed or candidates for federal listing, and species with designated critical habitat on the national forests), and (2) Forest Service-designated species of conservation concern. In contrast to categories described above that are derived under the Endangered Species Act, species of conservation concern is a new category developed and used by the Forest Service under the 2012 Planning Rule to describe animal and plant species that are known to occur in the plan area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the

species' capability to persist over the long-term in the plan area.[23] The species of conservation concern list guides forest planning; however, the designation of these species is not a forest plan decision. Just as there is a process for U.S Fish and Wildlife Service to change the federal listing status of a species; the Regional Forester has authority to change species of conservation concern lists to reflect new information.[24] The Forest Service "sensitive species" concept is not carried forward as part of the 2012 Planning Rule and is therefore not used in these plans.

The basis for the analysis requires a determination of whether plan components such as desired conditions, objectives, standards, and guidelines provide direction to provide the ecological conditions necessary to contribute to the recovery of federally recognized species and maintain the persistence of species of conservation concern within the plan area. Plan components were developed in an iterative way, which included identifying desired conditions and potential threats to species, and identifying whether proposed plan components are sufficient to address species and their habitat needs (Forest Service Handbook 1909.12 12.52.c-d). It is also recognized that due to circumstances that are neither within the authority of the Forest Service nor consistent within the inherent capability of the land, the plan area may be unable to provide the ecological conditions necessary to maintain a viable population of a particular species of conservation concern. When this occurs, the draft environmental impact statement documents this and where possible, focuses on other efforts that are within the capability and authority of the Forest Service.

Prior to issuing a final decision on the proposed forest plans, the Forest Service will consult with the U.S. Fish and Wildlife Service under the provisions of section 7 of the Endangered Species Act, which will include preparation of a biological assessment for federally recognized species. The U.S. Fish and Wildlife Service will provide a formal written response in the form of a biological opinion. This formal documentation will be available for the public to review at the final stage of planning. In the interim, draft" analytical conclusions for federally threatened, endangered, proposed, and candidate species or critical habitats are presented in this draft environmental impact statement for early review and comment by the public.

Federally Listed, Candidate, and Proposed At-risk Species

For each at-risk species federally listed, candidate, or proposed for listing, determinations indicate whether alternatives (1) maintain or restore habitats in the plan area to provide the ecological conditions necessary to contribute to recovery of threatened and endangered species, and (2) contribute to preventing proposed and candidate species from becoming federally listed in the future.[25] As described above, the extent and condition of habitat were the indicators used to determine if such ecological conditions were present to conserve species and to contribute to preventing species from becoming listed. The analysis also considers the authority of the Forest Service and the inherent capability of the plan area to provide for federally listed at-risk species.

When developing plan components (ecosystem and species-specific) to conserve at-risk threatened, endangered, candidate, and proposed species, we:

1. Considered conservation measures identified in existing conservation strategies and agreements relevant to proposed and candidate species in the plan area.

[23] 36 CFR 219.9
[24] See Forest Service Handbook 1909.12 chapter 20, section 21.22b
[25] Forest Service Handbook 1909.12

2. Considered limiting factors and key threats to species identified in proposed rules from the U.S. Fish and Wildlife Service for listing, candidate species assessments, or accepted petitions.
3. Consulted with (and will continue to consult with) the U.S. Fish and Wildlife Service in the evaluation of existing conditions for proposed and candidate species and in the evaluation of plan components designed to conserve the species.
4. Considered collaboration and cooperation beyond the plan area boundary with the U.S. Fish and Wildlife Service, States, tribes, other partners, landowners, and land managers to support an all-lands approach to conserve proposed and candidate species.

Relationship between Forest Plans and the Endangered Species Act Consultation Process

Forest plans do not have direct effects because they provide a strategic framework for planning but no actions are compelled or authorized by the forest plan decision. The analysis of consequences for the forest plans consider indirect and cumulative effects that could reasonably result from implementation of the plan overall. Information and science based recommendations for federally listed species under the Endangered Species Act is included in species recovery plans, biological opinions, and critical habitat designations. This information was considered in developing plan components that are designed to provide, as appropriate, ecological conditions in the plan area necessary to meet the requirements for each at risk species, grouping or ecosystem.

Prior to issuing a decision, the Forest Service will formally consult with the U.S. Fish and Wildlife Service and request a biological opinion regarding the selected alternative and proposed forest plans. During the consultation process, the U.S. Fish and Wildlife Service may provide additional information that may lead to refined plan components to better conserve habitats and contribute to the recovery of listed species. Where appropriate to a programmatic forest plan, some consultation direction will be incorporated. For example, the 2014 Programmatic Biological Opinion for the Sierra Nevada Yellow-legged Frog, northern distinct population segment of the mountain yellow-legged frog and Yosemite toad applies to all three national forests. Some, but not all, of this direction was applied as coarse or fine-filter plan components, though there is still other direction that is better suited to apply at the project level since conditions can vary widely. Forest plans are intended to be adaptive, and changes can be made for newly listed species, new critical habitat designations, or as new information becomes available. Once approved, consultation will be reinitiated on the forest plans, as needed. Consultation obligations will still apply to site-specific Forest Service actions independent of the forest plan, as required by the Endangered Species Act and agency procedures.

Table 71 summarizes the number of federally listed, proposed, or candidate species for each national forest by taxonomic grouping. These totals by national forest include some species that are found on more than one of the forest planning areas so totals should not be calculated by taxonomic group.

Table 71. Number of federally threatened, endangered, proposed or candidate species and species with critical habitat occurring in the forest planning areas

Forest	Mammals	Birds	Reptiles	Amphibians	Fish	Invertebrates	Plants	Total
Inyo	2	0	0	3	3	0	1	9
Sequoia	2	4	0	1	1	1	2	11
Sierra	2	1	0	3	2	1	2	11

Species of Conservation Concern

Table 72 summarizes the total number of species of conservation concern for each national forest by taxonomic grouping. Like the previous table, these totals include some species that are found on more than one of the forest planning areas so totals should not be calculated by taxonomic group.

Table 72. Number of species of conservation concern occurring in the forest planning areas

Forest	Mammals	Birds	Reptiles	Amphibians	Fish	Invertebrates	Plants	Total
Inyo	4	4	0	3	1	15	105	132
Sequoia	5	7	0	8	4	6	70	100
Sierra	4	5	0	5	3	3	37	57

At-risk Terrestrial Wildlife Species

Background

This section evaluates and discloses the potential environmental consequences of the four forest plan alternatives on at-risk terrestrial wildlife species and habitat. This analysis evaluates the effectiveness of the alternatives to provide direction to create the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of species of conservation concern within the plan areas (the three national forests).

The need for plan revisions is guided by three primary topics, including “Ecological Integrity” which addresses the need to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought, and climate impacts; restore wildlife and plant habitat and diversity; and reduce the risk of wildfire impacts to species and wildlife habitat. An issue related to terrestrial wildlife includes the concern that the perceived accelerated pace and scale of potential management activities to restore resilience may not provide adequate habitat for wildlife species that use forests with large trees and dense canopy cover. Conversely, a second issue is that overemphasizing wildlife habitat needs overshadows the resilience and sustainability need of the forest itself. There is a concern that wildfires that could be managed to meet resource objectives will continue to be suppressed instead. There is also a concern that with climate change and drought, aquatic, and riparian systems that provide habitat for many terrestrial wildlife species are under increasing stress and in need of restoration to increase their resilience. The four alternatives present a range of approaches that address the revision topics and issues, including these issues related to at-risk terrestrial wildlife species and habitat.

Conservation Plans as they Relate to Forest Plans

Conservation strategies and assessments provide science-based guidance for conserving and recovering species and their habitat. Typically, these are developed as decision-support tools to implement conservation measures to achieve conservation goals and objectives specific to a single or logical grouping of species. Because scientific information is constantly evolving under continually changing conditions, an adaptive planning framework is necessary to allow for adjustments in conservation strategies over time.

Conservation strategies and assessments, as opposed to conservation agreements, are not themselves “decision” documents because they have not undergone environmental analysis and public review. In addition, management recommendation in conservation strategies are often

developed to optimize benefits to the species regardless of the authority and responsibility of the Forest Service and other multiple-use considerations. Where appropriate, the forest plan alternatives have incorporated some of the science-based management recommendations from various strategies and assessments, but the elements incorporated may vary by alternative. These documents are referenced because they serve as a tool to guide forest plan development.

The various conservation strategies, assessments, management plans, recovery plans, and other habitat or species-specific documents are also used by forest managers when analyzing the consequences of site-specific project activities. These guiding documents are expected to be revised, replaced, or supplemented as new scientific information based on new data and reports becomes available over time. Therefore, the list below only includes those documents known to be available at this time or in preparation and is not intended to be a complete or exhaustive list.

- Southern Sierra Nevada Fisher Conservation Assessment (Spencer et al. 2015)
- Southern Sierra Nevada Fisher Conservation Strategy (Spencer et al. 2016)
- Willow Flycatcher Conservation Assessment (Green et al. 2003)
- Sierra Nevada Red Fox Conservation Assessment (Perrine et al. 2010)
- Tricolored blackbird Conservation Plan (Tricolored Blackbird Working Group 2009)
- California Bird Species of Special Concern (Shuford and Gardall 2008)

Analysis and Methods

This analysis uses a complementary ecosystem (coarse filter) and species-specific (fine filter) approach to assess the alternatives' potential for providing the habitat characteristics to support wildlife diversity and the persistence of native species in each plan area. The coarse filter approach assumes that wildlife diversity is broadly dependent upon the integrity of the function, composition, and structure of the forest's terrestrial, riparian, and aquatic ecosystems. This analysis compares the current abundance and condition of various habitats with ecological reference conditions (natural range of variation) based on the dynamic nature of ecosystems, recognizing they are not static (Landres et al. 1999). It recognizes that disturbances or processes (such as fire, flooding, insects, and disease) and responses to those are part of natural ecosystem processes. However, because integrity of whole ecosystems does not necessarily address all species' needs, additional fine-filter (species specific) analyses were conducted to ensure that persistence is provided for at-risk wildlife species.

As described in the "Agents of Change" section, a disruption of natural processes (such as the legacy of fire suppression) can impact diversity and lead to a departure from the natural range of variation. Maintaining or mimicking natural processes and naturally occurring structural diversity; promoting natural patterns and connectivity; restoring ecosystems, communities, and species; and protecting the ecological characteristics required by at-risk species are all means to maintain biodiversity in an ecosystem. The coarse-filter and fine-filter approaches used in this analysis help to disclose how well each alternative addresses these needs.

Overall, we used a qualitative approach for this analysis. It is based on scientific literature about species, their habitat, and effects of management. The analysis of habitat is based largely on that described in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections (coarse filter components). The evaluation of environmental consequences to habitat that supports species persistence is framed as a risk assessment in terms of alternative effectiveness. However, there is a level of uncertainty about the possible effects of forest management and activities on

habitat that supports species persistence because of gaps in knowledge about the complex interaction between species and their habitats (Holthausen 2002) and how some species respond to varying degrees of habitat alteration.

The analysis area includes all National Forest System lands within the Inyo, Sequoia, and Sierra National Forests. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, indicator measures and threat information from within the analysis area were used in making conclusions. Because available biological and threat information for federally recognized threatened, endangered, proposed, and candidate species differs from information for species of conservation concern, and because the Forest Service Handbook outlines different procedures to identify plan components necessary to provide for the two groups of species, we used different approaches in their analyses.

Indicators and Measures

The key indicators for the analysis are trends in habitat quantity and habitat condition measured at a landscape scale. Primary habitat associations and associated threats are described for each at-risk species.

- **Habitat quantity** is measured by the potential trend in amount and distribution of habitat types in the plan areas over the next 15 to 20 years.
- **Habitat condition** is measured by the potential trend in resiliency and ability of habitats to be adaptable to large-scale disturbances (such as wildfire, insect outbreaks, and drought).

These indicators were selected because they provide a reasonable assessment of ecological conditions needed to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan areas.

Management direction that may alleviate or exacerbate threats to habitat are evaluated at a programmatic level. The draft forest plans do not authorize site-specific projects or activities; therefore there are no direct effects from adopting these forest plans. The direct and indirect site-specific effects will be analyzed when projects are proposed. Although potential short-term effects may be described where appropriate, this evaluation focused on longer term (15 to 20 years) indirect effects.

Much of the analysis is based upon the premise that the natural range of variation provides important background information for evaluating ecological integrity and sustainability (Wiens et al. 2012). The natural range of variation was used in development of plan direction (desired conditions) and the selection of indicators and measures for the analysis because the condition and quantity of habitat available to a species helps predict the potential for species distribution and abundance within that habitat. Also important in the analysis of ecological integrity and sustainability of vegetation are consideration of climate and associated fire trends that may be creating a combination of conditions that are outside of the natural range of variation (Safford et al. 2012a, Millar et al. 2015).

Coarse-filter plan components (largely centered on desired conditions within the natural range of variation) are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area including at-risk species.[26] The coarse-filter approach is considered the primary context for evaluating at-risk species. Where

[26] Forest Service Handbook 1909.12

coarse-filter components would not provide sufficient conditions for one or more at-risk species, fine-filter (species-specific) plan components, including standards and guidelines, were incorporated.

The analysis involves:

- identifying habitat associations of and threats to at-risk species,
- reviewing plan components that have potential to influence habitat conditions, thereby influencing the ecological conditions that would support species persistence,
- evaluating the proposed magnitude of change in the management approach by alternative and potential consequences from the management approach, and
- revising plan components (including incorporating fine-filter components where necessary) to provide needed ecological conditions.

Sources of information include:

- peer-reviewed published literature, general technical reports and other reports by the Forest Service and other agencies;
- various databases (such as the California Natural Diversity Database, Forest Service Natural Resource Information System Wildlife database, and eBird);
- personal communications with researchers, species experts, and California Department of Fish and Wildlife staff;
- U.S. Fish and Wildlife recovery plans for threatened and endangered species;
- the final Inyo, Sequoia, and Sierra National Forests Assessments (USDA FS 2013a, 2013b, 2013c);
- the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016); "Southern Sierra Nevada Fisher Conservation Assessment" (Spencer et al. 2015); "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA FS 2015a); Science Synthesis to Support Sociological Resilience in the Sierra Nevada and Southern Cascade Range (Long et al. 2014);
- resource reports for terrestrial ecology, fire ecology, and aquatic ecosystems; and
- Natural Range of Variation Assessment reports for the various habitats in the Sierra Nevada as prepared by the Forest Service (Estes 2013a and 2013b, Gross and Coppoletta 2013, Merriam 2013, Meyer 2013a, 2013b, Safford 2013, Sawyer 2013, Slaton and Stone 2013a, 2013b).

Analysis Area

In general, the analysis area for indirect effects includes all lands managed by the three national forests; however, for the purposes of this document it may include areas outside the national forest boundaries. In some cases National Forest System lands may provide all or a high percentage of the habitat for a given species; however, in most instances, wildlife generally move from area to area and habitats on National Forest System lands may be important to a species' survival. Cumulative effects analyses generally include lands within other ownerships immediately adjacent to the national forests, including adjacent national parks (Yosemite, Sequoia, Kings Canyons, and Death Valley), national monuments (Giant Sequoia and Devil's Postpile), land managed by the Bureau of Land Management (particularly along Highway 395 and adjacent to the Inyo National Forest), and comparatively smaller sections of State, county, and privately owned lands (especially near the Inyo National Forest). For some wide-ranging

species, the analysis area was a little larger and included an evaluation of connectivity between larger areas of habitat. For species with migratory or travel routes that extend far beyond the Sierra Nevada, management direction under alternatives B, C, and D would only influence habitat persistence (both quantity and condition) within the national forest plan areas, but actions that occur outside of National Forest System lands is beyond the authority of the Forest Service to influence.

Assumptions

- If a species is associated with a particular habitat, then the condition, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance within that habitat.
- Habitat abundance and distribution similar to that which supported associated species during conditions as a consequence of evolutionary time, will likely contribute to their maintenance in the future (Haufler 1999). Therefore, habitat abundance, distribution, and condition similar to that within the natural range of variation for the habitats will likely contribute to species maintenance in the future. (See also the "Terrestrial Vegetation Ecology" section).
- In general, the further a habitat is departed from desired conditions (natural range of variation), the greater the risk to viability of associated species. Conversely, the closer a habitat is to desired conditions, the lower the risk to viability of associated species Therefore, comparing the degree to which the alternatives trend conditions toward desired conditions provides a comparison of each alternative's viability effectiveness.
- For the purposes of analysis, we are assuming the plan alternatives will be implemented as described and objectives will be realized over the life of the plan.

Species Evaluated

The following tables list the names and national forest locations of federally listed species, designated and proposed critical habitat, and species of conservation concern we considered in this analysis.

Federally Listed Wildlife Species

Table 73. Federally threatened, endangered, proposed, and candidate species for the Inyo, Sequoia, and Sierra National Forests

Species Common Name	Species Scientific Name	Status	National Forest
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened	Sequoia, Sierra
Least Bell's vireo	*Vireo bellii pusillus*	Endangered	Sequoia
Southwestern willow flycatcher	*Empidonax trailii extimus*	Endangered	Sequoia
Western yellow-billed cuckoo western distinct population segment	*Coccyzus americanus*	Threatened	Sequoia
California condor	*Gymnogyps californianus*	Endangered	Sequoia, Sierra
Sierra Nevada red fox – Sierra Nevada distinct population segment	*Vulpes vulpes necator*	Candidate	Inyo, Sequoia, Sierra
Sierra Nevada bighorn sheep	*Ovis canadensis sierra*	Endangered	Inyo, Sequoia, Sierra

Federally Designated and Proposed Critical Habitat

Table 74. Federally designated and proposed critical habitats for terrestrial wildlife species on the Inyo, Sequoia, and Sierra National Forests

Species	Type of Designation	National Forest
Southwestern willow flycatcher	Designated Critical Habitat	Sequoia
Western yellow-billed cuckoo	Proposed Critical Habitat	Sequoia
California condor	Designated Critical Habitat	Sequoia
Sierra Nevada bighorn sheep	Designated Critical Habitat	Inyo, Sequoia, Sierra

Wildlife Species of Conservation Concern

Mammals

Table 75. Mammal species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	National Forest
Yellow-eared pocket mouse	*Perognathus parvus xanthonotus*	Sequoia
Pacific fringe-tailed bat	*Myotis thysanodes verpertinus*	Inyo, Sequoia, Sierra
Townsend's big-eared bat	*Corynorhinus townsendii*	Inyo, Sequoia, Sierra
Pacific fisher	*Pekania pennanti*	Sequoia, Sierra
Sierra marten	*Martes caurina sierra*	Inyo, Sequoia, Sierra
Nelson’s desert bighorn sheep	*Ovis canadensis nelsoni*	Inyo

Birds

Table 76. Bird species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	National Forest
Willow flycatcher	*Empidonax trailii brewsteri and E.t. adastus*	Inyo, Sequoia, Sierra
Kern red-winged blackbird	*Agelaius phoeniceus aciculatus*	Sequoia
Tricolored blackbird	*Agelaius tricolor*	Sequoia
Greater sage-grouse - Bi-state distinct population segment	*Centrocercus urophasianus*	Inyo
Bald Eagle	*Haliaeetus leucocephalus*	Inyo, Sequoia, Sierra
American peregrine falcon	*Falco peregrinus anatum*	Inyo, Sequoia, Sierra
Great gray owl	*Strix nebulosa yosemitensis*	Sequoia, Sierra
California spotted owl	*Strix occidentalis occidentalis*	Sequoia, Sierra

Terrestrial Amphibians

Table 77. Terrestrial amphibian species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	National Forest
Inyo Mountain salamander	*Batrachoseps campi*	Inyo
Hell Hollow slender salamander	*Batrachoseps diabolicus*	Sierra
Fairview salamander	*Batrachoseps bramei*	Sequoia
Gregarious slender salamander	*Batrachoseps gregarius*	Sequoia, Sierra
Kings River slender salamander	*Batrachoseps regius*	Sequoia, Sierra
Kern Canyon slender salamander	*Batrachoseps simatus*	Sequoia
Yellow-blotched salamander	*Ensatina eschscholtzii croceator*	Sequoia
Limestone salamander	*Hydromantes brunus*	Sierra

Snails

Table 78. Snail species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	National Forest
Indian Yosemite Snail	*Monadenia yosemitensis*	Sierra
Merced Canyon Shoulderband	*Helminthoglypta allynsmithi*	Sierra
Tight Coin	*Ammonitella yatesii*	Sequoia

Butterflies

Table 79. Butterfly and moth species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	National Forest
Behr's Metalmark	*Apodemia virgulti davenporti*	Sequoia
Boisduval's blue	*Plebejus icarioides inyo*	Inyo, Sequoia
Tehachapi fritillary	*Speyeria egleis tehachapina*	Sequoia
San Emigdio blue	*Plebulina emigdionis*	Inyo, Sequoia
Sierra Sulphur	*Colias behrii*	Inyo
Square Dotted Blue	*Euphilotes battoides mazourka*	Inyo
Mono Lake Checkerspot	*Euphydryas editha monoensis*	Inyo
Sierra Skipper	*Hesperia miriamae*	Inyo
White Mountains Skipper	*Hersperia miriamae longaevicola*	Inyo
Atronis fritillary	*Speyeria mormonia obsidian*	Inyo
Apache fritillary	*Speyeria Nokomis apacheana*	Inyo

Other Invertebrates

A cave obligate pseudoscorpion, (*Tuberochernes aalbui)* is a species of conservation concern on the Inyo National Forest.

Affected Environment

The diverse landscapes of the Inyo, Sequoia and Sierra National Forests provide a rich assortment of ecosystems and habitat types that support hundreds of wildlife, fish and plant species. These landscapes include both the east side and west side of the Sierra Nevada, Glass Mountains, White Mountains and Inyo Mountains, as well as elevations extending from approximately 1,000 feet to 14,494 feet above sea level. They include a variety of topographic, geologic and soil conditions, and are influenced by a wide range of precipitation and temperature regimes.

Many of the terrestrial ecosystems that support wildlife species in this portion of the Sierra Nevada are outside the range of natural variation due to a variety of past and current land use practices as well as changing climate conditions. Past activities like dam construction and water diversion, livestock grazing, various kinds of timber harvest, and fire suppression have contributed to these vegetation types changing away from their natural states. Changing climate conditions like drought and warming temperatures are also fostering increasingly stressed vegetation conditions that are vulnerable to high-severity effects of large and frequent wildfires, and pest and insect outbreaks, among other disturbances.

As described in the "Fire Trends" and "Terrestrial Vegetation Ecology" sections, large fires with high-severity effects are occurring more frequently in the Sierra Nevada, particularly in the dense forested stands in montane vegetation. Although specific effects are generally not known, these fires are having adverse consequences on many species associated with large-diameter trees, dense canopy cover, and complex vertical and understory stand structure. For example, fires with high-severity effects can completely remove nesting and denning trees, roost trees, structurally complex understories that support prey, and denning and cover structures. In addition to fire, large trees and groups of trees are dying from widespread insect outbreaks and the spread of diseases and pathogens. Drought stress is not only weakening these trees and making them more vulnerable to insects, diseases, and pathogens, but it is also causing many trees to die. The sheer density of the forests in the Sierra Nevada and prolonged drought conditions pose a significant and growing threat to montane habitat and the species associated with it.

Terrestrial ecosystems of the Sierra Nevada are expected to continue to be dramatically influenced by changes in climate in the coming decades (Meyer et al. 2012a, 2012b, Mallek et al. 2012, Safford et al. 2012a). Consequently, the future range of variation in climate exposure for these ecosystems will almost certainly exceed the natural range of variation. Changing climate conditions have been influencing, and are projected to continue to have effects on terrestrial wildlife species. A total of 128 (36 percent) of 358 California bird species are considered vulnerable to climate change, including at-risk species like greater sage-grouse, western yellow-billed cuckoo, least Bells' vireo, and great gray owl (Gardali et al. 2012).

Climate change has also been correlated with latitudinal and altitudinal range boundary shifts (Parmesan 2006, Moritz et al. 2008, Crimmins et al. 2011) as well as phenological shifts (changes in timing of migration and blooming) for a variety of plants and animals (Parmesan and Yohe 2003, Root et al. 2003). Uphill and higher elevation range shifts in response to historical warming have been well documented (Lawler et al. 2012). For example, in Yosemite National Park, Moritz et al. (2008) found substantial upward shifts in elevation limits of 50 percent of small mammal species sampled as well as an expansion of ranges in low-elevation species, contraction of ranges in high-elevation species, and changes in the community composition at mid- and high-elevations. Forister et al. (2010) found a similar upward shift in elevation range of butterfly species in the Sierra Nevada.

In contrast, recent research on range shifts of 73 vascular plant species in various California mountain ranges over the last century showed that about half of them had shifted the center of their range slightly downhill (Crimmins et al. 2011). Based on their results, the authors suggest that cooler and wetter sites at higher elevations have potential to be more sensitive to changes in precipitation than warmer and drier sites at lower elevations, which would be more sensitive to temperature changes. Under changing climate scenarios, temperature and precipitation can interact in a variety of unusual ways that influence vegetation. Crimmins et al. (2011) suggest that downhill shifts in species' ranges are expected to be more likely at these higher elevation wetter sites (Crimmins et al. 2011). Although these results are not specific to terrestrial wildlife species, which some studies have shown to experience uphill and higher elevation shifts in the Sierra Nevada (Moritz et al. 2008, Forister et al. 2010), some terrestrial wildlife species could shift ranges in response to precipitation changes. For example, bird surveys along Grinnell transects across the Sierra Nevada originally surveyed between 1911 to 1929 and resurveyed between 2003 to 2008 have provided evidence that bird species may be tracking both precipitation and temperature or either over time (Tingley et al. 2009). Some species may not shift at all but show a retraction in their range in response to changing climate conditions.

At the ecosystem level, community composition will change as the ranges of species shift. It appears that related species and species in the same ecological community may respond differently to changing environmental variables and these disparate responses may result in the breaking up of existing ecological communities and formation of novel communities (Root et al. 2003, Moritz et al. 2008, and Stralberg et al. 2009). This reshuffling of species in communities can present species with new challenges such as changes in predator and prey relationships, parasitism, and competition.

Terrestrial Wildlife Habitat

Westside Foothill Vegetation

At the lowest elevations, vegetation communities on the west side of the Sierra Nevada (Sierra and Sequoia National Forests) primarily consist of blue oak woodlands and chaparral/live oak communities. These vegetation types provide cover, food resources (such as acorns and browse plants), and shelter for a variety of wildlife species. This ecological zone is among the most altered and fragmented from urbanization and agriculture, and lies mostly on private land outside the national forests (Franklin and Fites-Kaufman 1996, USDA FS 2001). The foothill hardwood habitat is one of a variety of known foraging habitats for the Pacific fringe-tailed bats. Great gray owls have been found nesting in oaks in the lower elevations (Wu et al. 2015). The upper westside foothill vegetation includes ponderosa pine and black oak habitat for Pacific fisher and California spotted owl. Pacific fisher in this zone are strongly associated with the black oak habitat at the upper elevational end and over half of suitable fisher target cells (delineated as hexagonal grid cells) is found in this zone in the planning area. California spotted owls also have been found nesting in foothill and riparian habitat and the Sequoia and Sierra National Forests have delineated protected activity centers in this zone.

Eastside Arid Shrublands(Pinyon-Juniper, Sagebrush, and Mountain Mahobany)

This zone is occupied by xeric shrub-blackbrush communities, mountain mahogany, sagebrush, and pinyon-juniper communities. Changes in climate, fire, and grazing regimes in the late 19th and 20th centuries have been particularly important factors influencing the structure, function, and distribution of arid shrublands and woodlands in this area (Slaton and Stone 2013a). There has been an increased expansion of non-native invasive species, increased density of woody shrubs and trees into shrublands, and an overall change in successional pathways, particularly

related to changing fire regimes. Some pinyon-juniper woodlands have grown into sagebrush shrub communities, due to a combination of factors including grazing, fire suppression, and climate change. Yellow-eared pocket mouse is supported by habitats like desert scrub, pinyon-juniper, chaparral, and sagebrush habitats. Sagebrush is important habitat for all life history requirements for the bi-state distinct population segment of greater sage-grouse. Various at-risk butterflies that forage in sagebrush habitats are associated with sagebrush. Pacific fringe-tailed bats use pinyon-juniper for foraging.

Montane Forests (Westside and Eastside)

The mixed conifer forest-dominated montane zone includes large areas of varied mixtures of ponderosa pine or Jeffrey pine, black oak, sugar pine, incense cedar, and white fir. The mixed conifer forests in this zone support a variety of wildlife species including Pacific fisher, California spotted owl, and great gray owl, and provide foraging habitat for Townsend's big-eared bats. The mixed conifer habitat, and to a lesser extent montane hardwood forest types in this zone, provide the majority of habitat within California spotted owl protected activity centers on the Sequoia and Sierra National Forests. A variety of at-risk snails inhabit the spaces within talus deposits, rock outcrops, or rock and woody debris within forest habitat in this zone.

Overall, the vegetation and fire ecology of this zone are far outside the natural range of variation and therefore, this zone constitutes a large focus of the restoration needs. Forest density is higher, canopy cover of trees is more uniform, small and medium tree density is higher, and large tree density is lower than desired (see "Terrestrial Vegetation Ecology" section). Due to the previous factors, there is less heterogeneity within stands of trees, which reduces habitat diversity and habitat quality. In addition to trees killed from fires, the amount of large trees dying has doubled in the last two to three decades across the western U.S. (van Mantgem et al. 2009). Trees are stressed by a variety of factors such as drought, air pollutants, and competition. Within this zone, wildfires are less frequent than historic, but evidence is strong that they are on average larger and more severe than they were pre-European settlement (Collins and Skinner 2014, Safford 2013). Overall, resilience of these forests to drought and fire has decreased considerably (Safford 2013).

There are differences in the composition and structure of forests in drier compared to more moist parts of the landscape in this zone (Lydersen and North 2012). South- and west-facing slopes are drier and more dominated by pines (dry mixed conifer), whereas forests on north- and east-facing slopes, with less sun, are more moist and have a greater fir component (moist mixed conifer) (Fites-Kaufman et al. 2007). Also, ridges and upper slopes tend to be drier and drainages and lower slopes tend to be moister. Historically, under a frequent-fire regime, both the moist and dry mixed conifer types had higher levels of heterogeneity than current conditions (Lydersen et al. 2013). Although it's not well understood how heterogeneity varied between dry and moist forests historically, reconstruction of historic forest patterns suggest that moist sites were denser than dry sites. Both types are currently far outside the natural range of variation and have low resilience and adaptability to climate changes and insect outbreaks, and high susceptibility to high-severity wildfire.

Upper Montane Forests (Westside and Eastside)

On both sides of the Sierra Nevada, upper elevation montane zone forests largely consist of conifer forests where snow is the primary precipitation (Meyer 2013a). A mosaic of red fir and Jeffrey pine forests dominate, along with interspersed meadows, rock outcrops, lodgepole pine and montane chaparral. Red fir and lodgepole pine forests vary widely from open to closed-canopied. Red fir forests provide habitat for a variety of wildlife including great gray owl. Red fir

forests also overlap a portion of the range of the California spotted owl and some protected activity centers in the planning area are found in the upper montane zone. Red fir and lodgepole pine forests are the primary habitat of Sierra marten. These forests are less departed from the natural range of variation than the montane forests, with fewer changes in forest density, heterogeneity, and resilience (Meyer 2013a).

Subalpine and Alpine Vegetation

Above the upper montane zone are the subalpine and alpine zones. The subalpine landscapes consist of a mosaic of subalpine forests and woodlands, extensive rock outcrops, scrub vegetation, meadows, and riparian corridors (Fites-Kaufman et al. 2007). Since alpine environments are found at the extreme end of the temperature gradient in the Sierra Nevada, the life forms that are narrowly adapted to those conditions essentially have nowhere to go as their environment changes, making them among the most vulnerable to climate change (Sydoriak et al. 2013). Due to the high elevation on the Sequoia National Forest, the last cold refugia may be in the mountains surrounding the Kern Plateau. These alpine ecosystems are more threatened due to rapid climate change (Loarie et al. 2008).

Coniferous forests in the subalpine zone in California typically support fewer species of birds and mammals than any other major forest type in the state (Verner and Purcell 1988). The reasons, though not clearly established, probably involve some combination of climate, short growing season, lower primary productivity, moisture stress, and lower production of insects and other invertebrates that provide food resources for many vertebrates (Verner and Purcell 1988). Wildlife species like the Sierra Nevada red fox use high-elevation barren, conifer and meadow habitats. Many butterflies have been located in high-elevation dry and wet meadows and rocky habitat. This zone also includes the areas of talus and rock outcrops that support a variety of at-risk species. For example, Sierra Nevada bighorn sheep use the upper montane, alpine, and subalpine habitats of the plan area, particularly rugged, rocky areas. A variety of snails prefer to seek refugia in talus deposits and rock outcrops, particularly on north-facing talus and rocky slopes and within woody debris in rocky areas within forests. Sierra marten uses some portions of the subalpine zone where dense patches of forest are interspersed with meadows and riparian areas.

Old Forest

Old forests are located across various elevations and ecosystems. Although old forests tend to contain old and usually large trees, tree size varies based on species and site productivity (see “Terrestrial Ecosystem Processes and Functions,” “Special Habitats” subsection). The density, size and arrangement of individual trees also varies by ecosystem type with higher elevations having a more open and scattered arrangement. Old forests at lower elevations tend to contain larger trees in a wide variety of densities and canopy covers. Old forests often contain large snags and logs in addition to large live trees. The densities of all of these old forest components varied widely in the past. Much of the montane mixed conifer and pine forests that contain large, old trees are more uniformly dense, with high tree cover, than they were in the past (Safford 2013, Stephens et al. 2015, and Collins et al. 2015). There are increased rates of old growth trees dying from competition with younger trees for water, climate change that influences carbon balances and growth reserves, insect-related mortality, and increased high-intensity fire. Dense, older forest conditions are strongly associated with the California spotted owl, Pacific fisher and Sierra marten. Individual old growth forest components such as large snags and trees are used by bald eagles and California condors.

Complex Early Seral Habitat

For this analysis, complex early seral habitat is defined as the stage of forest development that follows a significant mortality event in a mature forest (see "Terrestrial Ecosystems Processes and Functions," "Special Habitats" subsection). Typical major disturbance events in the Sierra Nevada currently include large wildfires with high-severity effects and wide-scale insect outbreaks. The death of many overstory trees creates openings that allow other plants and tree seedlings to reoccupy the site. The complex early seral habitat is often characterized by high densities of snags, the development of shrub cover and other native vegetation, downed wood and natural conifer regeneration. This transitional seral stage provides important habitat for a variety of birds and small mammals which are prey for species such as California spotted owls and Pacific fisher. This habitat can also be important for woodpeckers and cavity-nesting birds that benefit from the increase in snag habitat and food resources associated with dead and dying trees. With the change of vegetation from the natural range of variation, the size and distribution of complex early seral habitat in both location and timing has changed with large fires creating very large areas of high-severity fire.

Caves, Cave-like Habitat, and Cliffs

Large cliffs provide habitat for a variety of raptors including peregrine falcon, osprey, bald eagle, and golden eagle. Peregrine falcons currently nest in cliff habitat in the Sequoia National Forest. Caves and cave surrogates (such as mines, adits, and vacant buildings and structures) can provide habitat for many bat species, including Townsend's big-eared bat and the Pacific fringe-tailed bat, as well as a cave obligate pseudoscorpion (*Tuberochernes aalbui*). Natural caverns and large, abandoned mine shafts exist in the three national forest planning areas.

Aquatic Wildlife Habitat

Meadows

Meadows in the three national forests play important roles in hydrology, water storage, erosion control, nutrient cycling, wildlife habitat, and recreation (see "Aquatic and Riparian Ecosystem" section). The condition of meadows in the Sierra Nevada bio-region (including all three national forests) were assessed and 65 percent of meadow indicators (13 of 20 indicators) were outside the natural range of variation for various characteristics related to composition, structure, and process (Gross and Coppoletta 2013). In addition, the total area of meadows in the Sierra Nevada has decreased due to past and current land use practices such as dams, diversions, and recreation; upland vegetation encroachment from conifers and sagebrush as a result of fire suppression; or from drying due to stream channel incision (Gross and Coppoletta 2013). Meadows will continue to be at risk if the precipitation pattern in the southern Sierra Nevada shifts to more rain than snow because many meadows are dependent on snowpack to sustain the water table throughout the long dry period of summer.

Meadows provide nesting, burrowing, cover, and foraging habitat for a variety of terrestrial wildlife species including mammals that burrow in the ground (like gophers and voles) and are prey for a variety of species (like great gray owl and Sierra Nevada red fox), meadow nesting birds (such as willow flycatcher), herbivores, insectivorous bats (like Pacific fringe-tailed bats), and carnivores. Meadows support one or more life history requirements for the following species of conservation concern in the three national forests: butterflies, two willow flycatcher subspecies (*E. t. brewsteri* and *E. t. adastus*), great gray owl, bi-state sage-grouse, Sierra Nevada red fox, and Pacific fringe-tailed bat.

Lakes and Ponds

Many terrestrial wildlife species depend on habitat surrounding lakes, ponds, and associated habitats like marshes to support one or more life history requirements, particularly breeding or foraging. For example, bald eagles forage in lakes and other large bodies of water. The peregrine falcon breeds near open waters like lakes, ponds, rivers, or wetlands. A variety of bat species forage in or near waterbodies, like the Pacific fringe-tailed bat that uses open habitat or dry forest where it is adjacent to an open water source. Butterflies often persist adjacent to aquatic habitats. Nesting by tri-colored and Kern red-winged blackbirds is strongly associated with marsh habitat characterized by cattails and tules. In the Sequoia National Forest, the area surrounding Lake Isabella, the Kern River corridor, and South Fork Wildlife Area is a hotspot for many at-risk terrestrial wildlife species, particularly migratory birds like the western yellow-billed cuckoo.

Riparian Forests and Woodlands

Riparian forests and woodlands occur throughout the three national forests and have an exceptionally high value for many wildlife species, often supporting a higher concentration of species diversity than most terrestrial ecosystems. These areas serve as a link between aquatic and terrestrial ecosystems. Overall, within the Sierra Nevada and Great Basin bio-regions, riparian areas are outside the natural range of variation at low and mid-elevations, where fire suppression, land uses, and water development have been concentrated (Sawyer 2013). Many of the montane riparian communities in the three national forests have had an ingrowth of conifers due to the absence of fire. Without fire, this ingrowth of riparian forest woodlands will continue. Over the next century, climate change will continue to alter hydrologic and precipitation patterns, and the role of fire in riparian areas.

Riparian areas provide water, thermal cover, migration and movement corridors, and diverse nesting and feeding opportunities for wildlife (Grenfell Jr. 1988). The shape of many riparian zones, particularly the linear nature of streams, maximizes the development of a natural edge that is used by a variety of amphibians, birds, and mammals, as movement corridors. Riparian forests and woodlands provide habitat for all but one (Inyo Mountain salamander) of the at-risk salamanders. Montane riparian habitats also serve as important nesting, foraging, and cover habitat for a variety of birds. Two endangered species (least Bell's vireo and southwestern willow flycatcher) and one threatened species with critical habitat designated (western yellow-billed cuckoo) are dependent on low-elevation riparian habitat and are found exclusively in the South Fork Wildlife Area, in the South Fork Kern Valley near Lake Isabella. Riparian habitats are also especially important for a variety of invertebrates that forage and persist near aquatic features like streams. Bats often follow stream courses while foraging for insects, and some bats prefer to nest in riparian vegetation.

At-risk Terrestrial Wildlife Species

The following species accounts provide information for listing status, occurrence in each national forest, and threats for at-risk terrestrial wildlife species. Primary habitat associations are described in Table 73 through Table 75 above.

Federally Threatened, Endangered, Candidate, and Proposed Terrestrial Wildlife Species

Valley Elderberry Longhorn Beetle

Status: The valley elderberry longhorn beetle was listed as threatened in the Federal Register on August 8, 1980. Critical habitat was also designated at that time in Sacramento County, California. A final recovery plan was approved for the beetle on June 28, 1984 (USFWS 1984); the three national forests are not within recovery plan areas. The species is primarily found in the Central Valley and foothills and does not occur on the Inyo National Forest and has not been confirmed in the Sierra or Sequoia National Forests. Some unconfirmed exit holes were recorded but beetle exit holes can easily and frequently be misidentified.

Threats: At the time of listing, destruction of riparian habitat was identified as one of the most significant threats to the valley elderberry longhorn beetle.[27] Since that time, the following four specific threats were noted in the 2012 U.S. Fish and Wildlife Service analysis on the status of the species: (1) agricultural and urban development; (2) levees and flood protection; (3) road maintenance and dust; and (4) climate change. The first two threats are outside the authority of the Forest Service as these types of activities generally do not occur on National Forest System lands and are also managed or operated by other agencies or individuals.

Direct studies of the valley elderberry beetle near dirt and paved surfaces have shown that its distribution was not negatively affected by the proximity to dirt surfaces (Talley et al. 2006). Therefore, dust from low traffic dirt and paved access roads and trail did not directly or indirectly affect the species or the shrub host species. However, the species is threatened where road and trail maintenance and creation, including the construction of associated infrastructure, leads to the loss of habitat (Talley et al. 2006). The Sequoia and Sierra National Forests have a number of roads and trails that traverse the landscape; however, the species is currently not known to occur in the planning area. Elderberry longhorn beetle exit holes have been identified on the Sierra National Forest, but the beetle has not been confirmed as valley elderberry longhorn beetle.

In the long-term, the effects of changing climate conditions can have dramatic effects on species like the valley elderberry longhorn beetle because it is specialized on a specific host plant, making the beetle less able to adapt to losses in elderberry. Elderberry persists primarily in riparian areas which are at risk from continued warming temperatures and drought conditions. Warming temperatures could alter the timing of elderberry growth (and season length) and impact the quality of the plant as a host for the beetle (Holyoak and Graves 2010). Range shifts may occur, which could lead to hybridization with the California elderberry longhorn beetle (*Desmocerus californicus californicus*) (Holyoak and Graves 2010), which occurs at higher elevations and areas outside of the Central Valley (Linsley and Chemsak 1972). The species and host plant may also be directly affected by large high-intensity wildfire that can kill beetles and remove host plants.

[27] From the Federal Register at 45 FR 52805

In addition to the threats named by the U.S. Fish and Wildlife Service, habitat for the valley elderberry longhorn beetle may be threatened to the displacement of native vegetation by invasive plant species. In California, invasive black locust (*Robinia pseudoacacia*), giant reed (*Arundo donax*), and salt cedar (*Tamarix* spp.) have been shown to displace native riparian vegetation (Bossard et al. 2000).

The spread of Argentine ants may also threaten the valley elderberry longhorn beetle (Holyoak and Graves 2010) but is not considered a current known threat in the three national forests at this time. This aggressive ant species may prey on beetle eggs, although the exact mechanism of their interaction is unknown (Huxel 2000). The Argentine ant has been shown to be spreading an average of 52 feet per year along riparian woodland habitat and displacing native riparian invertebrates (Holway 1998). Projections from climate change modeling indicate suitable conditions will occur for Argentine ants to continue to spread in California during the next several decades (Roura-Pascual et al. 2004, Hartley et al. 2006, and Roura-Pascual et al. 2011).

Southwestern Willow Flycatcher

Status: The southwestern willow flycatcher, subspecies *extimus*,[28] was listed as endangered under the Endangered Species Act on February 27, 1995. A final recovery plan was completed on August 8, 2002 (USFWS 2002). A final ruling of critical habitat was designated January 3, 2013 including river corridors in the South Fork Kern Valley in the Sequoia National Forest. The riparian vegetation communities of the Kern River Valley, including the South Fork Wildlife Areas, are designated as critical habitat for this species.

Within the Sequoia National Forest and vicinity, the primary areas of suitable nesting habitat are located on the Kern River Preserve (owned and managed by the California Audubon Society) and the South Fork Wildlife Area managed by the Sequoia National Forest. Other areas of potentially suitable habitat have been identified on National Forest System lands around Lake Isabella including: west of Patterson Lane (including Hanning Flat), Tillie Creek, and the North Fork of the Kern River. Currently the Sequoia National Forest has approximately 1,050 acres of suitable habitat, all of which is potentially occupied. The California Department of Fish and Wildlife manages the Canebrake Ecological Area, which is also on the South Fork of the Kern River upstream from the national forest. In the past, restoration actions have created riparian forest, and invasive species removal projects have removed tamarisk species (also known as salt cedar) primarily in the Kern River Preserve.

Surveys for the flycatcher have been conducted in the Kern River Valley since 1989. The majority of the nesting records for this species have been found within the South Fork Wildlife Area and the adjacent (upstream) Kern River Preserve. Since 1989, the total number of flycatchers documented for this population has ranged between 27 and 44 pairs. Of this number, 5 to 12 pairs have been recorded breeding each year in the South Fork Kern Valley on the Sequoia National Forest (Whitfield 2014).

Threats: The principal cause of this species' decline is believed to be the alteration and destruction of riparian habitats (USFWS 2002, USFWS 2014b). Other factors contributing to the decline include nest parasitism by brown-headed cowbirds, grazing disturbances, loss of riparian habitat due to reservoir and hydroelectric development, fires in riparian habitats, and disturbances on wintering grounds outside of the United States (Serena 1982). Locally, tamarisk is spreading rapidly at Lake Isabella (USDA FS 2015b). If left untreated, tamarisk is likely to spread and

[28] The other subspecies (*brewsteri* and *adastus*) are managed as species of conservation concern.

possibly replace currently suitable native willow-cottonwood habitats used by the southwestern willow flycatcher and the western yellow-billed cuckoo (USDA FS 2015b).

Although grazing is a threat identified by the U.S. Fish and Wildlife Service, approximately 100 acres of Sequoia National Forest habitat for this species is outside the fenced and protected South Fork Wildlife Area. The 100-acre area within the Lake Isabella Grazing Allotment complies with formal biological opinions rendered by the U.S. Fish and Wildlife Service for the southwestern willow flycatcher, least Bell's vireo, and for proposed critical habitat for western yellow-billed cuckoo. Livestock grazing is not a major threat in this area for a variety of reasons including that the current timing and intensity of grazing minimizes impacts on mature riparian forest. In addition, this area lacks potential to be considered long-term suitable habitat due to frequent and long duration inundation episodes under routine operation of the Lake Isabella reservoir which is outside the authority of the Forest Service.

Least Bell's Vireo

Status: The least Bell's vireo was listed as endangered on May 2, 1986 and occurs only on the Sequoia National Forest. Critical habitat was designated on February 2, 1994 and but none is found within the Sequoia National Forest (USFWS 1994).

There are no recent systematic surveys for the species in the Kern River Valley prior to 1998, but sporadic reports of the subspecies were recorded from 1992 through 1996 (Laymon personal communication as cited in USACE 2004). Observations included seven documented sightings between 1995 and 1997 that included unmated, singing males. Surveys from 1998 to 2003 detected one singing male in the South Fork Wildlife Area (USACE 2004). Surveys of willow flycatchers from 2011-2014 by personnel experienced with least Bell's vireo recorded no detections of the species in the South Fork Wildlife Area (Whitfield 2014). However, two vireos were reported at different locations adjacent to the South Fork Wildlife Area in May 2014, one pair nested with three eggs but the clutch was lost following nest parasitism by a cowbird (Whitfield 2014).

Threats: Across the range of this species, primary threats include the loss or degradation of habitat and nest parasitism by brown-headed cowbirds (Franzreb 1989, USFWS 2006b, USFWS 2009b). Unmanaged livestock grazing and other agricultural practices can also degrade habitat in some areas (USFWS 2006b). Currently livestock grazing and agriculture development are not practiced in the South Fork Wildlife Area. Livestock grazing adjacent to this area is managed under a Forest Service allotment management plan and grazing permit, which incorporates appropriate measures to eliminate potential impacts to habitat (see threats for southwestern willow flycatcher above). Populations in Mexico, outside of the authority of the Forest Service, also are subject to ongoing habitat loss and uncontrolled cowbird parasitism (USFWS 2006b). The primary threats to occupied and potentially suitable habitat in the South Fork Wildlife Area of Sequoia National Forest that are within the authority of the Forest Service are high-severity wildfire, impacts from recreation, and loss of native riparian forest, including heterogeneity and structural diversity, due to the invasion of tamarisk and giant reed (*Arundo donax*).

Western Yellow-Billed Cuckoo

Status: The western distinct population segment of the yellow-billed cuckoo was listed as a threatened species on October 3, 2014. On August 15, 2014 the U.S. Fish and Wildlife Service proposed to designate critical habitat for the western yellow-billed cuckoo and public comment subsequently extended the evaluation period to January 12, 2015. Critical habitat has not yet been designated for this species but proposed critical habitat occurs on the Sequoia National Forest in

the upstream area of Lake Isabella, the South Fork Wildlife area, and in the adjacent grazing allotment.

Currently the 1,050 acres of suitable riparian habitat in the South Fork Wildlife Area is potentially occupied by this species during the breeding seasons. Surveys between 1985 and 2000 at the South Fork of the Kern River documented an annual average of 10.5 pairs (range 2-24) (USFWS 2011). Year to year population fluctuations may be influenced by water-level fluctuations at Lake Isabella, adverse conditions in the migratory routes or destinations outside of the Sequoia National Forest, or some other mechanism that has not yet been identified (Henneman 2010). In 2010, surveys for the species were conducted along the South Fork of the Kern River, yielding 71 detections, which potentially represented 20 individual birds, the maximum detected during any one survey period (USFWS 2011).

Threats: Much of the substantial historical decline in California has been directly attributed to breeding habitat loss from clearing and removal of huge areas of riparian forest for agriculture, urban development and flood control (Gaines 1974, Gaines and Laymon 1984, Laymon et al. 1987, Launer et al. 1990, Hughes 2015). The species also experiences impacts on their wintering grounds from loss of riparian habitat and exposure to the pesticide DDT and loss of habitat on the international winter range. Locally, in the Sequoia National Forest, habitat for the species is threatened by high-severity wildfire and potential conversion from native riparian forest to a monoculture of lower value from the spread of tamarisk and giant reed (USDA FS 2015b).

California Condor

Status: The California condor was listed as endangered on March 11, 1967 and critical habitat was designated on September 24, 1976. Critical habitat has not been designated on Sierra or Sequoia National Forests outside of 92 acres within the Giant Sequoia National Monument. Recovery plans were written and revised in 1975, 1979, 1984, and 1996 (USFWS 1996).

The expanding population of condors in southern California has recently resumed the use of a number of traditional roosting sites (USGS 2010). However, no nesting attempts have occurred on the Sequoia or Sierra National Forests since the condor reintroduction program began in 1992. Based on the population size and use patterns observed in 2010, a U.S. Fish and Wildlife Service condor biologist estimated that it would be at least 5 years before condors explore Sequoia National Forest with sufficient frequency to establish a reproductive territory (personal communication J. Brandt, USFWS 2010). Based on historic and contemporary condor travel patterns and continued observations at historically used roost sites on the Sequoia National Forest, the highest quality habitat for the condor within the analysis area is represented by the upper two-thirds of forested slopes on the west side of the Greenhorn and Breckenridge Mountains. Some fly-over activity has been recorded over the Sierra National Forest but there are no known modern-day records of foraging or nesting within the Sierra National Forest.

Threats: As part of its five-year review conducted in 2013, the U.S. Fish and Wildlife Service assessed the causes of California condor mortality since the condor reintroductions began in 1992 (USFWS 2013a). According to the most recent recovery plan 5-year assessment, the current primary threats to the population are: (1) loss or change in habitats from activities such as rangeland conversions, and powerline and wind energy development; (2) predation and disease; and (3) lead poisoning, shooting, micro-trash ingestion, organochlorines (especially for birds that feed on marine mammals), and climate change. Of these threats, lead ingestion by California condors and the subsequent behavioral and physiological effects of lead poisoning, including death, is the single most significant threat to the species. Since 2008 the California Department of

Fish and Wildlife has restricted the use of lead ammunition for hunting big game and coyotes in the condor range. The State of California is currently phasing in a ban on the use of lead ammunition for taking any wildlife statewide by July 2019 but lead use for target shooting could still continue.

Sierra Nevada Red Fox

Status: The Sierra Nevada distinct population segment of the Sierra Nevada red fox was designated a candidate for listing under the Endangered Species Act on October 8, 2015. Before 2010, two small populations of under 40 adults were known to exist around Mount Lassen Peak in the southern Cascades and Sonora Pass on the crest of the Sierra Nevada Mountains on the Humboldt-Toiyabe and Stanislaus National Forests. It has been confirmed through genetic analysis and photo documentation that the Sierra Nevada red foxes in the southern Cascades actually range widely, including north into Oregon as far as Mount Hood (USFWS 2015a). However, this more secure southern Cascades population is not believed to be connected to, or breed with the more southern Sierra Nevada red fox population (USFWS 2015a). Due to the threats faced by the Sierra Nevada population and small population size, the Sierra Nevada red fox distinct population segment was designated a candidate for listing under the Endangered Species Act. Known sightings of the species in the Sierra Nevada are limited to the Sonora Pass area and recent sightings in Yosemite National Park during the winter of 2013. This species is listed as threatened under the California Endangered Species Act.

Threats: The U.S. Fish and Wildlife Service evaluated a variety of potential stressors from the best available scientific and commercial information and determined that the most serious stressors impacting the Sierra Nevada distinct population segment at this time include small population size and isolation, hybridization with non-native red fox, climate change, and competition and predation from coyotes (USFWS 2015b).

Populations are small and isolated enough to make inbreeding a very real risk (USFWS 2015b). Although inbreeding may be an issue now (or in the future), the U.S. Fish and Wildlife Service lacks clear evidence to indicate that inbreeding depression has occurred (USFWS 2015b).

The U.S. Fish and Wildlife Service concluded that although hybridization with non-native red fox is not impacting the Sierra Nevada red fox at the subspecies level, it is likely to produce population-level impacts in the Sonora Pass area and therefore constitutes a stressor to the distinct population segment (USFWS 2015b). There is evidence that hybridization has already occurred in the population in the Sonora Pass area (Sacks et al. 2015).

Coyotes chase and kill red foxes and compete with them for prey (USFWS 2015b). It is hypothesized that red foxes remain at higher elevations than coyotes, particularly during the winter, to avoid interactions with coyotes. Sierra Nevada red foxes also restrict pup-rearing to these higher elevation areas. The trend in warming temperatures and reduced snowpack may allow coyotes to persist at higher elevations longer, possibly throughout the winters, increasing the potential for competition and aggressive interactions with the Sierra Nevada red fox (USFWS 2015b).

Climate change also has the potential to threaten the Sierra Nevada distinct population segment by causing increased wildfires, and loss of forested habitat from wildfires, drought stress, and pathogen and insect outbreaks (USFWS 2015b).

Sierra Nevada Bighorn Sheep

Status: The Sierra Nevada distinct population segment of the California bighorn sheep (now considered the "Sierra Nevada bighorn sheep") was listed as an endangered species on April 20, 1999 in an emergency listing. At the time, the population was thought to total no more than 125 animals distributed across five areas of the southern and central Sierra Nevada. On August 5, 2008 the U.S. Fish and Wildlife Service published the final rule on critical habitat designation for the Sierra Nevada bighorn sheep and made the taxonomic name change to *Ovis canadensis sierrae* (USFWS 2008). At least 90 percent of the critical habitat is within designated wilderness areas on the three national forests.

The most recent estimate shows the population climbing to over 500 animals and the range expanding (USFWS 2014a). The Inyo National Forest has the most individuals of the three national forests. On the Sierra National Forest, the species has two summer populations that migrate to and from winter ranges at lower elevations on the Inyo National Forest (T. Stephenson, California Department of Fish and Wildlife, personal communication, 2013). The Sequoia National Forest has a relatively small amount of designated critical habitat compared to the other two national forests. Although not currently occupied, this critical habitat could receive bighorn sheep migrants in the future.

Threats: The greatest threat to bighorn sheep is their susceptibility to pneumonia, usually caused by the bacteria *Mycoplasma ovipneumoniae*, which destroys lung tissues and often causes death (Besser et al 2008, Besser et al. 2014). Domestic sheep and goats carry this and other Pasteurella-related bacteria, and contact between domestic sheep and bighorn sheep under range conditions can lead to transferring these diseases (Clifford et al 2007). As a result of this threat, the Inyo National Forest has vacated, closed, or not authorized domestic sheep grazing within Sierra Nevada bighorn sheep habitat. In addition, the Inyo National Forest, working with the U.S. Fish and Wildlife Service, has implemented a risk assessment management plan that provides guidance for reducing the risk of disease transmission from other allotments. The Sierra and Sequoia National Forests do not currently issue permits for domestic sheep grazing. There are no permits for domestic goat grazing on any of the national forests.

Species of Conservation Concern

Nelson's Desert Bighorn Sheep

Status: Unlike the federally endangered Sierra Nevada bighorn sheep, the Nelson's desert bighorn sheep is not imperiled and is considered common and secure throughout its range. The focus in this planning effort is whether the local population of bighorn that occurs on the Inyo National Forest within the White Mountains can be maintained on the planning unit through Forest Service actions.

Threats: Domestic sheep and goats are host animals for a lung disease that is easily spread and are widely reported to have resulted in die-offs of entire bighorn sheep herds in the western United States (Besser et al 2008). The White Mountain bighorn population has had this respiratory disease since 2009 (CDFW 2015b). The disease is transmitted by domestic goats and or sheep through direct contact with bighorn sheep. Concerns about potential spread of disease from private livestock were specifically identified in the Chalfant and Hammil Valleys west of the White Mountains (CDFW 2015b). Some private land parcels are located immediately adjacent to the Inyo National Forest, but the majority are buffered by lands managed by the Bureau of Land Management. The Lone Pine and Silver Peak areas are east of Fish Lake Valley (to the east of the Inyo National Forest) and there are bighorn sheep located in those areas. These sheep have

exhibited disease issues and those sheep have been observed crossing Fish Lake Valley and entering the White Mountains on the Inyo National Forest. These adjacent mountains are managed by the Bureau of Land Management, where the Forest Service has no jurisdiction.

Yellow-eared Pocket Mouse

Status: The yellow-eared pocket mouse appears to have a highly restricted range and is found on the eastern slopes of the Piute Mountains and Sierra Nevada along the western fringe of the Mojave Desert (USDI BLM 1998). This subspecies has been captured in Kelso Valley, Horse Canyon, Sage Canyon, Freeman Canyon, Indian Wells Canyon, and Sand Canyon. Of the three national forests, the yellow-eared pocket mouse has only been detected on the Sequoia National Forest in the Kiava Wilderness. Similar habitat exists in adjacent canyons. Additional trapping is necessary to determine the current distribution of the species.

Little information is available regarding habitat requirements of the yellow-eared pocket mouse. The species has been found in Joshua tree woodland, desert scrub, pinyon-juniper, mixed and montane chaparral, sagebrush and bunchgrass habitats (Grinnell 1912, Williams et al. 1993). It occurs primarily in sandy soils with sparse to moderate shrub cover (Zeiner et al. 1990). Elevations of known localities range between 3,380 to 5,300 feet (Hall 1981, Zeiner et al. 1990)

Threats: No studies have shown a cause-and-effect relationship between yellow-eared pocket mice and management activities (USDI BLM 1998). Therefore, only potential threats are described for this species. Potential threats include cattle and sheep grazing due to the effects on plant assemblages or erosion of soils. Off-highway-vehicle activity and mineral extraction are other potential threats, due to their effects on native vegetation. Another potential threat to this species is collision with vehicles.

Pacific Fringe-tailed Bat

Status: The Pacific fringe-tailed bat is a subspecies of the fringe-tailed bat (*Myotis thysanodes*). The fringe-tailed bat appears to be in serious decline as historic maternity colonies have disappeared and those remaining are significantly reduced in size (Pierson 1998). The Western Bat Working Group considers the fringe-tailed bat to be imperiled or at high risk of imperilment in the majority of the national forests in California (Weller 2005). The fringed-tailed bat occurs throughout the Sierra Nevada Range; however, the species is patchily distributed showing irregular patterns of abundance (Bradley et al. 2005, CDFW 2005). The fringed-tailed bat is known to migrate, but little is known about the distance traveled or location of winter habitats (O'Farrell and Studier 1973). The California Natural Diversity Database has recorded occurrences of the fringe-tailed bat from the Sequoia and Sierra National Forests. The known range of this bat also includes much of the Inyo National Forest (Zeiner et al. 1990).

Threats: Bradley et al. (2005) state that the major threat identified for the fringed-tailed bat is loss or modification of roosting habitat. They listed closure or renewed activity at abandoned mines, recreational caving and mine exploration, loss of current and future large, decadent trees, and replacement of buildings and bridges with non-bat friendly structures as possible causes of roost loss or abandonment. Management activities that reduce the number of snags or potential creation of snags may reduce available roost sites. Disturbance at roost sites is considered a major threat to this species. If hibernating bats are disturbed, they awaken. Arousal from hibernation increases the possibility that the bat's stored fat will be insufficient to survive the winter (USDA FS 2005). Pesticides may affect fringed-tailed bats by reducing the quantity of prey or they can be consumed and accumulated in the fatty tissues of bats (McCracken 1986). Pesticides in fatty tissues are released during hibernation, migration, or periods of stress and may be passed to

nursing young. The emergence and spread of the pathogenic white-nose syndrome fungus (*Pseudogymnoascus destructans*) that infects hibernating bats and is prevalent along the eastern one-third of the U.S. has the potential to spread to California. Fringed-tailed bats may be at risk in the future from white-nose syndrome.

Townsend's big-eared bat

Status: Nearly 20 years ago, Pierson and Rainey (1998) found that the Townsend's big-eared bat had shown marked population declines over the past 40 to 60 years. Their results suggested a 39 percent loss in the number of maternity colonies, a 55 percent decline in the total number of individuals and a 32 percent decrease in the average size of remaining colonies. The most notable declines occurred in the central Sierra Nevada. This species is known to occur within the Inyo, Sequoia, and Sierra National Forests. This species is a candidate for threatened status under the California Endangered Species Act.

Threats: According to the Western Bat Working Group, this species now ranks as a high risk species due to habitat loss, habitat fragility, trend, and abundance (Piaggio 2005). High risk means that threats are well documented, are current and ongoing, and have a high probability of substantially impacting the species by reducing habitat over a widespread area. The Townsend's big-eared bat is highly susceptible to human disturbance and colonies are known to abandon roost sites after human visitation. The species is particularly vulnerable during the maternity season when females are aggregated and rearing defenseless young (Pierson and Rainey 1998). Pesticides may affect bats by reducing the quantity of prey or be consumed and accumulated in the fatty tissues of bats (McCracken 1986). Pesticides in fatty tissues are released during hibernation, migration, or periods of stress and may be passed to nursing young. The emergence and spread of the pathogenic white-nose syndrome fungus (*Pseudogymnoascus destructans*) that infects hibernating bats has the potential to spread to California. Townsend's big-eared bats may be at risk in the future from white-nose syndrome which is at time of press, has been verified as occurring in Washington State which is far west of previous eastern occurrences.

Pacific Fisher

Status: In October 2014, the U.S. Fish and Wildlife Service proposed listing the West Coast distinct population segment of fisher as threatened under the Endangered Species Act based on potential threats to its habitat from wildfire, some timber harvest practices, and indiscriminate and illegal use of pesticides to protect illicit marijuana plantations from rat infestations. These threats were subsequently found to be not as significant as previously thought. Although stressors exist at varying levels across the distinct population segment, they are not causing significant impacts or declines to the population. Therefore, on April 14, 2016 the U.S. Fish and Wildlife Service decided to not list the Pacific fisher distinct population segment as a federally protected species under the Endangered Species Act.

Although there has not been a definitive census, the current southern Sierra Nevada population of Pacific fisher almost certainly numbers less than 500 total individuals (Spencer et al. 2011) and probably less than 300 adult fishers and has been stable over the past decade based on occupancy estimates from the regional monitoring program (Zielinski et al. 2013). Regardless of the precise size, populations of a few hundred individuals, with only a small proportion of breeding-age females, are at an elevated risk of disappearing from the area as habitat decreases or is changed by unpredictable events such as wildfire.

Occupancy was estimated separately for three zones in the southern Sierra Nevada population: the northwestern (west slope of Sierra National Forest), the southwestern (west slope of Giant

Sequoia National Monument and Sequoia National Forest), and the southeastern (Kern Plateau). The overall probability of occupancy is estimated to be the lowest on the Kern Plateau and the highest in the southwestern zone (Zielinski et al. 2013). There was no detectable change in occupancy from 2002 to 2009 for the entire assessment area or for any individual zone (Zielinski et al. 2013). However, genetic patterns and survey data strongly suggest that the population expanded into areas north of the Kings River during the 1990s, before the regional monitoring program was established (Tucker et al. 2014).

Habitat modeling conducted for the "Southern Sierra Nevada Fisher Conservation Assessment" (Spencer et al. 2015) predicted habitat suitability is generally consistent with previous models and provides an excellent statistical fit to the fisher locality data. As with previous models and on-ground habitat assessments, the variables in this model indicated fishers are closely associated with forests at intermediate elevations with moderate climate conditions that support many large trees within stands having dense, green canopies. Because female fishers have the most stringent habitat requirements, the fisher conservation strategy area is based on female habitat requirements and breeding range size. The strategy area consists of 1,012 hexagonal cells that include all areas considered likely to contribute substantially to sustaining the fisher population over the next 15 to 30 years (Spencer et al. 2015). Each hexagon represents the size of an average female breeding home range (2,471 acres or 3.86 square miles). A hexagon within this grid is considered suitable if it is similar in composition and structure to actual measured female home ranges. An unsuitable hexagon could become suitable in the future. The Sequoia and Sierra National Forests overlap with about four percent and 20 percent of all suitable fisher hexagons, respectively. Within the Sequoia National Forest, approximately 90 percent of suitable fisher hexagons are found in the montane zone and about 9 percent are found in the upper montane zone. In the Sierra National Forest, 23 percent of suitable fisher hexagons are located in the westside foothill vegetation, 73 percent in the montane zone, and 3 percent in the upper montane zone (Spencer et al. 2015).

Threats: The greatest threat to Pacific fisher habitat and populations are large-scale, high-severity fire outside the natural range of variation. Large and severe wildfires that kill the majority of standing trees can negatively affect fisher habitat by removing canopy cover and essential habitat elements (Scheller et al. 2011, Thompson et al. 2011) and these effects may persist for many decades until canopy cover and large trees regrow sufficiently (Collins and Roller 2013). In light of the low population numbers and narrowly distributed habitat, wildfires that burn with high severity over large areas pose a significant risk to the population by reducing and fragmenting habitat.

There is a lack of scientific information on fisher use of burned areas; however, the evidence from habitat selection and long-term demographics studies suggests that fishers cannot meet all life requisites (establish home ranges or find sufficient resting and denning habitats) within large areas burned by high-severity fires (Spencer et al. 2015). Fire size and fire severity have been trending upward in low and mid-elevation forests on National Forest System lands over the last 20 to 30 years, and these trends have been linked to increasing forest fuels from historical forest management actions, fire suppression, and climate change (Miller et al. 2009, Miller and Safford 2012, Safford et al. 2012a, Mallek et al. 2013). Recent fires in the Sierra Nevada have included some very large patches of stand-replacing fire, extending for thousands or even tens-of-thousands of acres. This is in direct contrast to the expected size of stand-replacing patches from forests in reference landscapes of the Sierra Nevada (areas where the fire regime is minimally influenced by humans), where mean stand-replacing patch size is less than 10 acres and maximum patch size generally is 250 acres or smaller (Collins and Stephens 2010, Miller et al. 2012, Safford 2013).

Other major threats to Pacific fisher include timber harvest and habitat fragmentation that remove important denning or resting habitat elements or leave the treated landscape in a way where the habitat cannot meet the life history requirements of the species (Zielinski 2014). Activities that remove large-diameter trees, snags, or logs can severely limit the habitat condition for fisher by removing trees used for resting and denning. Down logs provide habitat for prey and cover when traveling on the ground. Activities that also create large openings in the canopy in otherwise dense canopied forests can also increase fragmentation and reduce the ability of the landscape to support fisher. Pacific fishers can be negatively affected by prescribed burning that unintentionally burns large-diameter trees that can serve as potential denning sites. Late-season prescribed burning has potential to directly threaten fisher denning success (Zielinski 2014). Prescribed burning on the Sequoia and Sierra National Forests are planned and conducted to consider fisher habitat needs to reduce impacts to large down logs, snags, and potential denning trees.

Pacific fishers are anticipated to be highly sensitive to changing climate conditions, particularly in the southern Sierra Nevada where there are projected changes in forest composition from mixed-hardwood forests to grasslands and shrublands, increases in fire frequency and intensity, and losses of large conifer and hardwood trees as fire severity increase (Lawler et al. 2012).

Pacific fishers are also negatively impacted by road-related deaths as well as poisoning from rodenticides used in illegal marijuana cultivation (Spencer et al. 2016).

Sierra Marten

Status: In addition to harvest of old forest, martens were trapped for fur until 1954 and it is thought that these actions contributed to declining numbers of Sierra marten (Zielinski 2014). In the southern and central Sierra Nevada the marten is considered well distributed but not in the northern Sierra Nevada (Kucera et al. 1995, Zielinski et al. 2005). Sierra martens are ranked by NatureServe as a G4G5 (apparently secure/secure) but S3 (vulnerable) in California. Sierra martens are listed as a species of special concern by California Department of Fish and Wildlife and were designated a species of greatest conservation need in the 2015 California State Wildlife Action Plan (CDFW 2015a). Marten occur in forested areas that receive considerable snowfall (Zielinski 2014). The upper montane forests serve as this subspecies primary habitat, which is considered within the range of natural variation (Meyer 2013a) on these forests.

Threats: Key risk factors to Sierra marten are climate and climate-driven changes including decreased snowpack and altered fire regimes. The capacity of the marten to adapt to climate change is limited by its reliance on deep snow for access to prey in winter through subnivean (under snow) foraging and caching of food (Hauptfeld and Kershner 2014). The other key risk factor is fragmentation (primarily due to roads) and, at lower montane or foothills elevations, past timber harvest. In the future, the forested habitat the marten relies upon may be further fragmented by changes in macro and micro forest conditions or reduced by increasing wildfires associated with climate warming (Zielinski 2014 and Hauptfeld and Kershner 2014). A vulnerability assessment by Hauptfeld and Kershner (2014) ranked overall vulnerability of the marten as moderate/high, due to its moderate/high sensitivity to climate and non-climate stressors, moderate adaptive capacity, and moderate/high exposure. Pacific martens are also listed as “climate vulnerable” in the 2015 California State Wildlife Action Plan (CDFW 2015a).

The southern extreme of the range for martens is within the three national forests planning area and generally populations at the edges of their range are more at risk than those in the center. Martens are extremely sensitive to the loss and fragmentation of mature forest habitat (Zielinski

2014). Lawler et al. (2012) predicted that the range of marten in California will contract to the north and become less common and more fragmented. High-intensity fires have been increasing in upper montane red fir forests and this trend is expected to increase with climate change (Schwartz et al. 2015). Changes could include a loss of red fir (Lenihan et al. 2003) and lodgepole pine habitat (replacement by white fir or loss by high-intensity wildfire) and increased competition from other carnivores (like Pacific fisher) no longer constrained by snow levels. Also, because of the marten's aversion to crossing large openings, large fires may fragment marten habitat and isolate populations leading to localized extinction. The increase in large trees killed by bark beetles will create new snags at the expense of living trees used for resting and denning. Finally, increased drying conditions would lead to further deterioration of montane meadows. Drier meadows would likely reduce the prey populations on which martens depend.

Willow Flycatcher

Status: The willow flycatcher is a polytypic species, with three subspecies breeding in California: *E. t. brewsteri* in isolated patches in northern California and along the western slope of the Sierra Nevada; *E. t. adastus* along the eastern slope of the Sierra Nevada; and *E. t. extimus* (southwestern willow flycatcher) breeding in riparian areas of southern California, including near Lake Isabella (Grinnell and Miller 1944, Unitt 1987, Browning 1993). *E. t. extimus* is a federally endangered species and was described in the federally listed species section above. The boundary between *E. t. brewsteri* and *E. t. adastus* in the Sierra Nevada and elsewhere is unclear (Sedgwick 2001), these subspecies are discussed collectively below. The willow flycatcher (*E. traillii*) is listed as endangered under the California Endangered Species Act; both subspecies *E. t. brewsteri* and *E. t. extimus* are listed as endangered.

The 2004 Sierra Nevada Forest Plan Amendment listed sites on National Forest System land that are within the current planning area: eight sites on the Inyo National Forest, eight on the Sierra National Forest, and one on the Sequoia National Forest (outside of Giant Sequoia National Monument). These sites were considered occupied, historically occupied or conditionally occupied based on records of detection.

The willow flycatchers documented on the Inyo National Forest in the lower Rush Creek area occur in atypical habitat. Lower Rush Creek is at roughly 6,500 feet above sea level and lies within a matrix of Great Basin big sagebrush scrub. After decades of heavy diversion, it has been under passive restoration for 22 years. Livestock grazing, once heavy on lower Rush Creek, has been excluded from the riparian corridor for over 10 years by the Inyo National Forest and the Los Angeles Department of Water and Power. Although lower Rush Creek (often referred to as the "Rush Creek Bottomlands") has one of the widest riparian corridors in the Eastern Sierra, the corridor's riparian vegetation can be patchy, with significant amounts of sagebrush scrub mixed within patches of riparian obligates that are supported by current and historic side channels (McGreedy 2005).

The status of these subspecies on the Sequoia National Forest is not well understood because the federally listed southwestern willow flycatcher and nonlisted willow flycatcher subspecies are extremely difficult to differentiate in the field. Willow flycatchers have been detected outside of the South Fork Wildlife Area and are presumed to be *E. t. brewsteri* but identity hasn't been confirmed.

Once common throughout the western United States, the willow flycatcher is gone from much of its range. Information from the Sierra Nevada indicates a substantial decline of subspecies *E. t. brewsteri* and *adastus* during the past 40 years, resulting in the absence or near-absence from

multiple areas that were historically inhabited (Gaines 1992, DeSante and George 1994, Craig and Williams 1998, Bombay et al. 2003, Green et al. 2003, Siegel et al. 2008).

Threats: Throughout the Sierra Nevada, loss and degradation of riparian and meadow habitats due to human influences (Siegel and DeSante 1999; Green et al. 2003) is a contributing factor to population declines of breeding willow flycatchers. Degradation could include, but is not limited to: (1) changes in hydrological patterns leading to meadow drying, (2) destruction of shrub vegetation resulting in loss of nesting sites and cover for predator avoidance, (3) increased predator access to meadow interior, (4) loss of foraging substrate and decreased insect abundance, and (5) potentially increased contact with brown-headed cowbirds (Green et al. 2003). It has been determined that none of the willow flycatcher sites on the three national forests occurs on an active livestock allotment. However, recent population declines of *E. t. brewsteri* observed in relatively pristine and seemingly unaffected habitats in Yosemite National Park suggest other reasons for these declines, including effects on the wintering grounds or migration routes, and climate change (Siegel et al. 2008). These factors, as they affect this species in the three national forests, are outside of the authority of the Forest Service to address.

Kern Red-winged Blackbird

Status: The Kern red-winged blackbird inhabits east central Kern County, in Walker Basin and on the South Fork of the Kern River on the Sequoia National Forest (Mailliard 1915a, 1915b). Important nesting areas are protected on the Kern River Preserve managed by the National Audubon Society, Canebrake Ecological Reserve managed by California Department of Fish and Wildlife, and the South Fork Wildlife Area managed by the Sequoia National Forest. This blackbird is a species of special concern for the California Department of Fish and Wildlife.

The breeding population in the South Fork Kern River Valley was estimated to number as many as 500 individuals, and a survey in the Walker Basin in 2001 found approximately 50 red-winged blackbirds believed to be this subspecies (Gallion 2008). It is unknown if the subspecies continues to persist in the Walker Basin.

Threats: Tamarisk and other invasive plants moving into wetlands along the South Fork Kern River may threaten the foraging and nesting habitat of the Kern red-winged blackbird (Gallion 2008). Any loss of wetland habitat through climate change or human water uses would likely adversely affect this subspecies.

Tricolored Blackbird

Status: The geographic range of this species is restricted to California's Central Valley and surrounding foothills, a few coastal areas, and other scattered sites (Meese et al. 2014). Statewide, the population of tricolored blackbirds declined 35 percent, from approximately 395,000 to 258,000 birds between 2008 and 2011 (Kyle and Kelsey 2011). From 2011 to 2014 the number of tricolored blackbirds dropped another 44 percent, from 258,000 to 145,000 birds (Meese et al. 2014). The blackbird's historic breeding range in California included the San Joaquin Valley and the foothills of the Sierra Nevada south to Kern County, and up to 3,400 feet in Walker Basin (Grinnell and Miller 1944). Within the Sequoia National Forest, breeding colonies have been recorded only in marshes around Lake Isabella and the Kern River. The tricolored blackbird was made a candidate species under California Endangered Species Act, effective January 08, 2016 with many of the concerns focused on grain fields and nesting colonies in areas of agricultural production.

Threats: The greatest effects to this species are related to habitat loss and alteration with virtually all suitable habitats being converted by agriculture and urbanization (Meese et al. 2014). In the limited habitat for this species on the Sequoia National Forest, loss of tules or cattails to invasive species like tamarisk is a major threat. Changes in water levels at Lake Isabella may also be a threat, but regulating those levels is outside the authority of the Forest Service.

Greater Sage-grouse Bi-state Distinct Population Segment

Status: The sage-grouse has experienced significant range and population reductions in many areas of eastern California and western Nevada where the species is a permanent resident. It is designated as a (third priority) California species of special concern in its nesting and breeding (lek) grounds. The U.S. Fish and Wildlife Service recognizes this species as a distinct population segment under the Endangered Species Act and proposed the bi-state distinct population segment of greater sage-grouse as threatened under the Endangered Species Act in 2013 (USFWS 2013b). Through collaborative efforts, a bi-state action plan was developed and funding commitments were made which led the U.S. Fish and Wildlife Service to make a final decision in 2015 that listing the species under the Endangered Species Act was not warranted (USFWS 2015c).

The bi-state population of greater sage-grouse occurs in portions of Carson City, Lyon, Mineral, Esmeralda, and Douglas Counties in Nevada, and of Alpine, Inyo, and Mono Counties in California and is only found on the Inyo National Forest. The State wildlife agencies in Nevada and California have jointly identified five bi-state area population management units (PMUs): Pine Nut, Desert Creek-Fales, Mount Grant-Bodie, South Mono and White Mountains. The most recent population study showed that sage-grouse populations within the bi-state area were stable from 2003 to 2012 (Coates et al. 2014). One exception was the Parker Meadow population in the South Mono Population Management Unit; the study showed that this subpopulation is at risk of extinction (Coates et al 2014). However, this subpopulation has relatively low influence on the overall population trend averaged across the entire bi-state area (Coates et al 2014).

Threats: Key risk factors to sage-grouse include pinyon-juniper expansion and ingrowth of conifers into sagebrush habitats, the spread of invasive species and noxious weeds, predation by ravens, and human development. On the Inyo National Forest, pinyon pine has grown into lower elevation sagebrush ecosystems at a high rate due to many factors such as wildfire suppression, historic livestock grazing, and changing climate (Slaton and Stone 2013a, 2013b). Jeffery pine has also grown into sagebrush ecosystems and threatens the condition of sage-grouse habitat.

In addition to conifer ingrowth, cheatgrass is invading sagebrush ecosystems and adversely affecting habitat condition. Cheatgrass becomes established after wildfire or other disturbance and changes the structure and composition of sagebrush habitat. Consequently, cheatgrass also makes habitat more flammable and susceptible to subsequent wildfires (Brooks and Minnich 2006).

Past land management practices and weather patterns may be correlated with a decrease in understory and shrub cover in sage-grouse habitats that has been linked with increased nest predation by ravens (Coates and Delehanty 2010). Although it has not been measured, the extent of human development impacting sage-grouse habitat has been limited and most impacts have probably occurred on private land development in the Chiatovich Creek area east of the White Mountains in Nevada. In addition to reducing and degrading habitat condition, developments can impact sage-grouse use and movement in habitats, especially winter range use where new roads and housing development fragment habitat.

Bald Eagle

Status: In 2007, the U.S. Fish and Wildlife Service delisted the threatened bald eagle in the contiguous 48 states due to population recovery. This species is still protected under the Bald and Golden Eagle Protection Act of 1940. The U.S. Fish and Wildlife Service continues to monitor the status of the bald eagle at 5-year intervals (USFWS 2009a) and the data indicate highly significant increases in California during the period from 1966 to 2007 (14 percent per year) and 1980 to 2007 (12 percent per year) (Sauer et al. 2008). The bald eagle population in the southern Sierras is believed to be stable or slightly increasing. This species is still listed as endangered under the California Endangered Species Act.

Bald eagles can be found as a migrant or wintering bird throughout the Sierras, especially near reservoirs, lakes and large rivers. Nesting has been documented at reservoirs on the Sierra National Forest (Southern California Edison Company 2011). Nesting has also been documented on the Inyo National Forest.

Threats: Disturbance from recreational activities such as boating, jet-skiing, fishing, and low flying aircraft can cause disturbances to nesting birds, but this species also shows some tolerance for the presence of humans (Buehler 2000). Timber harvest that removes potential nest or roost trees pose a risk. Climate change could reduce reservoir levels and prey availability. Collisions with objects, including wind turbines, have also been documented as a threat to bald eagles (Pagel et al. 2013). Use of illegal pesticide, such as DDT in marijuana grow sites continues to threaten egg shell development of bald eagles.

American Peregrine Falcon

Status: The American peregrine falcon is a resident breeding and wintering subspecies in the southern Sierra Nevada (White et al. 2002). Breeding Bird Survey data indicate significantly increasing population sizes of peregrine falcons in California during 1966 to 2007 at 12.8 percent per year, and between 1999 and 2007 it increased at 20.4 percent per year (Sauer et al. 2008). Peregrine falcons are uncommon on California national forests, including in the three national forests. This species was de-listed under both the Endangered Species Act and the California Endangered Species Act in 1999.

In the three national forests, peregrine falcons use many areas for hunting and numerous cliffs are suspected or known nesting sites. There are confirmed nests and unverified accounts of the species on the Sequoia and Sierra National Forests. There are unverified accounts of this species on the Inyo National Forest.

Threats: Disturbance of nests from rock-climbing activities has been documented (White et al. 2002). Other potential threats include recreation activities, over collecting of chicks by falconers and collisions with man-made structures, such as wind turbines. Use of illegal pesticides such as DDT in marijuana grow sites continues to threaten egg shell development of peregrine falcon.

Great Gray Owl

Status: Great gray owls are listed as endangered by the State of California. In the central Sierra Nevada this species is primarily found within Yosemite National Park and the adjacent Sierra and Sequoia National Forests, but breeding has been documented as far north as Plumas County and south to Tulare County (Hull et al. 2014, Wu et al. 2015). There is a gap in nest records from Calaveras and Amador Counties and between El Dorado and Plumas Counties (Wu et al. 2015). About 100 to 200 individuals have been estimated in California since 1980 (Hull et al. 2010a), and only 80 were estimated in 2006 (Maurer 2006). Yosemite National Park estimates that it has

65 percent of the nesting owls in California in what is described as the Sierra Nevada population. Recent surveys and genetic sampling of the Sierra Nevada great gray owl population indicate that it is s geographically-isolated population of a few hundred individuals in the central Sierra Nevada (Hull et al. 2014).

There are currently 11 great gray owl protected activity centers on the Sierra National Forest and one on the Giant Sequoia National Monument. There are records of detections at additional locations in the Sequoia National Forest but not with confirmed nesting. A landscape habitat suitability model used in Yosemite National Park highlights that high suitability great gray owl areas are rare within the park with only 0.8 percent of the landscape rated in the highest 20 percent suitability class (Keane 2011). However, a recent comparison of 47 great gray owl nest sites with paired reference sites throughout the Sierra Nevada indicates that this species may persist and nest in lower elevations than previously thought, with 21 percent of nests below 3,281 feet, which corresponds to the lower conifer zone/foothill zone (Wu et al. 2015). Additionally, this once perceived conifer forest specialist had 30 percent of all total nests surveyed in large oak trees (Wu et al. 2015). This species is not a species of conservation concern for the Inyo National Forest because there have been only incidental observation of great gray owls there with no known or suspected breeding.

Threats: Degradation or loss of mid-elevation coniferous habitats and meadows and meadow complexes at least 26 acres in size are thought to have degraded great gray owl habitat as a result of forestry practices, fire suppression, and rural development (Bull and Duncan 1993, Siegel and DeSante 1999, Kotliar et al. 2002, Maurer 2006, Bunn et al. 2007, Steel et al. 2011). Roads, trails, and other manmade structures that have modified the hydrologic flows within the meadows are another threat. Even-aged stands from past forestry activities, causing a loss of heterogeneity in stand structure, created two threats: loss of nesting structure that is hidden from predators and open edge areas where predators can easily attack. The most common predator is the great horned owl.

The diet of great gray owls is thought to be highly specialized on voles and pocket gophers, both meadow-associated species. In a two-year study of cattle grazed meadows on the Stanislaus National Forest and ungrazed meadows in Yosemite National Park, a weak negative correlation between grazing and vole abundance was found (Kalinowski et al. 2014). However, the weak correlation may have been influenced by various confounding variables, including the fact that some grazed meadows were surveyed before grazing for the season even began. Winter (1996) documented the threat of overgrazing, reducing cover and food sources for voles and pocket gophers. The concern lies in unmanaged grazing where plant cover is greatly reduced.

Human presence during recreational activities has been found to have an adverse effect on this species (van Riper III et al. 2013). Collisions with vehicles on roads around occupied meadows are substantial threats, in part because the population is so small (Bull and Duncan 1993, Maurer 2006, Bunn et al. 2007, Steel et al. 2011). West Nile virus infection has also been listed as a cause for concern in the owl population (Hull et al. 2010b).

California Spotted Owl

Status: California spotted owl nesting and roosting locations are strongly associated with mature coniferous forests with tree canopy cover greater than 70 percent, multilayered canopies, and an abundance of large trees and snags (Forsman et al. 1984, Bias and Guitierrez 1992, Call et al. 1992, Verner et al. 1992, Bond et al. 2004, Chatfield 2005). Territory occupancy is positively related to the amounts of mature forest at core area scales, with higher colonization rates and

lower extinction rates associated with territories having more mature forest (Blakesley et al. 2005, Dugger et al. 2011, Seamans and Gutiérrez 2007). California spotted owls nest in cavities, on tops of broken trees, and on platforms located in older, large-diameter live conifers, oaks, and snags. Conifer nest trees average about 45 inches diameter at breast height in the Sierra Nevada (Verner et al. 1992). California spotted owl foraging habitat consists of a broader range of vegetation types that may include younger, more open habitat (Williams et al. 2011, Roberts and North 2012, Keane 2014). These foraging patterns may be driven by the abundance and availability of important prey species. It has been suggested that some level of landscape (forest) heterogeneity may be an important consideration for California spotted owl management and can improve conservation (Williams et al. 2011, Roberts and North 2012). A synthesis of recent research indicates that higher California spotted owl survival and reproduction are associated with areas that have a mix of different vegetation types and edge between mature forest and other vegetation types (Keane 2014).

There are 238 protected activity centers on the Sierra National Forest and 71 protected activity centers on the Sequoia National Forest, excluding the Giant Sequoia National Monument. There are no California spotted owls on the Inyo National Forest. On the Sierra National Forest, approximately 50 percent of the overall protected activity centers acreage is in the mixed conifer vegetation type. On the Sequoia National Forest, approximately 32 percent of the protected activity center acreage is in the mixed conifer vegetation type and 23 percent is in montane hardwood and montane hardwood conifer vegetation types.

For all protected activity centers combined, 233 contain both dry and moist mixed conifer vegetation type, and 4 contain only dry mixed conifer. Dry mixed conifer comprises 21 percent of all vegetation types within all protected activity centers on the Sequoia and Sierra National Forests combined, and 45 protected activity centers contain more than 50 percent of the protected activity center in the dry mixed conifer vegetation type. Moist mixed conifer vegetation comprises 24 percent of all vegetation types within protected activity centers on the Sequoia and Sierra National Forests combined and 49 protected activity centers contain more than 50 percent moist mixed conifer.

California spotted owls are currently distributed relatively continuously and uniformly throughout their range in the Sierra Nevada (Verner et al. 1992, Noon and McKelvey 1996), although concern exists for fragmentation effects at finer scales due to habitat changes (Gutiérrez and Harrison 1996). The majority of owls occur within the mid-elevation, mixed-conifer forests on the west slope of the Sierra Nevada. Some owls also occur at lower elevations in the oak woodlands of the western foothills in the southern Sierra Nevada, at higher elevations in red-fir forests, and in conifer forests on the eastern slope of the mountains (Verner et al. 1992). Gradual, but steady population declines of California spotted owl over the past 20 years have been observed across the entire Sierra Nevada (Keane 2014). Conner et al. (2013) used a Bayesian approach for estimating the probability of different levels of population decline using realized population change and reported a 78 percent probability that a decline was occurring on the Sierra National Forest and an 8 percent probability of a stable or increasing population in the Sequoia and Kings Canyon National Parks. The factors driving these population trends are not known, and likely involve a complex interaction of multiple current and past factors.

Threats: Large, high-severity fires, which are occurring more frequently in the Sierra Nevada, are a major threat to the California spotted owl (USFWS 2006a). Large-scale stand replacing fires can be detrimental to California spotted owls, at least in the short term, because severely burned areas do not contain habitat features important to California spotted owls (Anthony and Clark

2008). High-severity fires that kill most or all of the living trees effectively reduce the availability of preferred nesting and roosting habitat, including dense canopy cover, multilayered canopies, and an abundance of large trees that can take centuries to regrow. In southwest Oregon, Clark (2007) and Clark et al. (2011) found that annual survival rates were lower in northern spotted owls inhabiting burned areas or displaced by the wildfire as compared to owls that inhabited areas outside the burn perimeter.

The rate of loss of protected activity centers from wildfire in the Sierra Nevada is alarming. From 2003 to 2008, a Geographic Information System (GIS) exercise by the Forest Service found that 33 protected activity centers had more than 75 percent of their area burned at either high or moderate severity, and rendered unusable by California spotted owl, due to eight major wildfires on National Forest System lands (see Table 1 and footnotes in Yasuda 2008). For example, in 2007, the Moonlight fire on the Plumas National Forest burned approximately 46,000 acres on National Forest System lands (31,682 acres at high and moderate-high severity) (Rotta 2011). This fire resulted in the long-term loss of 17 California spotted owl protected activity centers as well as the removal of 96 percent of the suitable nesting habitat and 86 percent of the suitable foraging habitat within the landscape (Rotta 2011). From just two wildfires (King and Rim) in two years (2013 and 2014), 20 protected activity centers were burned at high severity in the central Sierra Nevada; 14 were lost completely from the landscape and six were able to be re-mapped in nearby green forest. Re-mapped protected activity centers are based entirely upon available habitat and may or not may not be inhabited by owls.

California spotted owls seem to be able to persist in landscapes that experience low- to moderate-severity fire, as well as some level of mixed-severity wildfire (Keane 2014). All of these fire severities are beneficial for prey species. Low to moderate severity fires, which were historically common within Sierra Nevada montane forests, maintained important habitat characteristics for California spotted owl site occupancy (Roberts et al 2011). A high level of uncertainty remains regarding patch sizes of high-severity fire that affect California spotted owl survival and reproduction (Keane 2014). Clark (2007) observed that although 23 northern spotted owls used all types of fire severity, within burned areas owls strongly selected low severity or unburned areas with minimal overstory canopy mortality. In this burned landscape, owl high-use areas were characterized by lower fire severity and greater structural diversity. Bond et al. (2009) reported that foraging may occur preferentially in high severity burned areas; the study followed seven owls in 4-year-old burned areas on the McNally Fire on the Sequoia National Forest and found higher than expected owl foraging in high severity burned areas. The study is limited by small sample size (7 owls), short duration (12 weeks), nonrandom selection of owls, and delay (4 years) following a wildfire. Bond et al. (2002) hypothesized that wildfires may have few short-term impacts on spotted owls; the authors reported that northern, California, and Mexican spotted owl survival, site fidelity, mate fidelity, and reproductive success at 11 territories one year after fires seemed uninfluenced by the fires. Four of the territories were mapped as having experienced low- to moderate-severity fire and four experienced high-severity fire that burned more than 30 percent of the territories.

California spotted owls studied in Yosemite National Park were estimated to have similar detection, density, and occupancy rates between randomly selected unburned sites and recently burned (less than 15 years since burn) sites that had predominantly burned at low- to moderate-severity (Roberts et al. 2011). Jenness et al. (2004) found no statistical relationship between fire with mixed-severity effects and Mexican spotted owl occupancy and reproduction in Arizona and New Mexico, but the authors caution that higher occupancy and reproduction in unburned sites may not have been detected as statistically significant because of small sample size, lack of

information on temporal and spatial variability in owl occupancy rates, and high variability in burn extent and severity. In a comparison of California spotted owl occupancy dynamics in burned versus unburned sites in the Sierra Nevada, Lee et al. (2012) found that the probability (model mean-averaged) of colonization and local extinction did not differ substantially between burned and unburned sites and the authors concluded that fire has no significant effect on occupancy dynamics. The authors also found that California spotted owls continued to occupy sites (a distinct area in which a single or territorial owl or pair had been detected) where almost one third (32 percent) of suitable habitat had been burned at high severity. They hypothesize that there may be a critical spatial threshold (proportion of a site) above which a burn at high severity could adversely affect California spotted owl occupancy. Collectively, a large number of studies of fire effects on California spotted owls suggest the presence of large trees and dense overstory canopy closure are the most important pre- and post-fire conditions associated with California spotted owl occupancy (Roberts and North 2012). However, it is clear that additional information is needed to better understand the effects of fire on California spotted owls.

Years of fire suppression have led to dense forested conditions with heavy fuel loading; these conditions can not only contribute to an increased risk of high-severity wildfire and increased risk of trees dying from insect outbreaks, stress from competition with other trees, disease and pathogens, but such conditions also threaten the quality of foraging and nesting habitat due to structural changes in the stands (Roberts and North 2012). For example, extremely dense stand conditions characteristic of fire suppressed forests are not typically used for California spotted owl foraging (Verner et al. 1992, Irwin et al. 2007). Occupancy of nesting California spotted owls in fire suppressed forests may also be negatively influenced by an increasing proportion of smaller trees (less than 23 inches in diameter) around the nest (Blakesley et al. 2005).

In their 12-month finding to not list the California spotted owl under the Endangered Species Act, the U.S. Fish and Wildlife Service (USFWS 2006a) recognized:

> . . . the primary technique of fuel reduction, which is thinning understory trees with mechanical equipment and/or prescribed fire, may have detrimental effects on California spotted owl habitat in the short term, but may favor development of habitat in the longer term, and may reduce the likelihood of large high-intensity fire that could substantially degrade or eliminate habitat.

There continues to be a great deal of uncertainty about the nature of effects of fuel reduction treatments, particularly mechanical thinning, on California spotted owls (Keane 2014). This uncertainty creates very real challenges to design an approach to management that strives to improve resilience of owl habitat on the landscape while also maintaining sustainable owl populations in the short term (in other words, reducing the potential for severe short-term impacts that could affect species persistence). This challenge revolves around the dilemma of retaining sufficient areas of dense canopy cover and large trees for the species while also reducing density of increasingly homogenized stands to improve forest health and resilience. The collection of studies and monitoring efforts (summarized below) trying to identify the effects of (or correlations of) forest management on California spotted owls suggest varying levels of sensitivities, which is probably due to the differences among treatments studied, the retention versus loss of key habitat features, and other local factors (like predation, prey availability, weather, disease, and barred owls).

For example, the results of simulation modeling research summarized in Keane (2014) suggests that some fuels treatments can reduce fire risk with minimal effects on owl reproduction, and may have long-term benefits of reducing wildfire risk that outweigh short-term effects of treatments. The results of an opportunistic monitoring effort of fuel reduction treatments (mechanical

thinning of understory trees and/or prescribed fire) on protected activity center occupancy and owl reproduction in the Stanislaus National Forest indicates that owls continued to occupy the treated areas and produce young (Rich 2007). Tempel et al. (2014) also found that California spotted owl population growth and survival were positively associated with amount of edge habitat (potentially because of prey abundance) created from patches of higher intensity treatments that create small gaps. However, Tempel et al. (2014) found a negative association of medium-intensity timber harvest with California spotted owl reproduction (reducing reproductive potential). Based on their study, the authors suggest that where such treatments are implemented in forests with dense canopy cover, these may function to also reduce survival and territory occupancy.

Given the preponderance of dead trees in large areas of the Sierra Nevada due to recent large-scale events (wildfire, insect outbreaks, and drought stress), it becomes increasingly important to evaluate how the salvage of some dead trees in such areas influences wildlife species, including California spotted owls and their prey. Some studies have shown that northern spotted owls have avoided habitat treated during post-fire salvage logging (Clark 2007, Clark et al. 2011). In general, there is a need for more information on the effects of fire and non-fire-related salvage treatments on California spotted owl habitat condition.

California spotted owls face a number of stressors unrelated to fire and forest management activities including the invasion of barred owls (*Strix varia*), climate change, and diseases like west Nile virus. Barred owls are an increasing risk factor for California spotted owls in the Sierra Nevada (Keane 2014). Barred owls can hybridize and also out-compete California spotted owls. Although the majority of barred owl detections are confirmed in the northern Sierra Nevada, the species is a threat to California spotted owls in the southern Sierra Nevada also; five new records of barred owls were documented in the Stanislaus and Sierra National Forests in 2012, indicating further range expansion of barred owls in the southern Sierra Nevada (Keane 2014). Barred owl numbers are likely higher than documented in the Sierra Nevada, as there have been no systematic surveys for them to date. Across their range, California spotted owls exhibit population-specific demographic relationships with local weather and regional climates (Glenn et al. 2010, Glenn et al. 2011, and Peery et al. 2012). Based solely on projections of climate change (not incorporating other factors such as habitat), this population-specific variation could result in high species vulnerability (Keane 2014).

Terrestrial Salamanders

Status: The rare salamanders share many common attributes with rare plants in that many are narrowly endemic. All of the species require moisture to survive and because of this, at lower, drier elevations they are increasingly restricted to seasonal springs and seeps in otherwise arid environments. Habitat suitability appears to depend on microsite conditions such as north-facing talus and rocky slopes or under rocks and woody debris in forested habitats (Stebbins 1985). Many of these species occur in the foothills of these forests' drier vegetation types and elevations that include oak woodland, coastal sage scrub, and chaparral. Several of these species occur in the relatively moist conditions found in montane forests (red fir and Jeffrey pine), often occurring in forest litter in the shade of trees or rock crevices, ravines, creeks, and often on north-facing or shaded areas depending on the availability and constancy of moist conditions. None of the salamanders that are species of conservation concern are located in the harsh subalpine or alpine conditions of these forests. Salamanders are found under logs, woody debris, bark, moss, leaf litter and talus, crevices, or in animal burrows (Stebbins 1985, Lannoo 2005). The limestone salamander is dependent on a limestone substrate (Lannoo 2005). Generally, there are many subspecies of salamanders because their dispersal capability is often limited by features on the

landscape and habitat requirements; however, a few species do have local seasonal migrations (Jockusch et al. 1998). Eggs are deposited in terrestrial sites, probably in moist sites along springs, seepages, or creek margins (Lannoo 2005), and there is no aquatic larval stage. Food is not a limiting factor and consists of invertebrates including snails, crickets, earthworms, and a large variety of insects.

All localities for Kings River slender salamanders occur on public lands administered by the Forest Service or National Park Service and the Kern Canyon slender salamander's habitat occurs entirely within the Sequoia National Forest (Lannoo 2005). In other cases, a substantial portion of these salamanders' range is known to occur on public lands, though they can be an artifact of where they are more easily studied or the management of these lands has provided refugia from development and agricultural pressures on private lands.

Threats. There are no specific known limiting factors on the three national forests for salamander survival. Similar to many rare plants as well as invertebrates, these species are inherently limited in their geographic range resulting in limited occurrences and distribution. Several of these species have difficulty naturally dispersing or crossing man-made features such as highways, which can serve as barriers. For all of these species, population status is uncertain. The principal threats in the literature is habitat degradation or loss with concerns across all of these species for increasingly drier conditions resulting from climate change (Lannoo 2005). Potential losses of individuals could occur through fire suppression (compaction or deep soil disturbance from equipment), grazing that affects hydrology, logging, firewood collecting, mining and more consequential losses from impoundments, and hydro development. Climate change may eliminate or reduce the suitability of some of the existing habitat. Subterranean habitat may limit effect of wildfire on this species and habitat may be maintained with restoration of periodic fire. High-intensity fire is assumed to be a threat when individuals are above ground and at risk and likely impacts habitat in all respects and results in some direct mortality. However, the yellow-blotched salamander survived large fires in both the Breckenridge and Piute Mountains in forested habitats with large-scale, stand-replacing fire effects (S. Anderson, personal communication with J. Friedlander, April 7, 2016). This suggests that at least in the short term, salamanders can survive and demonstrate resilience under extreme fire conditions. Habitat was not found to be a limiting factor for any of these species.

Table 80 lists the status and threats for the terrestrial salamander species of conservation concern. Note that several species of primarily aquatic amphibians are addressed in the "Aquatic At-risk Species" section.

Table 80. Status and threats for terrestrial salamander species of conservation concern

Species	Status	Threats
Inyo Mountain salamander	Found on the Inyo National Forest. Dependent on microhabitat associated with isolated springs in the largely desert and desert scrub environment.	Any actions that would hydrologically impact springs in occupied habitat.
Hell Hollow slender salamander	Found on the Sierra National Forest. Found beneath rocks (often occurring in patches of talus), bark rubble, and downed logs.	Detailed knowledge of risk factors is fragmentary but concerns exist about holes in their distribution on the national forest.
Fairview slender salamander	Found on the Sequoia National Forest. Talus slopes, under rocks and logs.	Road barriers and fire
Gregarious slender salamander	Found on the Sequoia and Sierra National Forests. Downed logs, bark slabs, rocks, or within damp leaf litter usually associated with surface water and stream or seep margins in mixed conifer and riparian woodland forest.	Concerns for compaction of soils in these environments.
Kings River slender salamander	Found on the Sequoia and Sierra National Forests. Logs or rocks with tree overstory (shade) and talus slopes.	Ground disturbance, water quality, habitat fragmentation by roads and wildfire threats: The lower Kings River sites are located immediately adjacent to a road and probably could be affected by road construction.
Kern Canyon slender salamander	Found on the Sequoia National Forest. Rocks and logs, talus slopes.	Potential impacts to occupied habitat and hydrologic changes affecting the Kern River canyon.
Yellow-blotched salamander	Found on the Sequoia National Forest. Woodlands and riparian areas down logs and litter.	Potential compaction to occupied habitat and hydrologic changes to habitat.
Limestone salamander	Found on the Sierra National Forest. Foothill areas cliffs, crevices, ledges, and talus frequently a limestone substrate. Cover is pines, oaks, buckeye and chaparral.	Impacts to occupied limestone habitat, road building and road grading.

Indian Yosemite Snail

Status: This species is found on the Sierra National Forest. The main requirements for land snails are moisture, food, shelter and a source of calcium for shell building and physiological processes (Burch and Pearce 1990). As a consequence, some of the greatest species abundance and richness occurs in moist, deciduous forest (Pearce and Örstan 2006). Burch and Pearce (1990) suggest refuges may be the most important factor limiting terrestrial snail abundance which include the right assemblage if not juxtaposition of habitat components including access to a substrate of calcareous carbonate (often cliff habitats or talus slopes), sufficient moisture and food.

Threats: Burch and Pearce (1990) suggest refuges may be the most important factor limiting terrestrial snail abundance, which require the right assemblage of habitat components including access to a substrate of calcareous carbonate (often cliffs habitats or talus slopes), sufficient moisture (even in arid environments), and food consisting of herbaceous materials such as decaying leaf litter. Barriers include barriers to dispersal. Moisture is required for respiration and often hatching of eggs and lack of moisture can serve as a barrier to dispersal; therefore, lack of precipitation due to climate change can be a threat. Gastropods do not move much and usually

only to find food or reproduce and the suggested minimum separation distance is set at one kilometer as most movements are within this but could be far less. They are known to forage adjacent to areas with substantial grass or seasonal herbaceous vegetation as well as within leaf and needle litter and on fungi and lichens; thus fire can be a threat. Following the Megram Fire in 1999, a fall wildfire that burned in old forest and an area of extensive blowdown on the Six Rivers National Forest in northwestern California, spring mollusk surveys found remains of burned snail shells of all ages as well as numerous live detections of tiny first year juvenile snails, an indication that presumably eggs are laid underground protected from the heat and flames.

Merced Canyon Shoulderband

Status: This is a species of air-breathing land snail that is found on the Sierra National Forest. Local populations are small relative to those of other animal groups because terrestrial snails tend to be more sedentary. Baker (1958) claimed "long-distance dispersal of terrestrial gastropods is undoubtedly passive" although short distance dispersal is active involving slow, short-distance migration under favorable conditions. Passive migration of snails via wind, rafting on floating objects, or birds may occur over longer distances and may occur across barriers.

Threats: Terrestrial gastropods do not move much, usually only to find food or reproduce. There is very little information on this species; however, as a critically imperiled species, potential impacts to such a small refugia of small organisms could have severe impacts. Although these species have clearly evolved with fire in the landscape, altered fire regimes could have undesired consequences.

Tight Coin

Status: The tight coin is a species of small, air-breathing land snail found on the Sequoia National Forest. Terrestrial gastropods do not move much, usually only to find food or reproduce. Associated with carbonate calcareous cliff habitats.

Threats: Burch and Pearce (1990) suggest refuges may be the most important factor limiting terrestrial snail abundance, although the greatest richness of species among carbonate cliff habitats (one of the most diverse in North America) is associated with calcareous, as opposed to acidic, substrates (Nekola 1999, Nekola and Smith 1999). Ground disturbance can create potential barriers that could impact movements or habitat quality.

Butterflies

Status: The butterflies occur mostly at high elevations between 6,000-10,000 feet on the Sierra, Inyo, and Sequoia National Forests with ranges south into the southern Sierra Nevada and the Kern Plateau. Some of the butterflies occur at high elevations and primarily in Inyo and Mono counties, near Mono Pass, Whitney Pass, White Mountains, and Barcroft Field Station (12,000 to 13,000 feet). Collections of these species are associated with habitats during peak flowering times including dry and wet meadows, scree slopes, sagebrush scrub, lake and stream banks. Butterflies inhabit virtually every part of an ecosystem largely determined by their dispersal ability, feeding and reproductive habits. Habitat suitability for many species depends on microsite conditions that can vary with each life stage. Having both host and nectar plants available are usually critical requirements, and where both are present it may limit populations to the boundary of such habitats. For some, the majority of their life stages are limited to one or a few plants for larval, juvenile or pupa, and adult stages.

Threats: Many of the populations are highly isolated from one another and cover a small area often less than an acre in size. The small area occupied by populations make them very susceptible to subtle habitat changes particularly wildfire that results in habitat type conversion. Host plants are the plants that the female butterflies lay they their eggs on. Most species of butterflies have evolved to be very selective and will only lay their eggs on one or two specific species of plants which also serves as a primary food source. The host plants of all of these species can be susceptible to ground disturbance and some are threatened due to climate change. Changes in temperature extremes and precipitation could affect host plant availability. Fires that burn with low to moderate severity can regenerate flowering plants in fire-adapted ecosystems that are important for butterflies (see "Terrestrial Ecosystems Processes and Functions, Keystone Species Group" subsection). Application of pesticides that are used to control nuisance insects or other pests or to kill target plants are threats to many butterflies if they are not selective or if they affect larval plants or habitat. Certain species of ants prevent wasps from parasitizing butterfly larvae; therefore the presence and abundance of certain ant species can be a limiting factor that limits geographic range and occupied sites. Hobby collecting of butterflies can impact populations and more information needs to be gathered with respect to this potential threat.

A Cave Obligate Pseudoscorpion

Status: Found on the Inyo National Forest, this species is similar looking to a scorpion. Pseudoscorpions, commonly known as "false scorpions," pose no threat to humans and are members of the spider family. This species is only found in caves and thought to disperse by "hitchhiking" on other species.

Threats: Disturbance to occupied caves that could impact this species include smoke from fires, trampling, and changes in moisture or temperature conditions in occupied caves.

Migratory Birds

The source of any duty to consider migratory birds during plan revision is Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (2001). The executive order states that environmental analysis of Federal actions, required by the National Environmental Policy Act or other established environmental review processes, evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern.

A memorandum of understanding between the Forest Service and the U.S. Fish and Wildlife Service was signed in 2008.[29] The memorandum outlines the responsibilities for both parties regarding migratory birds, including the Forest Service's responsibilities regarding consideration of migratory birds in environmental analyses. The memorandum was used to help guide the development of this effects analysis.

In January of 2000 the Forest Service released a Landbird Strategic Plan (USDA FS 2000). The primary purpose of the strategic plan was to provide very general guidance for the agency's landbird conservation program. Among the suggested actions was the incorporation of landbird management into forest plans.

A recent report issued by several organizations and Federal agencies summarized the general condition of birds across the United States (North American Bird Conservation Initiative 2009, 2011). It painted a picture of declines in multiple species across a variety of habitats. Climate change was one of the contributing factors to these declines, and is likely to continue impacting

[29] FS Agreement 08-MU-1113-2400-264

birds into the future. As the climate warms, breeding seasons and migrations are being altered. These activities may become out of sync with prey abundance, and climate change may also impact where and when those food items are available. This reinforces the need to have resilient habitat that is better able to handle climate change.

Environmental Consequences to At-risk Terrestrial Wildlife Species

Environmental consequences are evaluated for the major ecological zones as described above in and as they support habitat for at-risk terrestrial wildlife species. Although old forest habitat elements can occur in any ecological zone, and complex early seral habitat can be created in any ecological zone, these two habitats are described as part of the montane ecological zone evaluation of effects. For alternatives B, C, and D, the evaluation focuses on the ability of the coarse-filter components to achieve the desired conditions and provide habitat sufficient to support the persistence of associated species. For each zone, at-risk terrestrial wildlife species supported by that habitat or elements of that habitat are listed. Where fine-filter plan components are incorporated for an individual species, those plan components are evaluated under the various alternatives for their ability to provide habitat sufficient to support the persistence of that particular species.

Consequences Common to All Alternatives

Migratory Birds

Habitat upon which migratory birds depend was considered during the development of plan components for alternatives B, C, and D. Such considerations are already in place under alternative A. Migratory birds are ubiquitous and use virtually all habitat types across a range of elevations. Therefore, restoration of many vegetation types at various elevations would benefit habitat for migratory bird species, especially in cases where restoration focuses on moving the vegetation toward the natural range of variation, improving resilience to wildfire and changing climate conditions, protecting and restoring riparian and watershed conditions, and controlling or eradicating invasive species (see plan components listed in Table 82 and Table 83 and the "Terrestrial Vegetation Ecology" section).

Partners in Flight produced a North American Landbird Conservation Plan in 2004 (Rich et al. 2004) and a Strategic Action Plan in 2012, which promotes the conservation of migratory and other birds. It has two main components: helping bird species at risk and keeping common birds common. The draft forest plans do the same by using a science-based conservation and restoration design. Plan components help identify and develop solutions to threats and other risks to ecological conditions important for high priority "at-risk species" (SPEC-FW-DC-01 to 03; TERR-SH-STD-01; SPEC-FW-GDL-04 to 06; FIRE-FW-GDL-05 to 06, 08, and 10). Plan components also guide projects to conserve or restore the proper functioning of ecosystems upon which at-risk species as well as common migratory birds and other species depend forestwide (see Table 82 and Table 83). Except for the bi-state distinct population segment of the greater sage-grouse, all bird species of conservation concern and federally listed birds identified for the three national forests are listed as migratory under the Migratory Bird Treaty Act.

Draft plan components were also designed to meet the needs of migratory birds and other species by addressing high priority habitats and their associated vegetation type or aquatic system where they depart from desired ecological conditions. These components include guidance on restoration approaches that reduce and limit impacts. Examples include systems that are highly altered such as some meadows where water tables have been lowered or vegetation reduced

(RCA-MEAD-OBJ-01; MA-RCA-GDL-04; MA-RCA-STD-11 to 12, -15 to 18), or altered montane forests and riparian areas that lack resiliency to wildfire under changing climatic conditions (TERR-FW-OBJ-01 to 03; MA-RCA-OBJ-01).

Habitat for migratory birds is anticipated to persist under all alternatives. Common migratory birds, by definition are expected to persist on the landscape because the plans strive to retain ecosystem diversity to provide for a range of habitats and ecological conditions expected for the respective national forest areas. However, different alternatives can provide more or less benefit to migratory at-risk bird species and more detailed analysis is provided for each of the species below. At the same time, there are some threats, for example, poisoning from pesticide residue or lead ingestion (condors) that may occur outside of the national forests; illegal uses on National Forest System lands where vegetation is removed or poisons are used; or cowbird parasitism of willow flycatcher nests that are outside of the authority of the Forest Service to control or manage.

Range Management

All alternatives maintain the same level of livestock grazing as the current plans (alternative A) and each national forest proposes to manage grazing similar to the current practices (although this approach differs by national forest) (Sequoia and Sierra National Forests: RANG-FW-STD-01 to 03; SPEC-GGO-GDL-01; Inyo National Forest: MA-RWLD-STD-02; DA-RNA-SUIT-08; SPEC-SHP-STD-01; RANG-FW-STD-01 to 02). This includes grazing management in meadows (MA-RCA-STD-11 to 17; MA-RCA-GDL-06 to 08). Grazing can adversely affect habitat for terrestrial wildlife species, particularly those that nest or forage in meadows, riparian areas, and grasslands. The standards and guidelines listed above from the draft forest plans are anticipated to improve grazing management, and result in positive meadow and riparian conservation area trends over time. These actions improve vegetative conditions, stability and resilience over time.

A recent study found a weak negative correlation between grazed meadows on Stanislaus National Forest allotments and vole abundance (Kalinowski et al. 2014). Although these findings indicate the need for further evaluation, there are a number of potentially confounding variables that influence these results, including the fact that some grazed meadows were surveyed before grazing for the season began, making it difficult to compare before and after or even grazed and ungrazed meadows. Grazing can cause structural changes to willow flycatcher habitat that could “expose nests, reduce substrate for insects, and diminish foliage cover that protects nests” (Mathewson et al. 2007). While poorly managed grazing can change the hydrologic and vegetative characteristics of meadows and contribute to poor quality habitat for nest selection and increased visibility (vulnerability) of nests to predation (Brookshire et al. 2002, Auble et al. 1994, Stanley and Knopf 2002, Scott et al. 2003), grazing on the national forests is managed to minimize and avoid these effects.

Some grazing can be beneficial for butterflies, but heavy grazing can degrade habitat. Livestock grazing, especially in and near Sierran meadows, may affect breeding success of the Sierra marten by reducing understory vegetation (Zielinski 2014). Livestock grazing levels have been substantially reduced over the last several decades and some grazing allotments are now currently vacant and ungrazed. Specific decisions on the numbers, types, seasons, and level and intensity of livestock grazing are made during allotment management planning. Allotment management plans also include monitoring of grazing activities so that the need for adjustments to livestock grazing practices and amounts can be identified and addressed in annual operations or in the allotment management plans. This would be the same under all alternatives. If new grazing allotments or activities are proposed in habitat that supports a threatened, endangered, proposed, or candidate

species, the U.S. Fish and Wildlife service would be consulted prior to making allotment management plan decisions.

Wilderness

Management of designated and recommended wilderness can benefit species by precluding management activities (like timber harvest) that might reduce habitat quality, and by limiting mechanized and motorized activities such as mountain biking and off-highway-vehicle use that could cause breeding disturbance. This conservation approach has long been employed as a means to help protect natural resources from degradation associated with human actions. Wilderness management areas are also locations where wildfires are often managed to meet resource objectives, such as restoring fire as a key ecosystem process in Sierra systems, which can substantially improve habitat condition, heterogeneity, structural diversity, and species composition of vegetation (MA-WILD-DC-01; MA-WMZ-STD-01 to 02). However, wilderness and recommended wilderness management direction can also impact species by precluding or limiting restoration activities and by continuing or increasing disturbance from wilderness users. In areas where vegetation and fuels have been impacted by past management, wildfires are becoming increasingly large and often have high-severity impacts. Many wildfires will be difficult to manage safely, especially under alternative A where they are predicted to increase two to four fold (See “Fire Trends” section), and increased occurrences of wildfires could cause the loss of forest habitats.

Climate change has been associated with and will continue to influence shifts in ecological processes and patterns, and species ranges, movements, and phenologies (Bradley et al. 1999, Cole and Yung 2010, Safford et al. 2012b) among other newly emerging patterns. Biotic communities may shift in complex ways, such as some species may shift sooner or later than others, or in different geographical directions than others causing disruptions in ecosystem functions. In this way, novel species assemblages may form with new predatory or competitive interactions (Stralberg et al. 2009). Furthermore, the concept of ecosystem management represents a shift in conservation ecology in that it takes on a view of “nature in flux, rather than balance” and aims to protect ecosystem structure and function through adaptive management to maintain both biodiversity as well as adaptive capacity (Kalamandeen and Gillson 2007, Grumbine 1994, 1997). Therefore, while wilderness designation can benefit terrestrial wildlife species, protection of species and community assemblages may be limited to a snapshot in time and may not be protective in the future if natural processes aren’t sufficient to maintain habitat conditions due to factors such as climate change, large high-intensity fire, non-native species invasions (like invasive plants and barred owl), insect outbreaks, and pathogens, among others.

Designated wilderness area allocations remain constant in all alternatives. However, areas recommended for wilderness varies by alternative. Alternative C would include the most acres recommended for wilderness and would offer the largest blocks of undisturbed habitat, yet the greatest potential for loss of habitat structure important to at-risk species due to increased potential for large wildfires (see “Terrestrial Vegetation Ecology” section). Alternatives A and D would not increase the areas managed as wilderness from the current plans.

Nelson’s Desert Bighorn Sheep

Effects of the forest plans on the Nelson’s desert bighorn sheep would occur regardless of the alternative selected because actions by the Forest Service are not responsible for either the outbreak or continuation of disease contact or spread. Therefore, it is not within the capability of the Forest Service to ensure that this population on the Inyo National Forest persists over time.

The risks of disease transmission from recreational pack goat use is currently very low due to limited trails and very low use levels in the areas occupied by this species. Also, pack goats are generally kept in close proximity to handlers, which minimizes the risk of direct contact with bighorn sheep.

Terrestrial Salamanders

There is no specific identified threat that required developing species-specific plan components for at-risk salamanders. High-intensity wildfires could result in hydrophobic soils or could render the microsite for these species unsuitable. However, even in some of the most severe recent fires, individual yellow-blotched salamander have shown remarkable resilience by surviving high-severity fire conditions beneath the surface. Regardless, alternatives B and D, which favor increasing resilience to large, high-severity fires would be more beneficial to all salamanders by lessening the potential for high-severity fire toward the range of natural variation. The effects of drying conditions resulting from climate change would have negative impacts on all salamanders that are moisture dependent for many life stages regardless of alternative. The use of heavy machinery for the increased pace and scale of harvest under alternatives B and D, would result in greater risk of impacts than in alternative A and especially alternative C. However, all of the salamanders evaluated are known to occur in locations such as rocky drainages, steep slopes, and wilderness where such machinery use is typically limited or restricted. Recreation or grazing activities that would compact, disturb, or result in drying of moist areas could impact these species at a local scale but are not known to be a systematic concern at the national forest level. In Table 82 and Table 83, draft plan components provide over-arching species and habitat protections for this group that would guide future projects to ensure the needs of these species are incorporated into design and implementation of actions, including those that have the potential to restore habitat.

Consequences Common to Alternatives B, C, and D

Recreation Management

Improved site conditions and access have the potential to increase recreation in dispersed and/or developed areas and adversely impact habitat condition. Under alternatives B, C, and D, there would be an emphasis on addressing a backlog of deferred maintenance at developed recreation sites and on trails (REC-FW-OBJ-01 to 03). Some areas like meadows, cliffs, riparian habitat, lakes and ponds, and rocky outcrops may experience greater impacts than other habitats from increased recreation demand because these areas tend to receive more intense or frequent use. Human disturbance, including various kinds of recreation activities (like rock climbing, road and trail use, off-highway or over-the-snow vehicle operation), is a known threat for species like Pacific fringe-tailed bats, Townsend's big-eared bats, bald eagles, peregrine falcons, Sierra marten, Sierra Nevada red fox, great gray owl, and yellow-eared pocket mouse. For example, rock climbing may adversely and directly affect nesting peregrine falcons.

Cave exploration can directly and adversely affect at-risk bat species that may be roosting or rearing young and cause site abandonment. Increased use of meadows, riparian areas, and lakes and ponds due to trends in population and visitor use (see "Sustainable Recreation" and "Economic Conditions" sections) can introduce more trash, more overall noise, cause a greater amount of habitat trampling (which could impact host plants or nest shrubs), create unauthorized trails through previously undisturbed habitat, or increase nest disturbance (especially when pets are brought to these areas). Therefore, habitat condition may be affected under any alternative by recreation activities. Plan components have been developed to help protect habitat condition for a

variety of species where recreation impacts could occur (REC-FW-GDL-02, -04 to 05). For example, alternatives B, C, and D all include a guideline (SPEC-BAT-GDL-01) to install bat gates at cave and mine entrances when bat maternity colonies or hibernacula may be adversely affected.

Plan Components Developed for At-risk Terrestrial Wildlife Species

Alternatives B, C, and D share the same desired conditions. The desired conditions by major terrestrial vegetation types were listed in Table 40 and Table 41 in the "Terrestrial Vegetation Ecology" section. These plan components provide for a broad range of ecological conditions (coarse filter) important to ensure habitat diversity for wildlife. In addition, other desired conditions specific to wildlife are listed in Table 81.

Table 82 lists standards and guidelines that specifically address consideration of habitat, especially for at-risk species and species of conservation concern.

Table 81. Draft forest plan desired conditions for terrestrial wildlife by habitat type or ecosystem function, alternatives B, C, and D

Summary of Content	Component
Mosaic providing ecosystem integrity and diversity. Provides habitat for native and desirable non-native plant and animal species.	Terrestrial ecosystems (TERR-FW): DC-01 Animal and plant species (SPEC-FW): DC 01
Conditions contribute to recovery of federally recognized species and persistence of species of conservation concern	Terrestrial ecosystems (TERR-FW): DC-03 Animal and plant species (SPEC-FW): DC-02
Provides landscape connectivity for wide-ranging habitat generalists (like deer) and habitat specialists (like those dependent on old forest and sagebrush)	Terrestrial ecosystems (TERR-FW): DC-04 Animal and plant species (SPEC-SG): DC 04
Riparian habitat supports native riparian-dependent species	Riparian conservation areas (MA-RCA): DC 01-02, 05, 07, 11-15
Meadow habitat supports native species	Meadows (RCA-MEAD): DC 02, 05, 07
Springs and seeps provide habitat	Springs and seeps (RCA-SPR): DC 01
Consider climate change effects on habitat and species in project design	Terrestrial ecosystems (TERR-FW): DC-02

Table 82. Draft forest plan standards and guidelines for terrestrial wildlife habitat, alternatives B, C, and D

Summary of Content	Component
Consider habitat for at-risk species, including special habitats in project design	Animal and plant species (SPEC-FW): GDL 04-05 Bats (SPEC-BAT): GDL 01
Restore and retain key snag habitat	Terrestrial ecosystems (TERR-FW): GDL 02
Retain oak habitat	Terrestrial ecosystems (TERR-FW): GDL 04; Black oak/canyon live oak (TERR-BLCK): GDL 01, 02; (Inyo: TERR-OAK): GDL 01
Restore and retain diverse chaparral habitat within NRV	Chaparral-live oak (TERR-CHAP): GDL 01, 02
Restore and conserve sagebrush habitat	Pinyon-juniper (TERR-PNY): GDL 01, 02
Ensure habitat integrity for riparian species	Riparian conservation areas (MA-RCA): STD 01, 04, 07, 10, 11, 12, 13, 15, 16, 17; GDL 01-04
Restore and conserve old forest habitat, including nest, roost trees	Old forest (TERR-OLD): GDL 01-02 Animal and plant species SPEC-FW-GDL 01
Consider wildlife habitat and connectivity in complex early seral forest areas	Complex early seral habitat (TERR-CES): GDL 01c-d, 03, 06
Restore and conserve aspen and willow habitat	Aspen (TERR-ASPN): GDL 01-50 Range (RANG-FW): STD 01
Consider special habitats and at risk species during wildfires	Fire (FIRE-FW): GDL 01-10

Table 83 lists the threats and principal habitats for each terrestrial wildlife at-risk species and the primary applicable draft plan components that provide for the ecological conditions necessary to ensure persistence of the species. While many other plan components may also provide generally for ecological conditions that would benefit a species, only the primary plan components are identified. The plan components are generally the same between each of the forest plans; however, some plan components are identified by forest code where needed for clarity.

Table 83. Draft plan components addressing the identified potential threats to at-risk terrestrial wildlife species in alternatives B, C, and D

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)*	Large-scale, high-severity fire outside the range of natural variability	Riparian and non-riparian uplands with above average soil moisture.	Watershed conditions (WTR-FW): GDL 01 Terrestrial ecosystems (TERR-FW): DC 02 Riparian conservation areas (MA-RCA) GDL 03, 06
Least Bell's vireo *(Vireo bellii pusillus)*	Conversion of riparian habitats by tamarisk and fire	Low elevation riparian habitat. In the plan area, exclusively near Lake Isabella	Watershed conditions (WTR-FW): DC: 02, 05, 06 Terrestrial ecosystems (TERR-FW): DC: 02 Special habitats (TERR-SH): DC: 01 Animal and plant species (SPEC-FW): DC: 03 Invasive species (INV-FW): DC: 01, 02 Riparian conservation areas (MA-RCA): DC: 01-03, 05, 07; STD: 04, 14, 16, 20, 26; GDL: 01, 03, 04, 06-08 Rivers and streams (RCA-RIV): DC: 01, 02
Southwestern willow flycatcher *(Empidonax trailii extimus)*	Conversion of riparian habitats by tamarisk and fire	Low elevation riparian habitat. In the plan area, exclusively near Lake Isabella.	Watershed conditions (WTR-FW): DC: 02, 05, 06 Terrestrial ecosystems (TERR-FW): DC: 02 Special habitats (TERR-SH): DC: 01 Animal and plant species (SPEC-FW): DC: 03 Invasive species (INV-FW): DC: 01, 02 Riparian conservation areas (MA-RCA): DC: 01-03, 05, 07; STD: 04, 14, 16, 20, 26; GDL: 01, 03, 04,06- 08 Rivers and streams (RCA-RIV): DC: 01, 02
Western yellow-billed cuckoo DPS *(Coccyzus americanus)*	Conversion of riparian habitats by tamarisk and fire	Low elevation riparian habitat. In the plan area, exclusively near Lake Isabella.	Watershed conditions (WTR-FW-DC: 02, 05, 06) Terrestrial ecosystems (TERR-FW-DC: 02) Special habitats (TERR-SH-DC: 01) Animal and plant species (SPEC-FW-DC: 03) Invasive species (INV-FW-DC: 01, 02) Riparian conservation areas (MA-RCA-DC: 01-03, 05, 07); (RCA-FW-GDL: 04, 06-08); (MA-RCA-STD: 04, 14, 16, 20, 26); (MA-RCA-GDL: 01, 03, 04, 08) Rivers and streams (RCA-RIV-DC: 01, 02)
California condor *(Gymnogyps californianus)*	Habitat loss from conversion, lead poisoning, collision with human-built structures and large, high-severity fire outside the range of natural variation	Roosting and nesting in large conifer trees, including giant Sequoia trees (foraging primarily outside of national forests)	Terrestrial ecosystems (TERR-FW): GDL: 02 Old forests (TERR-OLD): DC: 04, 05, 06; GDL: 04

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Sierra Nevada red fox – Sierra Nevada distinct population segment *(Vulpes vulpes necator)*	Climate change, conversion of habitat by human development, and expansion of coyotes and non-native red foxes. Interactions with people and pets (disease transmission) and from contact with rodenticides, including plague control activities.	Wide range of remote, high-elevation alpine and subalpine habitats including meadows, dense, mature forest, talus, and fell fields. Habitat use varies seasonally.	Watershed conditions (WTR-FW): DC: 04; STD 01, 02 Terrestrial ecosystems (TERR-FW): GDL 01, 05, 06 Old forests (TERR-OLD): GDL 01-05 Complex early seral habitats (TERR-CES): GDL 01-04, 06 Upper montane vegetation (TERR-UPPR): DC: 01, 02, 03 Animals and plants species (SPEC-FW): DC: 01-03 Meadows (RCA-MEAD): DC: 01-08; STD: 01, 07, 10, 14
Sierra Nevada bighorn sheep *(Ovis canadensis sierra)*	Pneumonia from domestic sheep or goat contact	Alpine, subalpine and upper montane habitats, primarily rugged, rocky areas.	Alpine and Subalpine (TERR-ALPN): DC: 01, 02, 03
Yellow-eared pocket mouse *(Perognathus parvus xanthonotus)*	Grazing, off-highway vehicle activity, and climate change	4,000 to 5,300 feet elevation in arid desert shrub and Joshua tree communities, pinyon-juniper, chaparral, sagebrush, and habitats with sandy soils and sparse to moderate shrub cover.	Terrestrial ecosystems (TERR-FW): DC: 01-04 Sagebrush (TERR-SAGE): DC: 01-03 Pinyon-juniper (TERR-PINY): DC): 01-05; GDL: 01-02 Xeric shrub/Blackbrush (TERR-XER): DC: 01-04; STD: 01; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-02; GDL: 01, 05, 06 Range (RANG-FW): STD: 02 Sustainable recreation (REC-FW): DC: 02-03, 06, 08, 11; GDL: 02, 04, 05, 07
Pacific fringe-tailed bat *(Myotis thysanodes vespertinus)*	Disturbance of roost and nest sites, loss of large snags for roost sites, potential threat of white-nosed syndrome.	Roost in caves, mines, buildings, crevices in rocks, and large/tall snags. Forages in pinyon-juniper, valley foothill hardwood, hardwood-conifer habitat, and open habitats that have nearby dry forest and an open water source.	Watershed Condition (WTR-FW): STD: 01-03 Terrestrial ecosystems (TERR-FW): DC: 01-04; GDL: 02 Blue oak Interior live oak woodland (TERR-BLU): DC: 01-03 Black oak/canyon live oak (TERR-BLCK): DC: 01-02; GDL: 01-02 Ponderosa pine (TERR-POND): DC: 01, 05 Dry mixed conifer (TERR-DMC): DC: 01, 02,06 Pinyon-juniper (TERR-PINY): DC: 01-05; GDL : 01-02 Old forest (TERR-OLD): DC: 01, 06; GDL: 01-02 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 05, 06 Bats (SPEC-BAT): GDL: 01 Sustainable recreation (REC-FW): GDL: 02 Geology and minerals (GEO-FW): DC: 01 Riparian Conservation Areas (MA-RCA): -DC: 13, 15; STD: 06; GDL: 01, 04, 06 Lakes, pools, ponds (RCA-LPP): DC: 01

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Townsend's big-eared bat *(Corynorhinus townsendii)*	Disturbance at roost or nest sites, potential threat of white-nosed syndrome.	Desert scrub, coniferous forests, mid-elevation mixed conifer, mixed hardwood-conifer forests, riparian habitats; roosts in caves, abandoned mines, and buildings; strong affinity for use of caves, and cave-like roosting habitat.	Watershed Condition (WTR-FW): STD: 01-03 Terrestrial ecosystems (TERR-FW): DC: 01-04; GDL: 02 Blue oak Interior live oak woodland (TERR-BLU): DC: 01-03 Black oak/canyon live oak (TERR-BLCK): DC: 01-02 Chaparral-Live oak(TERR-CHAP): GDL: 01-02 Ponderosa pine (TERR-POND): DC: 01, 05 Dry mixed conifer (TERR-DMC): DC: 01, 02, 06 Old forest (TERR-OLD): DC: 01, 06; GDL: 01-02 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 05, 06 Bats (SPEC-BAT): GDL: 01 Sustainable recreation (REC-FW): GDL: 02 Geology and minerals (GEO-FW): DC: 01 Riparian conservation areas (MA-RCA): DC: 13, 15; STD: 06; GDL: 01, 04, 06 Lakes, pools, ponds (RCA-LPP): DC: 01
Pacific fisher (*Pekania pennanti*)	Large high-intensity wildfire, late season prescribed fires, loss of mature forest components (large trees, high canopy cover).	Mature mixed-conifer forest and ponderosa pine with dead and downed wood, dense, often multi-layered canopies, and large trees.	See Table 84. Terrestrial Ecosystems (TERR-FW): GDL: 02 Old Forest (TERR-OLD): DC: 01-07; GDL: 01, 02 Pacific fisher (SPEC-PF): DC: 01-10; STD: 01-04; GDL: 01-04 California spotted owl, Pacific fisher and Sierra marten (SPEC-CSO-PF-SM): DC: 01, 02; GDL: 01
Sierra marten (*Martes caurina sierra)*	Loss of mature forest from fire and insect and disease; decrease in snow from climate change; fragmentation from legacy forest practices	Patches of mature old forest linked by effective corridors in high-elevation upper montane (red fir is important) and large trees.	Terrestrial Ecosystems (TERR-FW): GDL: 02 Upper montane vegetation (TERR-UPPR): DC: 01, 02, 03 Complex early seral habitats (TERR-CES): GDL 01-04, 06 Old Forest (TERR-OLD): DC: 01-07; GDL: 01, 02 Animals and plants species (SPEC-FW): DC: 01-03 Pacific fisher (SPEC-PF): DC: 01-10; STD: 01-04; GDL: 01-04 California spotted owl, Pacific fisher and Sierra marten (SPEC-CSO-PF-SM): DC: 01, 02; GDL: 01 Meadows (RCA-MEAD): DC: 01-08; STD: 01, 07, 10, 14

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Nelson's desert bighorn sheep (*Ovis canadensis nelsoni*)	Limiting factor is a respiratory disease (*Mycoplasma ovipneumoniae*) verified in the White mountains since 2009.	Found in mid-to higher elevations (6,000 to 12,000 feet) in the White Mountains on the Inyo in areas with steep, rocky cliff or rock faces. Forages on shrubs located near or on these cliff faces and within meadow systems. Requires visually open areas with suitable escape terrain (rock cliff faces).	This subspecies is different from the federally listed Sierra Nevada bighorn sheep, which is addressed by plan components elsewhere in this document and draft plan. While many plan components will benefit Nelson's desert bighorn sheep, none address the one factor that could result in the loss of persistence on the national forest. The Forest Service does not have authority over the threat of sheep or goat contact outside of the national forest. Therefore, the Forest Service cannot ensure that viability will be maintained for populations on the Inyo National Forest from actions that may occur on other lands.
Willow flycatcher (*Empidonax traillii and E.t. adastus)*	Declining meadow condition due to climate change, invasive species, poorly managed livestock grazing.	Dense willow or other shrub thickets within large (more than 10 acres) wet meadows between 3,900-7050 feet elevation. Meadows with standing or running water needed for breeding.	Watershed conditions (WTR-FW): DC: 01-03; STD: 01-03; GDL: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04, 06; GDL: 05 Special Habitats (TERR-SH): STD: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 03, 04 Invasive species (INV-FW): DC: 01-02; GDL: 02-05 Range (RANG-FW): DC: 02-03 Riparian conservation areas (MA-RCA): DC: 01-05, 07, 10, 11, 13, 15; STD: 01-02, 07, 11, 15-17, 18; GDL: 01-08 Meadows (RCA-MEAD): DC: 01, 03, 07 Rivers and Streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Critical aquatic refuges (MA-CAR): DC: 01-03 Range (RANG-FW): STD: 01
Kern Red-winged blackbird *(Agelaius phoeniceus aciculatus)*	Changes in water level in wetlands at Lake Isabella due to climate change, habitat conversion by invasive species, and large high-intensity wildfire.	Freshwater cattail and tule marshes, marsh vegetation bordering ponds and lakes, riparian forests near wetlands, wet pastures, annual and perennial grasslands.	Watershed conditions (WTR-FW): DC: 01-03; STD: 01-03, 05; GDL: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04, 06 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 05, 06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-02, 04-05 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, Pools, Ponds (RCA-LPP): DC: 01 Fire (Fire-FW): GDL: 04-05

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Tricolored blackbird *(Agelaius tricolor)*	Changes in water level in wetlands at Lake Isabella due to climate change, habitat conversion by invasive species, and large high-intensity wildfire.	Breed in freshwater marshes and winter primarily in open fields including pastures.	Watershed conditions (WTR-FW): DC: 01-03; STD: 01 -03, 05; GDL: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04, 06 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 05, 06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-02, 04-05 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, Pools, Ponds (RCA-LPP): DC: 01 Fire (FIRE-FW): GDL: 04-05
Greater sage-grouse, bi-state distinct population segment (*Centrocercus urophasianus)*	Pinyon-juniper expansion and conifer encroachment into sagebrush habitats, invasive species, and predation by ravens.	Large and contiguous sagebrush stands mixed with areas of wet meadows, riparian, or irrigated agriculture fields.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Sagebrush (TERR-SAGE): DC: 01-04 Animals and plant species (SPEC-FW): DC: 01-02; GDL: 01, 05-06 Sage-grouse habitat (SPEC-SG): DC: 01-09; STD: 01-13; GDL: 01-07 Invasive species (INV-FW): DC: 01-02 Fire (FIRE-FW): DC: 03; GDL: 05 Riparian conservation areas (MA-RCA): DC: 01 - 08, 11-15; STD: 01-02, 04-07, 10-14; GDL: 01-07 Meadows (RCA-MEAD): DC: 01-07 Rivers and streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refuges (MA-CAR): DC: 01-03
Bald eagle *(Haliaeetus leucocephalus)*	Human recreation disturbance, loss of roost or nest trees.	Large bodies of water (lakes or reservoirs) or free flowing large rivers with adjacent large live trees or snags.	Watershed conditions (WTR-FW): STD: 01-05; GDL: 01 Terrestrial ecosystems (TERR-FW): STD: 01; GDL: 01-02 Old forest (TERR-OLD): GDL: 01-02 Animal and plant species (SPEC-FW): GDL: 01, 04, 05 Invasive species (INV-FW): STD: 01 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Critical aquatic refuges (MA-CAR): DC: 01-03

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
American peregrine falcon *(Falco peregrinus anatum)*	Human recreation disturbance	Nesting and roosting primarily in remote cliff habitat; breeding in areas near rivers, wetlands, lakes or other aquatic features.	Watershed conditions (WTR-FW): DC: 01-03; STD: 01-03 Terrestrial ecosystems (TERR-FW): DC: 01-04, 06 -07; GDL: 01-02, 05 Special habitats (TERR-SH): DC: 01-02; STD: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 04-06 Sustainable recreation (REC-FW): DC: 02-03, 11; GDL: 02, 04-05 Riparian conservation areas (MA-RCA): DC: 01-03, 10-11, 15 Meadows (RCA-MEAD): DC: 01, 03, 07 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01
Great gray owl (*Strix nebulosi)*	Loss of mature forest habitat, large scale high-intensity wildfire, meadow degradation from unmanaged grazing, loss of large snags, disturbance at nest sites	Forage in meadows and open areas; nest in decayed large trees in higher elevation forest with dense canopy (more than 65%) and also low elevation conifer-dominated forests just above the transition from oak woodlands and near meadows.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): STD: 01; GDL: 01-02, 04, 05 Black oak/Canyon live oak (TERR-BLCK): DC: 01-02; GDL: 01-02 Old forest (TERR-OLD): DC: 01-07; GDL: 01-02 Animal and plant species (SPEC-FW): GDL: 01, 04, 05, 06 Great gray owl (SPEC-GGO): DC: 01); GDL: 01 - 02 Riparian conservation areas (MA-RCA): STD: 01, 10 -17; GDL: 04, 07- 08 Meadows (RCA-MEAD): DC: 01-08 Fire (FIRE-FW): GDL: 01-02, 04-05, 08-10
California spotted owl *(Strix occidentalis occidentalis)*	Large, high-intensity wildfire, past forest management activities such as even-age stand structure, removal of lower vegetation layers and large snags.	Mature mixed conifer and fir forests with high tree canopy cover, multi-layered canopies, and an abundance of large and mature trees and snags; possible use of young stands for foraging; occasionally lower elevation riparian and montane hardwood forests.	Terrestrial ecosystems (TERR-FW): STD: 01; GDL: 01-02, 04, 05 Black oak/Canyon live oak (TERR-BLCK): DC: 01-02; GDL: 01-02 Old Forest (TERR-OLD): DC: 01-07; GDL: 01-02 Animal and plant species (SPEC-FW): DC: 01- 03; GDL: 01, 04, 05 California Spotted owl (SPEC-CSO): DC: 01-04; STD: 01-06; GDL: 01-07 California spotted owl, Pacific fisher and Sierra marten (SPEC-CSO-PF—SM): DC: 01, 02; GDL: 01 Fire (FIRE-FW): GDL: 01-02, 04-05, 08-10

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Inyo Mountain salamander (*Batrachoseps campi*)	Drying of permanent springs and seeps. Loss of springs and seeps due from historic livestock grazing and wild horse grazing.	Small permanent desert springs and seeps with riparian vegetation. May extend out from riparian areas in canyon bottoms at higher elevations.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): DC: 02-04 Sagebrush (TERR-SAGE): DC: 01-04 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Range (RANG-FW): DC: 02 Riparian conservation areas (MC-RCA): DC: 01- 05, 10-11, 15; STD: 11-13; GDL: 04, 06, 07 Meadows (RCA-MEAD): DC: 01- 07 Lakes, Pools, Ponds (RCA-LPP): DC: 01
Hell Hollow slender salamander (*Batrachoseps diabolicus*)	Limited distribution and rarity	Mixed pine-oak woodland and chaparral communities of the foothills of the Sierra Nevada.	Watershed conditions (WTR-FW): DC: 01-04 Terrestrial ecosystems (TERR-FW): DC: 01-03 Animal and plant species (SPEC-FW): DC: 01-03 Invasive species (INV-FW): DC: 01-02 Fire (FIRE-FW): DC: 03 Geology and minerals (GEO-FW): DC: 01
Fairview salamander (*Batrachoseps bramei*)	Road maintenance and road grading of Mountain Highway 99 (Kernville-Johnsondale).	Often found beneath rocks, talus, logs, leaf litter, or other cover in a chaparral plant community. Very limited range from 2,800-4,200 feet above sea level.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Chaparral-live oak (TERR-CHAP): DC: 01-02 Special habitats (TERR-SH): STD: 01 Animals and plants (SPEC-FW): DC: 01-03; GDL: 04-06 Fire (FIRE-FW): GDL: 05, 08 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-06 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refuges (MA-CAR): DC: 01-03
Gregarious slender salamander (*Batrachoseps gregarius*)	Potential compaction of occupied habitat.	Found in a wide range of habitats, from mixed Sierran coniferous forests at high elevation, to open woodlands, to open grasslands at low elevation.	Watershed conditions (WTR-FW): DC: 01-04 Terrestrial ecosystems (TERR-FW): DC: 01-03 Animal and plant species (SPEC-FW): DC: 01-03

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Kings River slender salamander (*Batrachoseps regius*)	Road construction.	Mixed pine-oak/chaparral association, in moist side canyons or shaded, north-facing slopes and ravines; ferns and mosses are present at some sites.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04; GDL: 01-2, 04-05 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Fire (FIRE-FW): DC: 03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-06 Rivers and Streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refuges (MA-CAR): DC: 01-03
Kern Canyon slender salamander (*Batrachoseps simatus*)	Potential impacts that would degrade occupied habitat in narrow ravines. Substantial changes to hydrologic functions such as development of water storage facilities within the Kern River Canyon	Near streams in shaded, narrow canyons and on ridges and hillsides, particularly those facing north under logs,	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02 Fire (FIRE-FW): DC: 03; GDL: 05, 08 Range (RANG-FW): DC: 02-03, 05; STD: 02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Meadows (RCA-MEAD-): DC: 01-06 Rivers and Streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refuges (MA-CAR): DC: 01-03
Yellow-blotched salamander (*Ensatina eschscholtzii croceator*)	Potential compaction to occupied habitat and hydrologic changes to habitat.	Typical habitat includes coniferous forest, deciduous forest, oak woodland, coastal sage scrub, and chaparral under logs, bark, moss, leaf litter, and talus or in animal burrows	Watershed conditions (WTR-FW): DC: 01-04; GDL: 01 Terrestrial ecosystems (TERR-FW): GDL: 01-2, 04-05 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Limestone salamander (*Hydromantes brunus*)	Potential threats: include direct impacts to occupied limestone habitat. Potential road construction along Yosemite access road.	Inhabits mossy limestone crevices and talus in the Grey Pine, Oak, Buckeye, Chaparral belt of the lower Merced River Canyon, typically on steep slopes. Sierra foothill habitats along moist steep (more than 35 degrees) canyon slopes to mid-elevation.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03 Terrestrial ecosystems (TERR-FW): DC: 01-03 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 02 Fire (FIRE-FW): DC: 03 Geology and minerals (GEO-FW): DC: 01; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03
Indian Yosemite snail (*Monadenia yosemitensis)*	This species has very little capability to disperse and even relatively small barriers are limiting. Drought and climate changes are threats as well as stochastic events that might affect this single location.	Occurs on limestone outcrops on the western foothills of the Sierra Nevada. Dry, xeric areas with less than six inches precipitation annually, as moisture is required for respiration and often hatching of eggs.	Special habitats (TERR-SH): DC: 01, 02
Merced Canyon shoulderband (*Helminthoglypta allynsmithi*)	High-intensity fire outside typical burn season	Talus deposits and outcrops, rocks and woody debris in forest habitats.	Terrestrial ecosystems (TERR-FW): DC: 01-03 Special habitats (TERR-SH): DC: 01, 02 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 02 Fire (FIRE-FW): DC: 03 Geology and minerals (GEO-FW): DC: 01; GDL: 01-02
Tight coin (*Ammonitella yatesii*)	Barriers to movement in occupied habitats	Carbonate calcareous cliff habitats.	Terrestrial ecosystems (TERR-FW): DC: 02-04; GDL: 01-02, 05 Animal and plant species (SPEC-FW): DC: 01-03, GDL: 04-06
Behr's metalmark (*Apodemia virgulti davenporti*)	Known from relatively few populations. Problems with invasive weeds, especially cheatgrass.	Tehachapi and Piute Mountains in Kern County between 4,000 to 6,000 feet.	Watershed conditions (WTR-FW): STD: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04 All montane vegetation Types (TERR-MONT): DC: 01-02 Special habitats (TERR-SH): STD: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 03, 05 Invasive species (INV-FW): STD: 01; GDL: 01-05
Boisduval's blue (*Plebejus icarioides inyo*)	Disturbance within known sites to larval food plant *Lupinus* species.	Occurs in the Inyo Mountains, uses several *Lupinus* species for larval food plant.	Watershed conditions (WTR-FW): DC: 01-04

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
Tehachapi fritillary (*Speyeria egleis tehachapina*)	Potential disturbance within known sites to larval food plant thought be *Viola purpurea xerophyta.*	Summit peaks and ridges on Tehachapi Mountains and Piute Mountains.	Watershed conditions (WTR-FW): GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Range (RANG-FW): DC: 02-03, 05; STD: 01-03
San Emigdio blue (*Plebulina emigdionis*)	While the food plant is not rare, this butterfly is extremely localized and known from perhaps only 20 sites This species may be subject to stochastic events such as wildfire.	Localized species ranging from 3,000 to 5,000 feet, in washes and alluvial fans. Habitats are lower Sonoran zone desert canyons and along riverbeds. Host plants are shrub species *Atriplex canescens*.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): DC: 02-04 All Montane Vegetation Types (TERR-MONT): DC: 01-02 Special habitats (TERR-SH): STD: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 01, 03, 05 Fire (FIRE-FW): GDL: 05 Riparian conservation areas (MA-RCA): STD: 11-13; GDL: 04, 06, 07 Meadows (RCA-MEAD): DC: 01- 07
Sierra Sulphur (*Colias behrii*)	Disturbance to known sites at wet and dry meadows where food plants occur. (*Vaccinium caespitosum* and various grasses or sedges). Alpine population less prone to collecting pressures due to lack of access but drought and climate change a concern.	Common N side of Saddlebag Lake and above timberline on ridge below Mt. Conness at over 10,000 feet, northern limit at Yosemite. Wet and dry meadows where food plants occur (*Vaccinium caespitosum* and various grasses or sedges).	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): DC: 02-04 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02 Range (RANG-FW): DC: 02 Riparian conservation areas (MA-RCA): STD: 11-13; GDL: 04, 06, 07 Meadows (RCA-MEAD): DC: 01- 07
Square dotted blue (*Euphilotes battoides mazourka*)	Potential disturbance within known sites to food plant *Eriogonum umbellatum subaridum.*	Limited to Westgard Pass area between 8,000 and 13,000 feet on scree slopes, barren ridges, and pumice fields.	Watershed conditions (WTR-FW): STD: 01 Upper montane vegetation types (TERR-UPPR): DC: 01-02 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; GDL: 02
Mono Lake checkerspot (*Euphydryas editha monoensis*)	Potential disturbance within known sites to food plants; *Penstemon rydbergii* and *Collinsia parviflora*	East side Sierras in Great Basin Scrub habitat, Sonora Pass to Big Pine Creek Canyon.	Watershed conditions (WTR-FW): GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; GDL: 01-05 Invasive species (INV-FW): STD: 01 Range (RANG-FW): DC: 02-03, 05; STD: 01-03
Sierra skipper (*Hesperia miriamae*)	Potential disturbance within known sites to various grasses including *Festuca brachypphylla*	Mount Barcroft in the North to Mount Campito in the south above 10,500 feet.	Watershed conditions (WTR-FW): STD: 01 Upper montane vegetation types (TERR-UPPR): DC: 01-02 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; GDL: 02

Species	Known Threats Persistence	Principal Habitats	Forest Plan Components for Habitat Integrity, Sustainability and/or Species Persistence
White Mountains skipper (*Hesperia miriamae longaevicola)*	Butterfly is confined to highest elevations of the White Mountains and prone to stochastic threats such as wildfire.	Food plant is various grasses in high meadows of White Mountains. Found in the White Mountains of Mono County from Mount Barcroft to Mount Campito, CA. Also found at Boundary Peak in NV.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): DC: 02-04 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Riparian conservation areas (MC-RCA): STD: 11-13; GDL: 04, 06, 07 Meadows (RCA-MEAD: DC: 01- 07 Fire (FIRE-FW): GDL: 05
Atronis fritillary (*Speyeria mormonia obsidiana*)	Potential disturbance within known sites to larval food thought to be *Viola adunca*.	Sawmill Meadow, Glass Mountain vicinity	Watershed conditions (WTR-FW): DC: 01-04 Meadows (RCA-MEAD): DC: 01- 07
Apache fritillary (*Speyeria nokomis apacheana*)	Significant drop in numbers at Mono Lake Park because of loss of water runoff and loss of habitat from converting Mono Lake Park into an unnatural habitat. It remains more common elsewhere and in the Rovana area near Bishop	Spring-fed meadow at Round Valley, Inyo County	Watershed condition (WTR-FW): DC: 01-04; STD: 01 Terrestrial ecosystems (TERR-FW): DC: 02-04 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW-DC: 01-02); (INV-FW): GDL: 02-05 Fire (FIRE-FW-GDL: 05).Range (RANG-FW): DC: 02 Riparian conservation areas (MC-RCA): STD: 11-13; GDL: 04, 06, 07 Meadows (RCA-MEAD): DC: 01- 07
A cave obligate pseudoscorpion (*Tuberochernes aalbui*)	Disturbance to caves	Cave environments	Special habitats (TERR-SH): DC 01, 02

Consequences to At-risk Wildlife by Vegetation Zone

The analysis by vegetation zone is based in part on the "Terrestrial Vegetation Ecology" and "Agents of Change" sections. These sections describe consequences to vegetation that affect habitat. The alternatives vary in their ability to reduce the risk of habitat degradation across large forested areas from large-scale disturbances like drought-related vegetation mortality, large high-intensity fire, and insect outbreaks (see "Agents of Change" section). The alternatives also vary in their ability to move toward the desired conditions for structure, composition, and resilience of each vegetation type (see "Terrestrial Vegetation Ecology" section).

Westside Foothill Vegetation

Under alternatives B, C, and D, habitat in the lower elevations of this zone would predominantly be treated to reduce fuels in the community buffers near structures and along roads and ridges because much of this zone is adjacent to communities. This zone includes low elevation blue oak woodlands, chaparral, and some ponderosa pine and black oak. The following species are known to use portions of this zone to meet some life history requirements:

- Pacific fringe-tailed bat at this elevation forages in valley foothill hardwood (oak) habitat.
- Pacific fisher uses the ponderosa pine, blue oak, and particularly black oak habitat.
- California spotted owl uses riparian/hardwood habitat (blue oak).
- Great gray owl has been detected nesting in lower elevation oak woodlands.
- Yellow blotched salamander typical habitat includes coniferous forest, deciduous forest, oak woodland, coastal sage scrub, and chaparral under logs, bark, moss, leaf litter, and talus or in animal burrows.
- Kings River slender salamander is found in mixed pine-oak/chaparral association, in moist side canyons or shaded, north facing slopes and ravines; ferns and mosses are present at some sites.
- Limestone salamander inhabits mossy limestone crevices and talus in the Grey Pine, Oak, Buckeye, Chaparral belt of the lower Merced River Canyon, typically on steep slopes; and in Sierra foothill habitats along moist steep canyon slopes to mid-elevation.
- Fairview salamander is often found beneath rocks, talus, logs, leaf litter, or other cover in a chaparral plant community from 2,800-4,200 feet above sea level.

In terms of fine-filter plan components, all alternatives retain the current direction (plan components) to protect known nests and nesting habitat for great gray owls in protected activity centers. These areas include at least 50 acres of the highest quality habitat established around all known great gray owl nest stands. The four alternatives protect habitat condition or quantity within protected activity centers for this species the same since this approach does not differ by alternative.

Consequences Specific to Alternative A

Habitat quantity is not expected to change as a result of management activities under this alternative but could be at a risk of loss from large, high-intensity fires, which are predicted to increase the most (two to four times) under this alternative.

Habitat condition is anticipated to trend further away from the desired conditions (and natural range of variation) under this alternative (see "Terrestrial Vegetation Ecology" section). Treatments to restore vegetation types to within the natural range of variation are generally

limited under alternative A. Treatments in this ecological zone are focused primarily on reducing fuel volumes (and reduce fire risk) rather than on restoring the vegetation condition to within the natural range of variation because so much of this zone overlaps with the wildland-urban intermix defense and threat zones. Treatments remove mostly small- and medium-diameter trees and treat some shrubs, and include standards and guidelines to retain moderate to high canopy cover and retain habitat features in sensitive areas like great gray owl protected activity centers, California spotted owl protected activity centers, and the southern Sierra fisher conservation area. These treatments do not necessarily restore forest structure, composition, and heterogeneity toward the natural range of variation that would increase resilience of habitat for terrestrial wildlife species. The relatively slow rate of restoration under this alternative and emphasis on treating the wildland-urban intermix, rather than strategically treating vegetation across the landscape, can't keep pace with the build-up of high fuel volumes throughout the landscape, improve landscape heterogeneity, and help the forest vegetation trend toward the natural range of variation. Overall, the composition and structure of vegetation and spread of invasive plants are predicted to have low or low to moderate similarity to the desired conditions for this zone.

Alternative A continues to take a species-specific approach to habitat protection in which treatments are very limited in great gray owl protected activity centers, California spotted owl protected activity centers, and the southern Sierra fisher conservation area, including in the wildland-urban intermix. This alternative is also prescriptive in that it restricts the removal of 30-inch or larger diameter trees and restricts reduction in canopy cover. Although the foothill zone (except portions of the Sierra National Forest) does not have many large-diameter trees due to past land management practices, some dense, even-aged stands of large-diameter trees exist in areas that were logged by the railroad starting in the late 1800s. In these 90- to 110-year-old, even-aged second growth forests, many of the trees growing on highly productive forestlands have been previously thinned and most trees are now 30 inches or larger. These forests have fewer pine trees and are denser than they would have been historically and are outside the natural range of variation. Stands with large trees and moderate to dense canopy cover are now classified as suitable habitat for fisher further restricting potential restoration treatments. Vegetation treatments are limited within protected activity centers and fisher habitat, limiting the opportunity to restore resilience of these protected areas to support species in the future as oaks, pines, and other important habitat elements are lost to fire, insect outbreaks, intense drought conditions, and competition with shade-tolerant trees. Large areas of Pacific fisher habitat and many California spotted owl protected activity centers have already been lost in the Sierra Nevada to large wildfires with high-severity effects that have completely removed forested landscapes, including canopy cover, live trees, and structurally complex understories (see species accounts in "Affected Environment" section).

Consequences Specific to Alternative B

There would be some increase in restoration in the foothill zone in alternative B because of management direction to reduce fire risk to communities and increase resilience of oak woodlands to climate change. Within the community wildfire protection zone and general wildfire protection zones there is plan direction to incorporate ecological desired conditions wherever possible, so that vegetation in these areas moves toward vegetation desired conditions and the natural range of variation (MA-CWPZ-DC-02; MA-CWPZ-GDL-02; MA-CWPZ-GOAL-02; MA-GWPZ-DC-02; MA- GWPZ-GDL-01; MA-GWPZ-GOAL-01). This alternative incorporates new desired conditions for blue oak, interior live oak, and chaparral live oak habitat types and fire behavior in this zone that would more clearly direct management than under alternative A and would result in improved habitat condition (Table 40 and Table 41 in

"Terrestrial Vegetation Ecology"; and Table 81.) With these desired conditions, objectives (TERR-FW-OBJ-01 to 03), and guidelines (TERR-FW-GDL-01 to 02, -04; TERR-BLCK-GDL-01 to 02), management is directly addressing the desire to improve resilience, recruitment, and structural diversity and complexity of this habitat type. As a result, it is anticipated that the composition and structure of the habitat in this zone will move from low/moderate to moderate similarity to desired conditions in restoration areas (see "Terrestrial Vegetation Ecology" section). Although this alternative improves habitat condition beyond alternative A, the magnitude of this improvement may not be as dramatic as for the montane zone because fewer acres in this zone are proposed for mechanical treatment.

Alternative B also emphasizes restoration in focus landscapes. These will overlap with portions of the westside foothill vegetation, especially where there is fisher and owl habitat. Vegetation types in these areas would include ponderosa pine and black oak. Treating in large focus landscapes under alternatives B and D would more rapidly improve the resilience of the greater landscape to wildfire and changing climate conditions than alternatives A and C. Alternatives A and C emphasize treatments on the patch and stand scale, which does not translate into a greater degree of resiliency that is achieved with landscape scale restoration. Focus landscape treatments not only function to disrupt the spread of high-intensity wildfires over large landscapes, they are also intended to move the vegetation types closer to within the natural range of variation (see "Terrestrial Vegetation Ecology" section Table 37). This shared emphasis would improve habitat condition for at-risk terrestrial wildlife species where treatments help the habitat trend toward improved heterogeneous conditions with enhanced structural diversity and landscape connectivity. Therefore, this alternative has less of a risk of habitat loss in this zone to large-scale disturbances and better potential to maintain or improve habitat condition on the landscape than alternatives A and C.

This alternative has more flexibility than alternative A to use a variety of management techniques to achieve the desired conditions more rapidly. Although managed wildfire would not usually be used near communities, there is potential to use more mechanical treatments and larger landscape scale prescribed fires (TERR-OLD-GDL-01; SPEC-CSO-GDL-07; SPEC-PF-GDL-04; SPEC-CSO-STD-01 to 02; SPEC-PF-STD-01). Therefore, where this habitat occurs, particularly outside of the community buffers but within focus landscapes, it is expected that this alternative would be in a better position than alternative A to move vegetation toward desired conditions using more effective treatment techniques.

The consequences for habitat resilience in westside foothill vegetation differs for blue oak woodlands or chaparral from ponderosa pine or black oak. The management approach under this alternative is anticipated to maintain a moderate resilience to large, high-intensity fires in blue oak woodlands and chaparral. For ponderosa pine and black oak, the management approach is anticipated to move the landscape from a very low to a low resilience overall and to a moderate resilience in focus landscapes to large, high-intensity wildfires and improve resilience beyond alternative A to the stressors of changing climate conditions. Improving the resilience of the landscape would improve habitat condition and reduce the risk of habitat loss for wildlife. However, large, high-intensity wildfires are anticipated to continue under this alternative (see "Fire Trends" section) and may remove habitat and important habitat elements (such as canopy cover, large-diameter trees) for mature forest associated species (see "Terrestrial Vegetation Ecology" section). But given the emphasis on landscape treatments, it is anticipated that high-intensity fires would affect smaller and more variable patches of habitat than those that currently burn and are predicted to burn under alternative A. A mosaic pattern of varying fire effects on the

landscape can improve heterogeneity for species like California spotted owls and Pacific fisher that may use low, moderate, and mixed-severity burned areas for foraging.

There is a greater risk of treatment-related effects to habitat quantity and condition under this alternative compared to alternative A because of the greater flexibility to remove larger diameter trees within the two wildfire protection zones and to treat within California spotted owl protected activity centers and suitable fisher target cells within community buffers and focus landscapes. There is no restriction on the size of tree that can be removed in the community and general wildfire protection zones, but vegetation treatments that may include the removal of some large trees would be designed to move toward desired conditions for vegetation, old forest, and wildlife (TERR-OLD-DC-03 to 04, TERR-OLD-GDL-01; SPEC-FW-GDL-01).

On the Sierra National Forest, most of the community wildfire protection zone overlaps with westside foothill vegetation. The combined area overlap contains 25 percent of suitable fisher target cells and 20 percent of California spotted owl protected activity centers. The removal of some large-diameter trees could reduce prey abundance, reduce canopy cover, and remove potential resting, denning, nesting, and roosting sites. It could also be compounded by the potential for loss of some large-diameter trees from patches of mixed- and high-severity fires, and insect and pathogen outbreaks. Old forests would likely benefit if treatments reduce the loss of other large and old trees in the future. Management in California spotted owl protected activity centers and suitable fisher target cells could also cause temporary impacts on habitat condition, particularly where canopy cover is reduced.

Although there is potential for treatment-related impacts to habitat condition, there are a variety of plan components to guide project design, including in sensitive habitats like California spotted owl protected activity centers and suitable fisher target cells (TERR-FW-GDL-01 to 04; TERR-OLD-GDL-01 to 02; TERR-CES-GDL-01, -03, -06; SPEC-CSO-STD-03 to 06; SPEC-PF-STD-01 to 04). These plan components are intended to allow treatments to preserve habitat condition and reduce the risk of habitat loss in the long term, while tempering the magnitude of effects in the short term. For example, the desired conditions for vegetation types, including old forests, describe the number and size of large trees that are desired (see Table 37 in "Terrestrial Vegetation Ecology" section, TERR-OLD-DC-03 to 04), which were developed with mature forest-associated species needs in mind (SPEC-CSO-DC-02, -04; SPEC-PF-DC-02, -05, -07).

For California spotted owl protected activity centers and suitable fisher target cells, there are new fine-filter plan components (see Table 83); these provide flexibility to address fire risk where these habitats overlap with community buffers (SPEC-PF-DC-06) and provide long-term habitat resilience in the two wildfire protection zones and focus landscapes while maintaining key habitat elements in most of these habitats in the short term (SPEC-CSO-STD-01 to 02; SPEC-CSO-GDL-04, -07; SPEC-PF-GDL-04). All of these coarse and fine-filter plan components were developed to improve resilience of these habitats to changing climate conditions and reduce the risk of loss from large-scale disturbances like large, high-intensity wildfires. They were developed using a combination of recommendations included in General Technical Report 220 (North et al. 2009), General Technical Report 237 (North 2012), the "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA FS 2015a), and the "Southern Sierra Nevada Fisher Conservation Strategy" (Spencer et al. 2016). Therefore, these plan components, at the programmatic level of these plans, are anticipated to provide long-term habitat in sufficient quantity and condition for terrestrial wildlife species.

Consequences Specific to Alternative C

Effects to habitat condition and risk of habitat loss from large-scale disturbances are similar to those described under alternative A. Although the desired conditions for oak woodlands are the same as described under alternative B, this alternative proposes fewer acres of mechanical treatment, prescribed fire, and wildfire managed to meet resource objectives than alternative B and has less ability (similar to alternative A) to incorporate prescribed fire as a restoration tool due to existing heavy fuels and increasingly dense stand conditions. The landscape under this alternative, similar to alternative A, is less able to adapt to changing climate conditions and is less resilient to large high-intensity wildfire than the landscape under alternative B. Additional area in recommended wilderness in alternative C increases the area where there is little active management from 29 to 34 percent of the westside foothill vegetation. Overall, plan components to maintain current structure and density in the short term for California spotted owl and Pacific fisher would minimize short-term impacts to species but would constrain treatment pace and scale. This restriction on treatment intensity and treatment methods would make habitat for at-risk terrestrial wildlife species more vulnerable than under alternative B to loss from climate change, large disturbances such as high-intensity wildfire, drought- and insect-related tree mortality, and other stressors. Similarly, habitat condition is anticipated to move further away from the desired conditions without treatments designed to improve heterogeneity, structural complexity, and landscape connectivity.

Consequences Specific to Alternative D

In alternative D, the benefits to improve habitat condition and quantity, achieve resilience, and lower the risk of habitat loss are expected to be similar to those described under alternative B. However, this alternative would more rapidly achieve the desired conditions to move vegetation toward the natural range of variation due to the faster pace and scale of restoration (chapter 2, Table 6 through Table 8). This alternative is designed to improve the resilience of the landscape to large, high-intensity wildfire more than any other alternative and to improve resilience to climate change similar to alternative B, which is greater than under alternatives A and C. Similarly, this alternative would reduce the risk of habitat loss from wildfire and improve habitat conditions by creating diverse, heterogeneous landscapes more than any other alternative.

This alternative has the greatest potential for treatment-related short-term effects because of the increased pace and scale of treatment, enhanced flexibility to treat in California spotted owl protected activity centers during the breeding period after hatching, more flexibility to treat within suitable fisher target cells, and the ability to remove some large-diameter trees in all four strategic fire management zones. There are no diameter limits for the removal of some large trees but the emphasis is on managing toward desired conditions for large tree densities for each vegetation type and condition. In addition a guideline (SPEC-FW-GDL-01) is designed to protect known nest, roost, or den trees and surround trees for species of conservation concern. Although the approach under this alternative presents a greater short-term risk to habitat quantity and condition than alternative B from treatment actions, this alternative has the greatest potential to preserve existing habitat for at-risk terrestrial wildlife species by lowering the risk of large-scale disturbance events that create large areas of dead and dying trees.

This alternative also has the greatest potential to improve condition of currently unoccupied habitat that could support at-risk terrestrial wildlife species in the future. Although treatments would generally be limited in the westside foothill vegetation as compared to the montane zone, the benefit of improving current and potential future habitat condition in this zone, enhancing the distribution of potential habitat, and reducing the risk of widespread vegetation mortality is estimated to outweigh the potential for short-term impacts. This alternative continues to

implement fine-filter plan components for many mature forest-associated species (Table 83) with some minor adjustments discussed above.

Eastside Pinyon-Juniper, Sagebrush, and Mountain Mahogany

In this zone, sagebrush and pinyon-juniper are the primary habitats that support at-risk terrestrial wildlife species. These habitats occur predominantly on the Inyo National Forest but also occur on the eastside of the Sequoia National Forest. The following species are supported by the habitats in this zone:

- Bi-state sage-grouse meet all of their life history requirements in this zone, particularly in sagebrush habitat,
- Yellow-eared pocket mice are supported by pinyon-juniper and sagebrush habitats in this zone, and
- Pacific fringe-tailed bat forages in pinyon-juniper habitat.

There is analysis of eastside arid shrublands and woodlands, especially sagebrush, pinyon-juniper and eastside Jeffrey pine vegetation in the "Terrestrial Vegetation Ecology" section. This analysis builds upon that analysis and emphasizes wildlife habitat and species requirement aspects.

Consequences Specific to Alternative A

Habitat condition for at-risk terrestrial wildlife species in this zone would be relatively unchanged by management activities due to limited proposed treatments. Alternative A proposes the least amount of restoration of all alternatives. Treatments to reduce invading pinyon in sagebrush would occur focused primarily on sage-grouse habitat, but not at an increased pace as under alternatives B, C, and D. Pinyon would be treated where it overlaps the wildland-urban intermix and presents a fire risk. Under this alternative, the structure and composition of the habitat would likely remain departed from the desired conditions and this alternative is the least able to prepare the landscape to adapt to changing climate conditions. The landscape under this alternative would continue to have a low resilience to large high-intensity wildfire. Although fire is a natural part of these systems, large wildfires with high-severity effects could remove large areas of these habitats from the landscape until they are able to recover, assuming that native vegetation is not overwhelmed by invasive species. However, the condition could deteriorate and the amount of habitat could be reduced more than under any other alternative due to habitat type conversion from increases in cheatgrass, loss of quality habitat due to the spread of pinyon and Jeffrey pine into sagebrush habitat, and the increasing risk of large high-intensity wildfires.

Consequences Specific to Alternative B

This alternative would increase restoration levels compared to alternative A but would still treat relatively little of the woodland habitat in this zone (about 5 percent) compared to other areas on the Inyo and Sequoia National Forests. Eastside Jeffrey pine habitats are the most outside of the natural range of variation and at the greatest risk to stressors and, therefore would have increases in treatment (chapter 2, Table 6 through Table 8). Still, this alternative proposes to treat more habitat in this zone (including sagebrush and pinyon-juniper) than alternative A, focused on restoration of sage-grouse habitat and areas around communities at risk (TERR-FW-OBJ-01 to 03; SPEC-SG-OBJ-01). This would include restoration of 1 to 10 percent of sage-grouse habitat. There would be restoration of riparian areas, most of which would occur in this area on the Inyo National Forest (MA-RCA-OBJ-01). There would be an increase in the area treated to reduce nonnative invasive plants (INV-FW-OBJ-01). There are specific goals and management

approaches to increase emphasis on cooperation with adjacent landowners and other interested collaborators in managing habitat (SPEC-FW-GOAL-01 to 02, -04; SPEC-SG-GOAL-01). Management approaches include the following:

> Continue coordination and communication with the California Department of Fish and Wildlife, Nevada Department of Wildlife and the U.S. Fish and Wildlife Service during project development for all projects occurring within sage-grouse habitat.
>
> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, non-native species.

Habitat condition for at-risk terrestrial wildlife species is more likely to improve under this alternative and risk of habitat loss from large-scale disturbances is more likely to be less than under alternative A. This alternative has clear desired conditions for the resiliency, structural diversity, recruitment, functioning, and connectivity of these habitats (TERR-SAGE-DC-01 to 04; TERR-PINY-DC-01 to 05; TERR-XER-DC-01 to 04; TERR-MOMA-DC-01 to 02; TERR-SH-DC-01 to 02; SPEC-FW-DC-01 to 04; SPEC-SG-DC-01 to 09). This alternative also takes a landscape-level approach to restoration that would translate into large-scale improvements to habitat condition, including connectivity. The composition and structure of vegetation in restored areas in this zone would likely move from low similarity to desired conditions under alternative A to low-moderate similarity to desired conditions in restored areas under this alternative as described in the "Terrestrial Vegetation Ecology" section. Encroaching pinyon and Jeffrey pine would be more effectively removed from large zones of sagebrush. Although the use of prescribed fire would be somewhat limited (although not as limited as in alternative A), this restoration technique would move the structure of these habitats toward the desired conditions. There are specific standards and guidelines to guide restoration project design to enhance or limit impacts to wildlife habitat, especially for sage-grouse and other at-risk species (TERR-SH-STD-01; SPEC-SG-STD-01 to 13; TERR-XER-STD-01; RANG-FW-STD-01; TERR-XER-GDL-01; SPEC-FW-GDL-04 to 06; SPEC-SG-GDL-01 to 07). In addition, the following potential management approaches could help improve this zone:

> Prevention of unwanted fire in priority habitat can be accomplished through managing sagebrush systems to be resilient, implementing proactive fire prevention and limiting cheatgrass expansion.
>
> An adaptive management strategy shall be used when conducting vegetation treatments within sage-grouse habitat. Treatment methods and intensities will be determined based on the results of past treatments as information from those past treatments becomes available. If the results of past treatments show that those treatments have caused an increase in non-native annual grasses and poor sagebrush recruitment, further treatments within sage-grouse habitat will not adhere to the same prescription.
>
> When a right-of-way is no longer in use, relinquish the right-of-way and reclaim the site by removing powerlines, reclaiming roads and removing other infrastructure.
>
> Where sage-grouse habitat is being degraded due to wild horse and burro use, determine site-specific measures to improve or restore sage-grouse habitat.

Direction to limit the invasion and spread of nonnative plants is similar to alternative A (INV-FW-GDL-01 to 06). Nonnative invasive plants greatly reduce native plant composition, structure and fire patterns and consequently impact habitat (see "Terrestrial Vegetation Ecology" section).

Where these habitats occur in wilderness and support at-risk terrestrial wildlife species, the restoration approach proposed under this alternative would be better positioned to use managed wildfire to restore habitat condition (see "Fire Management" section). Most wilderness areas

would be in the wildfire maintenance zone where managing wildfires can safely be used to meet resource objectives is emphasized. This alternative is not expected to have as many severe and large, high-intensity fires like those predicted under alternative A (see "Fire Trends" section), which can completely remove this habitat from the landscape. Unlike alternative A, the management approach under alternative B moves the landscape toward to a moderate resilience to large high-intensity fire and better positions the vegetation to adapt to changing climate conditions.

Although short-term effects to habitat condition could occur due to the increased pace and scale of restoration and more intensive management tools (such as mechanical equipment), these effects would be site and project-specific and cannot be fully assessed at this programmatic level. At the programmatic level of the proposed plan, the long-term benefit to habitat condition and reduction in potential for habitat loss under this alternative is expected to outweigh the potential for short-term effects.

Consequences Specific to Alternative C

Alternative C emphasizes the management of fire, both the active use in prescribed burning at greater landscape scales as well as through managing wildfires to meet resource objectives. However, alternative C proposes to treat far fewer acres than alternative B, especially in this zone (chapter 2, Table 6 through Table 8). The exception is that restoration of sagebrush habitats important for sage-grouse would be slightly higher than alternative B. There is 3 percent more sagebrush and pinyon-juniper habitat in recommended wilderness in this alternative.

This alternative is more limited in the use of mechanical equipment that can effectively target specific trees for removal and help move vegetation toward the desired conditions. Therefore, although the potential for short-term effects related to implementation could be less under this alternative than under alternatives B and D, the long-term condition of many pinyon-juniper habitats that support a variety of at-risk terrestrial wildlife species would continue to trend away from desired conditions for structure, composition, function, and connectivity over time while conditions of sagebrush habitats would improve similar to alternative B. The forested habitat would be more vulnerable than alternative B to climate change and large high-intensity fire that can completely remove large areas of this habitat. Invasive species and encroaching pinyon and Jeffrey pine would continue to threaten sagebrush habitat where treatments are limited by restricting harvest to only smaller diameter trees.

Consequences Specific to Alternative D

In alternative D, benefits to habitat quantity and condition including structure, composition, and resilience to climate change and large high-intensity wildfire, and potential for short-term effects would be the same as those described for alternative B. This alternative proposes to treat about the same, or slightly more habitat in this zone than alternative B (chapter 2, Table 6 through Table 8). However, this habitat already faces threats due to invasive species (cheatgrass) and this alternative has the greatest risk of spreading invasive species due to more acres treated and more mechanical treatments.

Montane Forest (includes old forest components and complex early seral habitat)

This zone supports a large number of at-risk terrestrial wildlife species and is also the primary focus of restoration treatments under alternatives B, C, and D to move vegetation toward the range of natural variation. This zone and treatments within this zone would occur on the Sierra and Sequoia National Forests only. The following species are supported by habitat and specific habitat elements in this zone:

- California condors nest and roost in large conifers and giant sequoias.
- Pacific fishers fulfill most to all of their life history requirements in mature mixed conifer, ponderosa pine, and black oak forests with dead and downed wood, high and multi-layered canopy cover, and large trees (live and dead).
- Bald eagles nest in large live conifers and roost in large live and dead conifers especially where these trees are located near aquatic habitat (large lakes, rivers, streams).
- Great gray owls nest in large, decayed trees in forests with high canopy cover that are near meadows.
- California spotted owls fulfill most to all of their life history needs in mature mixed conifer and fir forests with high and multi-layered canopy cover and an abundance of large and mature trees and snags.
- Pacific fringe-tailed bats will roost in large and tall dead trees and forage in hardwood-mixed conifer forests.
- Townsend's big-eared bats are foraging generalists that use mid-elevation mixed conifer and hardwood mixed-conifer forests.
- Yellow blotched salamander typical habitat includes coniferous forest, deciduous forest, oak woodland, coastal sage scrub, and chaparral under logs, bark, moss, leaf litter, and talus or in animal burrows.

Although old forest habitat can occur in any zone, the potential effects of the draft plan alternatives on old forest characteristics are described in this section because many of the at-risk terrestrial wildlife species that persist in the montane zone are strongly associated with old forest habitat features such as large live and dead trees and complex stand structure. Similarly, complex early seral habitat can be developed anywhere there is a significant tree mortality event in mature forest, not strictly in the montane zone. Complex early seral habitat provides an important habitat type to several mature forest-associated species in that it can provide cavities for roosting (bats), an increased prey base for a variety of species, and a level of heterogeneity and edge habitat that can benefit some species like California spotted owls and great gray owls and the Sierra Nevada red fox. Because many of the species that persist in this zone are also associated to some degree with complex early seral habitat the potential effects on this habitat type are described in this section. In the "Terrestrial Vegetation Ecology" sections, there is analysis on montane vegetation, old forests and complex early seral habitats. This section builds upon that analysis with an emphasis on wildlife habitat and species requirements.

There are specific desired conditions for vegetation for alternatives B, C, and D that provide a template for restoration of habitat toward the natural range of variation (TERR-MONT-DC-01 to 07; TERR-POND-DC-01 to 05; TERR-DMC-DC-01 to 06; TERR-MMC-DC-01 to 06). All three alternatives would continue to implement the current fine filter components for the protection of great gray owl known nests and nesting habitat in protected activity centers (SPEC-GGO-GDL-01 to 02; see also Table 83 above). Therefore, the alternative analysis focuses on the relative ability of varying coarse-filter plan directions to provide habitat that supports the persistence of the species.

Consequences Specific to Alternative A

Throughout the three national forests the habitat in the montane zone is becoming increasingly dense and homogenized under the current management approach (see "Terrestrial Vegetation

Ecology" section). There is little vertical structural complexity and diversity, and low levels of habitat heterogeneity. These conditions are generally the result of decades of fire suppression, relatively slow treatment rates, limited treatment tools, emphasis on treatments at the patch and stand scale (instead of landscape scale) in the wildland-urban intermix, and requirements to retain all large-diameter trees and dense canopy cover everywhere except in the wildland-urban intermix. Forested habitat within this zone is moving further away from conditions that support at-risk terrestrial wildlife species. There is generally a lack of habitat heterogeneity and structural complexity that supports terrestrial wildlife, particularly prey species. Increasingly uniform canopy condition from the rapidly growing understory of shade-tolerant trees reduces the amount of sunlight needed to maintain the understory shrub layer that supports forage and cover for a variety of prey species. The increase in small- and medium-diameter trees competes with larger trees for critical resources, exacerbating existing stressors on these systems (like drought) and generally limiting the ability of these larger trees to grow and support nesting and denning habitat for a variety of wildlife species like Pacific fisher, California spotted owl, great gray owl, and bald eagle that are strongly associated with large-diameter trees.

As a result of these habitat conditions that continue to trend away from the natural range of variation, the landscape under this alternative has the lowest adaptive capacity to climate change that would promote long-term ecological sustainability and resilience. Alternative A would provide a low level of long-term connectivity for forest-dependent species (lower than alternatives B and D) because it is the least flexible management approach in addressing rapidly changing climate conditions that could lead to the large-scale loss of contiguous areas of forested habitat.

Alternative A also has a lower potential than alternatives B and D to reduce the risk of large, high-intensity wildfires (see the "Fire Trends" section) which can increase the quantity of early seral habitat but also substantially reduce the quantity of forested habitat within this zone. Under this alternative, burned area, fire size, and fire intensity are expected to continue to increase. Wildfires under this alternative are predicted to have large patches of high-intensity and high severity effects that could completely remove habitat and habitat elements (such as large live trees, dense canopy cover, and high structural diversity). Where these fires occur and the habitat trends toward early seral conditions, there would be an overall increase in the amount of early seral habitat. Post-fire and early seral habitats are valuable to a variety of species, including avian species (White et al. 2015) and some small mammals. Species like California spotted owls can benefit from an increase in these kinds of habitats where prey abundance increases. However, such large fire events (and other large-scale disturbances) threaten contiguous patches of dense forest that have good canopy cover and large trees, which are preferred nesting and roosting habitat for California spotted owls.

The relatively slow rate of restoration (chapter 2, Table 6 through Table 8) and emphasis on treating the wildland-urban intermix under this alternative can't keep pace with the build-up of high fuel volumes throughout the landscape, improve landscape heterogeneity, and help the forest vegetation trend toward the natural range of variation. Treatments in the wildland-urban intermix are important to reduce the fire risk to communities. However, treatments primarily focused on reducing fuels in these areas may not necessarily restore structure, composition, and heterogeneity toward the natural range of variation that would support terrestrial wildlife species. The uniformity of stand structure in these areas is characterized by very little to no vertical complexity, few to no surface fuels (like shrubs and down woody debris), and relatively fewer snags than in unmanaged areas, which translates into poor habitat condition for many specialized terrestrial wildlife species. Elsewhere on the landscape, outside of the wildland-urban intermix,

stand structure is becoming increasingly homogenized due to continued ingrowth from fire suppression. These stands may struggle to support terrestrial wildlife species in the future as shade-tolerant trees compete with larger trees for resources needed to grow (like nutrients, light, and space) and reduce the vertical and horizontal structural complexity, including the shrub layer that supports prey.

The forested habitat in the montane zone outside the wildland-urban intermix continues to be at a high risk to large high-intensity fire without treatment priority and landscape-level treatments. Although fire is a natural component of Sierra ecosystems, fires are becoming increasingly massive and often burn large areas at high intensity rather than in a mosaic of intensities (Collins and Skinner 2014). The result is that habitat that previously supported dense conditions and canopy cover is converted to burned snag habitat and early seral habitat. Although early seral and burned forest habitats are important ecosystems and support a large variety of terrestrial wildlife species, the loss of forested habitat at such large scales is not sustainable for terrestrial wildlife habitat. Ultimately, a landscape that continues to burn, such as has been seen in recent years, cannot sustain habitat for species associated with dense canopy cover stands unless treatments can be done to break up the fuel loading and restore heterogeneity back on the landscape, and change fire behavior to promote early seral and burned forest habitat while also protecting densely forested, high canopy cover habitat.

Under this alternative, plan direction is generally prescriptive and species-specific, with limitations on two primary metrics: diameter limits of trees that can be removed and requirements to retain certain amounts of tree canopy cover. This alternative includes forestwide canopy closure requirements and prohibits the removal of trees greater than 30 inches diameter (except for removal of hazard trees and to enable equipment operation). Even where trees less than 30 inches in diameter are marked for removal, the maximum diameter limit is often set to a much lower size because removing these larger trees (even under 30 inches) would drop the residual canopy cover below that described in the designation for certain wildlife habitats (such as protected activity centers and southern Sierra fisher conservation area). Nearly all of the at-risk terrestrial wildlife species associated with these habitat elements would experience no direct adverse consequence to habitat condition because of the direction to retain these elements. However, without the flexibility to remove some large trees within increasingly dense and homogenized forests, there would be limited opportunity to improve long-term habitat resilience to changing climate conditions and decrease the risk of loss to large, high-intensity wildfires and other large-scale disturbances. California spotted owl and Pacific fisher habitat would continue to be vulnerable to loss from the landscape. Habitat condition would deteriorate over time as stands become increasingly dense and homogenized, large trees become more stressed for adequate growing conditions, and vertical and understory complexity and habitat heterogeneity decrease.

Similarly, the current management direction includes species-specific direction designating sensitive habitat and protecting that habitat from disturbance. Fisher habitat is designated and protected in the southern Sierra fisher conservation area and California spotted owl nest and roost locations are protected in designated protected activity centers which are inside larger designated home range core areas. These management areas are severely limited from treatment except in certain parts of the wildland-urban intermix. Even in these areas, there are restrictions on the use of mechanical equipment and prescribed burning, and requirements for the maintenance of canopy cover. Limited operating periods preclude treatments during critical breeding times. This species-specific approach has generally prohibited treatments from occurring in these areas under the current plan and retained habitat elements (such as canopy cover and dense conditions) that are important to these species. However, these management areas are becomingly increasingly

dense, far outside the range of natural variation in many cases, and are proving vulnerable to large-scale disturbances. For example, large areas of Pacific fisher habitat and California spotted owl protected activity centers have been lost to large wildfires with high-severity effects that have completely removed forested landscapes, including canopy cover, live trees, and structurally complex understories. For the California spotted owl, a species that ranges throughout the Sierra Nevada, many protected activity centers throughout the range have been lost to large wildfires. Although management direction under the current plan has intended to protect habitat for these species, and protection in designated areas with treatment restrictions should continue to occur under any alternative, precluding carefully guided treatments from these areas or requiring that treatments retain unnaturally dense conditions throughout the landscape makes these species and their habitat more vulnerable to being lost on the landscape.

Where fires and other large-scale tree mortality events occur, and the landscape is characterized by dead standing and down trees with no canopy cover and no understory vegetation, the removal and sale of burned trees over portions of the areas would continue. However, for large fires, salvage would not occur in at least 10 percent of the burned area to provide habitat for species dependent upon complex early seral habitats, such as some migratory birds. Although this habitat is not preferred nesting or denning habitat for California spotted owls and Pacific fisher, or roosting habitat for bats, removal of large snags and downed woody debris from large areas may still affect other habitat conditions. These areas can support a strong prey base for these species, and prey for bats, as well as large snags and large downed woody debris that could be used as rest and roost sites. These habitat values change over time as dead trees fall down, vegetation grows, and understory conditions change, affecting prey habitat and prey availability.

The current plan includes direction to design projects to protect and maintain critical wildlife habitats, including retaining at least 10 percent of large wildfires unsalvaged, which provides undisturbed habitats for wildlife species. In reality, on most recent very large wildfires, substantially more than the required minimum 10 percent has been left unsalvaged. However, some recent research indicates that areas burned by high to moderate-severity wildfire had an increase in standing snags and shrub vegetation which in combination with severe fire weather, promoted high-severity fire in these areas later (Coppoletta et al. 2016). Therefore, under this alternative, where fires are predicted to burn larger and at higher intensities, there would be some value in removing some areas of snag habitat, in strategic locations on the landscape, because of the trade-off of long-term benefit to habitat condition by reducing the frequency with which these burned areas sustain future wildfires with high-severity effects. Removing some snags from these areas may also increase the ability to better contain large, rapidly spreading high-intensity fires safely, thereby reducing the total amount of forested habitat lost to wildfires.

Consequences Specific to Alternative B

In comparison to alternative A, the management approach proposed under alternative B increases the pace of restoration. An overall increase in restoration treatments to improve resilience and trend vegetation toward desired conditions would likely improve forest habitat condition in this zone and reduce the risk of habitat loss (preserve habitat quantity) to large-scale disturbances such as high-intensity wildfire and insect outbreaks more successfully than under alternative A. More area would be treated using mechanical treatment and prescribed fire (TERR-FW-OBJ-01 to 04), including in riparian areas (MA-RCA-OBJ-01). Treatments would also be more flexible, allowing greater movement toward vegetation desired conditions and the natural range of variation in most treated areas, particularly in focus landscapes and in the fire protection zones. In these areas, there is more flexibility to treat California spotted owl and Pacific fisher habitat. The

table below summarizes management direction specific to these montane species that affects vegetation restoration and varies in and out of focus landscapes and community buffers.

Table 84. Plan components guiding vegetation treatments in fisher and owl habitat that differ between areas in community buffers, focus landscapes, and outside of these two areas

In Community Buffers	In Focus Landscapes	Elsewhere
Fisher habitat desired conditions are same as vegetation ecological desired conditions (SPEC-PF-DC-06 to 07)	Fisher habitat desired conditions are same as vegetation ecological desired conditions (SPEC-PF-DC-06 to 07)	Fisher desired conditions, managed toward at least 60 percent of target cells for high canopy cover (mostly greater than 60 percent) (SPEC-PF-DC-05)
None	None	Fisher limited operating periods (SPEC-PF-GDL-04)
Limits on acres of spotted owl protected activity centers treated to 5 percent per year or 10 percent per decade (SPEC-CSO-GDL-07)	Limits on acres of spotted owl protected activity centers treated to 5 percent per year or 10 percent per decade (SPEC-CSO-GDL-07)	Limits on acres of spotted owl protected activity centers treated to 5 percent per year or 10 percent per decade (SPEC-CSO-GDL-06)
Limits on treatment levels in Fisher target habitat cells (SPEC-PF-STD-02). Up to 50 percent of each cell in 10 year period	Limits on treatment levels in Fisher target habitat cells (SPEC-PF-STD-02). Up to 50 percent of each cell in 10 year period	Limits on treatment levels in Fisher target habitat cells (SPEC-PF-STD-02). Less than 13 percent of each cell in 5 year period

Alternative B proposes to restore vegetation at a landscape scale (focus landscapes) which can more effectively improve habitat connectivity for species than alternative A and also better enable wildfires to move through the treated landscape in a mosaic pattern with smaller patches of varying severities of fire effects. Most of the focus landscape areas would occur in the montane zone because the emphasis is on restoration of resilience in California spotted owl and Pacific fisher habitat (see description of focus landscapes in the "Terrestrial Vegetation Ecology" section). The following potential management approaches would emphasize restoration of larger landscapes in owl and fisher habitat, especially at higher risk of large, high-intensity fires:

> Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to the Pacific fisher and California spotted owl.
>
> To protect old forest components from uncharacteristic fire, prioritize restoration in key old forest areas. Methods of protecting existing old forest components on the landscape may include thinning, selective harvest, prescribed fire and wildfires managed to meet resource objectives.
>
> Prioritize ecological restoration of protected activity centers that have departed furthest from protected activity center and/or vegetation desired conditions, and that promote the greatest ecological resilience of the protected activity center. Also consider prioritizing protected activity centers with the highest wildfire risk in the community buffers, such as on upper slopes or ridge tops or in canyons with large areas of chaparral below. Consider the risk of large high-intensity wildfire to clustered protected activity centers, degree of departure from desired condition, and whether some should be managed to reduce wildfire risk and increase overall resilience of protected activity centers and vegetation in an area. (California Spotted Owl).
>
> Within protected activity centers, locate restoration treatments to minimize impacts to the protected activity center while considering opportunities to increase the resilience of the overall network of protected activity centers. Prioritize areas where dry vegetation is

most departed from desired conditions and where treatments would provide for the most resilient conditions for the entire protected activity center.

Prioritize ecological restoration in landscapes around key linkage areas and areas with suitable habitat at highest fire risk.

Large, high-intensity fires are predicted to occur across the analysis area but fire-severity effects would be reduced in treated focus landscapes and other large areas with at least 40 percent of the area restored to vegetation desired conditions (see "Fire Trends" and "Terrestrial Vegetation Ecology" sections). This includes the Kern Drainage on the Sequoia National Forest that is already largely resilient. In these restored landscape areas, there would be less area in high severity and smaller patches of high severity. Wildfires with low to moderate-severity effects (that don't become crown fires) can benefit habitat condition for terrestrial wildlife species by reducing stand density, improving structural complexity of habitat, creating snags, improving heterogeneity of the landscape, and increasing shrub regeneration (for cover and prey resources) while also retaining some key habitat features like large, fire-tolerant trees and canopy cover. Small patches of high-severity fires can also benefit habitat for mature forest wildlife species because the resultant habitat, particularly as it trends toward complex early seral habitat, can support a variety of prey.

Overall, ecological resilience to large, high-intensity wildfire is anticipated to move from low resilience under alternative A to moderate resilience under this alternative in the focus landscapes and other areas where larger landscapes are restored (see "Fire Trends" section). This improved resilience would have long-term positive benefits for the habitat condition and quantity for at-risk terrestrial wildlife species associated with mature forest habitat in these areas. However, because this alternative does not treat enough of the overall montane landscape (about 40 to 60 percent) within a decade to achieve a greater resilience to large, high-intensity wildfire (see "Fire Trends" section, Westerling et al. 2015), habitat for mature-forest-associated species and key habitat elements like large trees and dense canopy cover would continue to be at risk of loss, especially in untreated areas. This includes two-thirds or more of the montane zone in the analysis area. This risk is less than under alternatives A and C but more than under alternative D, which proposes to treat a greater proportion of the landscape and promote a greater resilience to large wildfires.

Where high-severity wildfires occur, salvage would be conducted under this alternative using an integrated approach that considers safety, the ecological value of complex early seral forest, areas to anchor for follow-up prescribed burning, and economic recovery of forest products (TERR-CES-GDL-01, -03 to 06). Like alternative A, at least 10 percent of burned areas are left unsalvaged to provide for complex early seral habitat using passive restoration. Additionally, fine-filter plan components are in place to guide salvage projects in protected activity centers and suitable fisher target cells (SPEC-CSO-STD-06; SPEC-CSO-GDL-02a; Table 83). Therefore, short-term impacts to habitat condition under this alternative are expected to be similar to alternative A, but this alternative provides more specific guidance for project development that takes into account the value of this seral stage.

Unlike alternative A, alternatives B, C, and D guide project development through a set of desired conditions, standards, and guidelines to manage some areas within the natural range of variation while using habitat science for canopy cover desired conditions in some vegetation types. Most of the vegetation desired conditions are described with ranges. For example, for moist mixed conifer, desired canopy cover ranges from 20 to 90 percent, with a median of 60 percent (TERR-MMC-DC-02). Similarly for dry mixed conifer, desired canopy cover ranges from 10 to 60 percent, with a median of 30 percent (TERR-DMC-DC-03). With the emphasis on restoring

heterogeneity, there would be groups of trees or at least small areas that have more canopy cover on dry and especially moist sites (TERR-FW-GDL-01). See Figure 33 in the terrestrial vegetation section for maps showing an example of changes that would occur with restoration.

Focus landscapes also reduce the potential for severe short-term impacts that could result from single or double-entry treatments that substantially reduce basal area and canopy cover. Many species in this zone, including California spotted owls and Pacific fisher, persisted and evolved on the landscape when the forest structure, especially in the montane zone, was far less dense (a lower basal area and less canopy cover) than it is today (Safford 2013). It may be that the increasingly dense forest conditions created from decades of fire suppression and limitations on mature forest restoration, particularly in the mixed conifer vegetation types, have inflated the overall amount of habitat for these species on the landscape. By emphasizing the movement of vegetation types toward these natural conditions, over time, the amount and condition of habitat similar to that which supported these species for hundreds of years, will likely contribute to their maintenance in the future (Haufler 1999).

The tradeoff under any management approach is finding an appropriate balance between short-term risks from restoration treatments and long-term gains from improvement in habitat condition. To improve resiliency, there is a need for greater flexibility than alternative A to treat the landscape, including habitat within California spotted owl protected activity centers and suitable fisher target cells and habitat elements preferred by these species. Although impacts might occur on a project-specific basis, these treatments would be carefully guided by coarse and fine filter desired conditions for vegetation types and wildlife habitat, and restricted in important ways by fine-filter standards and guidelines (see Table 83 above). These plan components were crafted with the idea that treatment to improve habitat condition is needed and warranted for these species but such treatments in these sensitive habitats should retain large areas of preferred habitat elements that support these species. In addition to the plan direction described in Table 82 above on the rate of treatment and limited operating periods for fisher and owls, there is additional direction on management in protected activity centers (SPEC-CSO-STD-01, -03 to 05; SPEC-CSO-GDL-01 to 03, -05, -06), fisher denning habitat, and for habitat connectivity (SPEC-PF-STD-01 to 04, SPEC-PF-GDL-01; SPEC-PF-GDL-02 to 03). The direction for protected activity centers is similar to alternative A but with some increased consideration of restoration needs to increase resilience to large high-intensity fires in areas at greatest risk. For example, in protected activity centers in focus landscapes where the dry vegetation type is restored, restoration is limited to one-third of the protected activity center per decade (SPEC-CSO-STD-02). The rest of the protected activity center is not treated toward the dry vegetation type desired conditions. In this way, the potential for short-term risks is lessened and balanced with the need for restoration.

Still, changes in forest structure to achieve resilience, particularly in the focus landscapes where there is a greater degree of flexibility to treat in wildlife habitat (see Table 82 and Table 83 above) can have short-term impacts on habitat condition. The magnitude of these impacts would be the subject of project-specific analyses and are beyond the scope of this programmatic analysis. In the focus landscapes, the majority (greater than 60 percent) of restoration under alternative B is prioritized for the dry vegetation type. Although many mature forest-associated species, especially fisher and owl, are strongly associated with dense canopies more typical of moist mixed conifer habitat, some protected activity centers and suitable fisher target cells occur in areas with dry vegetation types. For example, dry mixed conifer forest comprises an estimated 21 percent (21,000 acres) of all habitat within California spotted owl protected activity centers on the Sequoia and Sierra National Forests, and 45 (20 percent) of all California spotted owl protected

activity centers contain more than 50 percent of the dry mixed conifer type. This dry vegetation type is now characterized by unusually dense stand conditions and canopies that have resulted from decades of fire suppression (Safford 2013). As a result, many species that would typically not nest, den, or roost in dry vegetation types may now use this habitat. It is possible that this trend of increasingly dense stand conditions, especially in the dry vegetation type, has unnaturally increased the distribution of owl and fisher habitat on the landscape. Where this dry vegetation type is treated to move closer to the desired conditions in the focus landscape, which could include substantial reductions in canopy cover (down to possibly 30 percent average cover in some patches) and removal of some large trees, temporary local declines in owl and fisher abundance may occur. However, fine-filter plan components limit the acreage of California spotted owl protected activity centers and number of suitable fisher target cells (and percent of each) that may be treated for the dry vegetation type (see Table 82 above), thereby retaining important habitat elements like dense canopy cover and large trees where they exist throughout much of their habitat. Outside of the fire protection zones, the diameter limit restricting harvest of trees greater than 30 inches for other than safety or very limited operational issues remains (TERR-FW-STD-01). This is the same as in alternative A, but in alternative B it only applies to areas outside of the fire protection zones. In all areas, there are specific desired conditions for large tree densities (TERR-OLD-DC-04 to 05) and direction to retain older, decadent trees (TERR-FW-GDL-01 to 02).

Some moist vegetation sites, more typical of those supporting mature forest species like Pacific fisher and California spotted owl, would also be treated where they are outside the natural range of variation, especially to increase heterogeneity (TERR-FW-GDL-01 to 02). There would be less change in canopy cover compared to the dry vegetation type but there would be potential for considerable thinning of various diameter trees to improve heterogeneity, complexity, provide competitive release for the growth of the largest trees, and reduce stand density to improve resilience to large-scale disturbances. There is some risk to habitat condition in the short term under this alternative where the canopy is reduced and where large-diameter trees are removed in areas in the two wildfire protection zones. Such changes could reduce prey abundance in the short term, increase predation by opening up the canopy and forest, and remove potential denning, nesting, and roosting structures. However, a one-size-fits-all quantitative limit on canopy cover retention may prevent managers from restoring vegetation heterogeneity (North et al. 2007). This may limit enhancing long-term habitat condition and may perpetuate the risk of habitat loss from large, high-intensity wildfire (Collins and Skinner 2014). This may be the case especially in some areas that were railroad logged at the turn of the century where entire stands are dominated by young large trees (see “Terrestrial Vegetation Ecology” section). There are many fine-filter plan components (especially desired conditions, see Table 83) that clearly describe the value of canopy cover (and large trees) for these habitats, including where they occur outside of the focus landscapes.

There is a potential for the loss of large-diameter trees by both management actions and large-scale disturbance (like high-intensity wildfire) in this zone under alternative B. This is analyzed in the “Old Forest” subsection of the “Terrestrial Ecosystem Processes and Functions” section. Here, additional analysis on the implications for wildlife habitat is described. Effects of large-diameter tree loss from management actions in the two wildfire protection zones are anticipated to be greater than alternatives A and C, which propose limited removal, but less than alternative D, which proposes twice the numbers of acres restored. There is a strict 30-inch diameter limit in alternative A and outside the fire protection zones in alternative B. In alternative C, there are diameter limits but with specific exceptions for restoration purposes within fisher habitat. In the community and general wildfire protection zones in alternative B and in all areas in alternative D,

there is no diameter limit but management is focused on desired conditions for large tree densities. Large-tree removal can have short-term impacts on mature-forest-associated wildlife species, but overall, the removal of large-diameter trees under this alternative and alternative D is expected to improve long-term habitat condition in these zones. Removal of large-diameter trees could temporarily alter prey abundance, reduce canopy cover, remove potential or unidentified nest, roost, den, or rest sites, increase potential for predation, or influence thermal conditions within treated stands. Known nest, dens, roosts, rest sites, and any trees providing immediate protection of these sites (such as thermal or predatory cover) would not be removed. Although such short-term impacts could occur, the removal of some large-diameter trees is expected to improve long-term habitat condition in these zones as vegetation treatments would be designed to promote the growth and vigor of existing large or larger trees, improve resilience, and increase heterogeneity, all of which are described in the desired conditions. Importantly, the flexibility to remove a large-diameter tree would not be a relied upon tool to achieve restoration under this alternative.

The removal of large-diameter trees (greater than 30 inches in diameter) would be an exception and considered as part of project-level planning and design with desired conditions for vegetation (TERR-OLD-DC-01 to 02; TERR-OLD-GDL-01) and wildlife habitat condition (SPEC-FW-GDL-01) in mind. Removal is generally intended over the long term to improve the health and vigor of existing large or older trees, increase heterogeneity in severely homogenized forests, improve resilience to stressors, restore and sustain old forest conditions, or, in the short term, to address health and safety risks. Large trees would not be removed to favor the growth of much smaller trees. Such projects would be planned by an interdisciplinary team (including a wildlife biologist) and based on site-specific conditions. Treatments would generally not reverse seral stage development (that is, convert late-seral to mid-or early-seral stands by removing large and old trees). Canopy may be opened by removing individual trees but canopy cover would not drop below median values for vegetation types (dry and moist) or drop below desired conditions for wildlife habitat except as permissible in the portions of focus landscapes and community buffers that are in the community wildfire protection zone or general wildfire protection zone. Projects would retain clumps of trees where project objectives can be achieved. Projects would also retain known nest, den, or roost trees or adjacent trees that provide necessary conditions for these trees as well as large trees with deformities, cavities, open tops, or other complex features that are identified as providing habitat features for wildlife. Few large-diameter trees would be removed through management actions in the wildfire restoration and wildfire maintenance zones, except those trees specifically designed to restore other ecological conditions, such as aspen or hardwood stands, or to address tree diseases or health and safety risks.

Within these zones, removal of large-diameter trees would primarily occur in portions of focus landscapes, community buffers, and roads and ridges that are within the two wildfire protection zones. In these areas, standards and guidelines exist, particularly for the focus landscapes, to build sidebars relevant to wildlife habitat protection into the project design.

Areas outside of the focus landscapes and community buffers would have less intensive restoration and retain more canopy cover due to treatment limitations in fisher and owl habitat (see Table 84). Large trees would be minimally treated, with the only exceptions being for equipment operability and safety. Examples of specific restoration treatments would be to remove conifers to improve aspen or hardwood stands or to treat small areas affected by tree diseases. Although this constraint could substantially reduce the potential for short-term impacts, this management approach risks the loss of large trees to wildfires and other large-scale disturbances, and degradation of habitat condition where the flexibility to treat even-aged, dense, homogenized

stands is severely limited. Although this risk would be greater under alternatives A and C due to the predicted increase in large, high-intensity wildfires and high risk of drought, and insect- and pathogen-related mortality, this still constitutes a long-term risk under alternative B. Large trees outside these zones may continue to be at risk of large-scale disturbances where some removal could improve the vigor and health of existing larger trees but is precluded.

When conducted on a landscape scale and guided by best available science and monitoring, restoration efforts focused on old forest conditions that move forest vegetation toward the natural range of variation and reduce the risk of large-scale habitat loss would have a long-term benefit to species associated with mature forest conditions like the spotted owls and fishers that would outweigh short-term effects (less than 5 years after implementation).

Consequences Specific to Alternative C

Similar to alternative A, the landscape under alternative C would continue to be at a low resilience to large, high-intensity fire. This alternative is slightly better than alternative A by increasing the amount of prescribed burning and areas where wildfires are managed to meet resource objectives, which would help restore the ecological function of fire but not as successfully as alternatives B and D at improving overall resiliency to climate change stressors.

This alternative emphasizes restoring fire as an ecosystem process in fire-adapted ecosystems (ponderosa and Jeffrey pine, and mixed conifer). However, there is reduced emphasis on the use of mechanical equipment for restoration and any treatment would focus on the removal of small diameter trees. It is uncertain how much fire could be restored without first mechanically treating areas. Dense forest conditions would severely limit the ability to safely use fire (prescribed and managed wildfire) as a restoration tool.

Thinning would be more limited within habitat of Pacific fisher and California spotted owls than in alternative B because this alternative incorporates relevant recommendations in the “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands” (USDA FS 2015a) and the “Southern Sierra Nevada Fisher Conservation Strategy” (Spencer et al. 2016). Incorporating this guidance in whole may facilitate greater habitat protection and connectivity for species in the short term. However, under changing climate conditions in the long term, the greater resilience of forest habitat under alternative B is anticipated to maintain relatively greater levels of habitat connectivity for forest dependent species by facilitating species movements into suitable future habitat, as compared to alternative C. Alternative C encourages higher levels of heterogeneity in and around California spotted owl habitat for both direct (foraging) and indirect (habitat resilience) goals (USDA FS 2015a), but given the restrictions in the owl recommendations it is unlikely that these levels of heterogeneity could be reached (see “Terrestrial Vegetation Ecology” section).

Alternative C is likely to have the least potential for short-term impacts to habitat condition given the limitations on vegetation restoration and salvage. Under this alternative, hand treatments would be emphasized and mechanical treatments rare. There would be no exceptions to treat owl habitat in the wildland-urban intermix defense zone as there are under alternative A. No overstory trees could be removed in designated owl habitat (most vegetation within a 1.5-mile radius of owl activity centers with greater than 50 percent canopy cover) regardless of diameter. No salvage could occur in California spotted owl protected activity centers or suitable fisher target cells other than limited hazard tree removal (mostly along major roads). Large-diameter tree removal in fisher target cells would be extremely rare and driven only by the need to improve fisher habitat, on a case-by-case basis, and guided by the fisher conservation strategy. Due to the multitude of

restrictions, management would rarely occur in California spotted owl protected activity centers and suitable fisher target cells leading to virtually no short-term adverse impacts on habitat condition from management activities. Forest density would continue to increase and canopy cover would be relatively unaffected. Habitat elements important to these species like large snags, down woody debris, dense canopy cover, and large trees would continue to persist on the landscape in the short term. However, the long-term adverse consequences due to a lack of guided and thoughtful restoration of at least some habitat elements would outweigh the tradeoff of little to no short-term adverse impacts. Similar to alternative A, the lack of restoration under this alternative would continue to move the forests to increasingly dense conditions where vertical complexity of the forest structure and understory complexity would be reduced over time. Likewise, heterogeneity of the landscape would decrease. There would be an increased vulnerability of habitat loss from drought stress, severe fire, competition, and climate change. This alternative, like alternative A, would be unable to move enough of the landscape to a higher resilience to large high-intensity wildfires and climate change stressors and represents a long-term risk to mature forest-associated species in the montane zone.

Similar to alternative A, alternative C has a high likelihood of continuing large, high-intensity wildfires that would create complex early seral habitat on the landscape. Large disturbance events, particularly high-intensity wildfires, are expected to increase under this alternative, creating more post-disturbance habitat than under alternatives B and D. Where this habitat is created, reforestation would be very limited because of the emphasis on minimal post-fire salvage and manipulation of burned forest areas. Providing for complex early seral forest habitat would be the primary consideration in post-fire restoration projects. No salvage would be allowed in owl protected activity centers. This approach would benefit wildlife habitat quantity and creation similar to that described under alternative B but could increase the risk of future wildfires with high-severity effects where this habitat does not receive some treatment to reduce some snags and shrubs, particularly under prolonged drought conditions (Coppoletta et al. 2016).

Consequences Specific to Alternative D

As stated previously, alternative D is similar to B but increases the pace and scale of restoration. More focus landscapes would be treated, much of them in this zone, and it is anticipated that 20 to 60 percent of the landscape in the montane zone would be treated under this alternative. It reduces the risk of habitat loss to wildfire and degradation of habitat condition from increasingly dense stand conditions more than any other alternative.

As with all alternatives, tradeoffs exist. Alternative D emphasizes long-term habitat conservation, recognizing the short-term tradeoff that there may be some impacts to species associated with mature forest conditions. This alternative assumes that it is too risky to wait to restore resilience to forests until there is scientific certainty about the consequences of management actions given the expected losses of habitat to wildfires under the other alternatives. This alternative has the greatest potential for treatment-related impacts as described under alternative B but the greatest potential to preserve existing mature forest habitat for at-risk terrestrial wildlife species in the long-term. This alternative also has the greatest potential to improve condition of currently unoccupied habitat that could support at-risk terrestrial wildlife species in the future. The perceived benefit of improving current and potential future habitat condition, enhancing the distribution of potential habitat on the landscape, and reducing the risk of widespread vegetation mortality is estimated to outweigh the potential for short-term impacts. Alternative D would continue to implement fine-filter plan components for many mature forest-associated species (Table 83) with some minor adjustments that would reduce the potential for short-term impacts. These changes include:

- Pacific fisher standard 02 (SPEC-PF-STD-02) under alternative B allows mechanical treatment in up to one-third of all suitable target cells in a 10-year period but alternative D allows mechanical treatment in up to one-half of all suitable fisher target cells in a 10-year period.
- California spotted owl guideline 03 (SPEC-CSO-GDL-03) under alternative B prohibits vegetation treatments during the breeding season within approximately 0.25 mile of the known nest site or, where the nest site is not known, the most recent known roost site, unless surveys confirm that California spotted owls are not nesting. Under alternative D, any portion of the 0.25 mile buffer that is not included in the protected activity center can be treated using hand, mechanical, or prescribed fire treatments after June 1.
- California spotted owl standard 06 (SPEC-CSO-STD-06) under alternative B allows salvage if more than half of a protected activity center burns at very high severity with greater than 90 percent basal area tree mortality. Alternative C would have limited salvage overall and would avoid salvage in protected activity centers regardless of the amount burned except for hazard trees. Alternative D has the same direction as alternative B but has more emphasis on reforestation and recovery of burned forests so more burned protected activity centers would potentially be treated.

Although alternative D has the greatest flexibility to remove large-diameter trees, the need to conduct such an activity would be evaluated on a case-by-case basis, and driven by the need to promote the growth and vigor of existing large or larger trees, improve resilience, and increase heterogeneity. In addition, although more large trees may be removed in the wildfire restoration and maintenance zones under this alternative, more large trees would potentially be maintained on the landscape due to the predicted decrease in large, high-intensity wildfires.

This alternative is anticipated to produce less complex early seral habitat than the other alternatives over time because under the natural range of variation there would be fewer widespread tree mortality events (fewer large high-intensity wildfires and less risk of insects killing large areas of trees). There is some uncertainty about how much burned areas would be salvaged because it is dependent upon the amount of area burned at high severity and the capacity of lumber mills and market demand to purchase burned trees. Under this alternative, treatment of large areas of dead trees would be focused on short- and long-term restoration and on leveraging the economic recovery of the value of dead trees to maximize the amount of restoration accomplished. This alternative has the same requirement as alternative B to retain at least 10 percent of burned areas to provide for complex early seral forests. To the extent that more areas are treated by removing dead trees and are restored by reforesting with conifers, there could be more short-term impacts on species that benefit from this habitat type but greater long-term benefits to species that use mature conifer forests than the other alternatives. Over time, this alternative is expected to shift more areas toward having fire regimes similar to the natural range of variation with more frequent patches of mixed fire severity. This would result in more areas of complex early seral habitat being distributed more widely in smaller and more variable patches across the forests, providing habitat conditions more similar to those present prior to widespread fire suppression.

Alternative D is anticipated to have long-term benefits to habitat condition and quantity that outweigh short-term impacts. However, the monitoring program would evaluate if adjustments in plan components or the pace or scale of restoration may be needed to ensure removing large-diameter trees, salvaging trees after a large disturbance, and restoring landscapes at a larger scale and faster pace provides the ecological conditions that support the persistence of at-risk species.

Upper Montane Forests, Subalpine, and Alpine Vegetation

Under all alternatives, vegetation treatments are not prioritized in the upper montane zone except where needed around communities, developed recreation sites, and various assets like communication towers, water supplies, and powerlines. Much of this zone is in designated wilderness or has limited access. Habitat within wilderness areas would remain generally undisturbed by management activities because natural processes are the primary mechanism of habitat maintenance in these areas. Relatively low amounts of mechanical treatment are expected and a heavier focus is on the use of wildfires managed to meet resource objectives. There is very little to no mechanical treatment expected in subalpine and alpine zones. Natural features like rock outcrops, areas of talus, or barren areas that are naturally open with little to no vegetation and fuels.

The following species are supported by habitat and/or specific habitat elements in this zone:

- California condors nest in a variety of habitats including rock crevices, behind rock slabs, on large ledges in high, isolated rocky outcrops often in steep rugged areas.
- Sierra Nevada red fox fulfill all of their life history requirements in high elevation barren, conifer, fir, and pine habitat, and shrub habitat.
- Pacific fisher may persist in habitat in the upper montane zone (3 percent and 9 percent of suitable fisher target cells on the Sierra and Sequoia National Forests, respectively).
- Sierra Nevada bighorn sheep is exclusively associated with rugged, rocky terrain in the upper montane, subalpine and alpine zones.
- Sierra marten is highly associated with red fir and lodgepole pine forests.
- Some snails prefer rocky outcrops and talus areas at high elevations.
- Butterflies are associated with high elevation meadows, rocky areas, riparian woodlands and forests, and lakes and ponds.
- Bi-state sage-grouse occur in the subalpine zone of the White Mountains, which is dominated by sagebrush and includes some meadow systems.
- California spotted owls persist in some upper montane forests (11 percent and 26 percent of protected activity centers on the Sierra and Sequoia National Forests, respectively).
- Yellow blotched salamander typical habitat includes coniferous forest, deciduous forest, oak woodland, coastal sage scrub, and chaparral under logs, bark, moss, leaf litter, and talus or in animal burrows.

This section compares the environmental consequences of the four alternatives on the dominant habitat types associated with the at-risk terrestrial wildlife that inhabit this zone, such as red fir and conifer forests, sagebrush (White Mountains), rocky terrain, and barren habitat. Environmental consequences for high elevation aquatic habitats such as meadows, riparian woodlands and forests, and lakes and ponds are described below in the “Aquatic Habitat” effects analysis within this section.

The ability of fine-filter plan components to provide habitat for the persistence of Pacific fisher and California spotted owls are described in the montane zone.

Consequences Specific to Alternative A

Limited mechanical treatment would occur in forested portions of these zones. Fine-filter plan components addressing management in Sierra marten would continue. This includes limited operating periods in known den sites, consideration of connectivity in project planning, and mitigating impacts of existing disturbance to den sites from recreation, trail and road use. Where restoration is conducted, the emphasis would be on the use of managed wildfire. However, due to extremely limited restoration treatments under this alternative and excessively heavy fuel volumes, vegetation in these zones would likely have the lowest resilience to climate change and large, high-intensity wildfire, except in the Kern Drainage on the Sequoia National Forest (see the "Fire Trends" section). In alternative A, habitat conditions would be furthest from the natural range of variation of all alternatives. Condition of forested habitat would be more vulnerable to degradation than under other alternatives. Although management under this alternative is generally prohibited from removing large-diameter trees, these trees are at a greater risk of dying from insect outbreaks, spread of diseases and pathogens, competition, and large wildfire with high severity impacts. Although wildfires in forested areas in these higher elevation zones tend to occur less frequently than in lower elevations and most are small with mixed severity effects, under alternative A, burned area, fire size, and fire intensity are predicted to increase two to four fold (see the "Fire Trends" section).

Habitat condition and quantity would continue to be influenced by climate change due to the relatively low restoration rates and naturally high climate exposure of this region. Ecosystems in these zones are among the most vulnerable to climate change and would continue to have low resilience to climate change (see "Terrestrial Vegetation Ecology" section), especially under alternative A because of the limited ability to restore habitat in these zones. Warming temperatures and drought conditions have the potential to seriously degrade habitat condition over time, including drying of high alpine water sources that are particularly important to the Sierra Nevada bighorn sheep and of higher elevation meadow systems important to sage-grouse brood-rearing.

Consequences Specific to Alternative B

Restoration under alternative B would result in improved structure and resilience of habitat condition in these zones because it would provide a greater opportunity to treat vegetation and uses more managed wildfire for resource benefit than alternative A (chapter 2, Table 6 through Table 8). Although fires are naturally infrequent in the upper montane, subalpine and alpine zones, they are an important part of the disturbance regime (see "Terrestrial Vegetation Ecology" section). Restoration would promote greater structural heterogeneity of forested habitat and a trend toward achieving the desired conditions. This alternative also has specific desired conditions for these habitats to more clearly direct management actions (TERR-UPPR-DC-01 to 03; TERR-RFIR-DC-01 to 07; TERR-UMJF-DC-01 to 07; TERR-MCHP-DC-01 to 02; TERR-MJF-DC-01 to 07; TERR-SAGE-DC-01 to 04; TERR-ALPN-DC-01 to 04). Overall this alternative would be better at improving and sustaining the condition of wildlife habitat over the long term than alternative A.

Some species that inhabit these zones tend to be found along ridges and restoration treatments under this alternative place a strong emphasis on treating vegetation along ridges (except in the Inyo National Forest) to restore vegetation conditions and provide an anchor for conducting prescribed burns and managing wildfires to meet resource objectives. Given that most of the ridge top areas are in the dry vegetation type, the canopy in these areas would tend to be more open, similar to the natural range of variation. Overall this restoration emphasis would improve habitat conditions for raptors and other species hunting prey in these habitats such as the great gray owl.

Conversely, where ridges intersect dry vegetation that has become unnaturally dense and the canopy is opened, such treatments could adversely affect habitat condition for mature forest associated species like the Sierra Nevada red fox, California spotted owl, Sierra marten and Pacific fisher. However, these treatments are strategically placed to try and prevent loss of large areas of habitat from large wildfire and there are plan components to incorporate consideration of habitat fragmentation and connectivity at fine scales during project design (SPEC-PF-STD-04; Sequoia: TERR-FW-GDL-05; SPEC-CSO-GDL-01, SPEC-PF-GDL-01; SPEC-PF-GDL-02). With this tradeoff in mind, it is likely that strategically placed treatments at ridges would not constitute a long-term adverse effect to habitat for mature-forest-associated species.

Although the emphasis of treatments in the upper montane zone under alternative B is mostly on Jeffrey pine forests, this emphasis is not anticipated to adversely affect habitat condition or quantity for species more strongly associated with other forest types. There would also be some restoration in red fir forests and in white pine stands at risk from white pine blister rust (TERR-UPPR-DC-03) that are greatly deviated from desired conditions and at high risk from climate change. Jeffrey pine forests are more departed from desired conditions (and the natural range of variation) than many of the other forest types in this zone. Therefore, treatments focused on this forest type (and particularly on reclaiming the dominance of Jeffrey pine trees) would likely benefit many terrestrial wildlife species, particularly where these treatments also improve heterogeneity, structural complexity, and resilience.

However, treatments would be relatively less focused in habitats that are known to support some at-risk terrestrial wildlife species like the Sierra Nevada red fox that uses open canopy red fir forests but also relies on closed canopy red fir and lodgepole pine forest, and California spotted owl and Sierra marten that are associated with high elevation closed canopy red fir forest. These forest types will be restored in this zone for structural complexity, heterogeneity, and resilience but not to the degree that Jeffrey pine forests will be restored. These habitats are generally not as far departed from desired conditions as Jeffrey pine forests and can continue to support wildlife needs. Still, focused treatments in these forests to promote resilience would be conducted with the needs of these species in mind during project development, such as considering Sierra marten habitat strategies. These restoration treatments would promote resilience to large-scale disturbances like high-intensity fire that can remove large areas of habitat.

In the Kern Drainage, where upper montane forests (Jeffrey pine, red fir, lodgepole pine, aspen) have been restored in the last 15 years through wildfires managed for resource objectives (Fites-Kaufman et al. 2003, Ewell et al. 2012, Vaillant 2009, Meyer 2015), at least one-third to one-half of the area is similar to desired conditions (see “Fire-Trends” and “Terrestrial Vegetation Ecology” sections). Most of this area is in the wildfire maintenance zone and would continue to have wildfires managed for resource objectives to maintain and further restore conditions similar to the natural range of variation for vegetation, fire, and climate resilience. Habitat in these areas would be resilient.

Alternative B includes desired conditions for climate change resiliency in subalpine and alpine ecosystems. Although the more rapid pace and larger scale of restoration under alternative B (especially the use of managed wildfire) is anticipated to create more resilience to climate change in the upper montane, subalpine, and alpine zones, the zones would continue to have low resilience to climate change overall (but better than under alternative A) because of limited restoration rates and the high climate exposure of these areas (see “Terrestrial Vegetation Ecology” section).

Alternative B adds fine-filter plan components for Sierra marten (SPEC-SM-DC-01 to 03; SPEC-CSO-PF-SM-DC-01; SPEC-FW-GOAL-04; SPEC-CSO-PF-SM-GDL-01; SPEC-SM-GDL-01) to provide for habitat at local scales and connectivity at broader scales. This includes the following potential management approaches:

> Maintain or increase understory heterogeneity in marten denning habitat to promote "hiding cover" such as shrub patches, coarse woody debris, and slash piles following vegetation treatments. Design projects to have non-linear edges.
>
> Reduce human-caused mortalities associated with illegal marijuana growing and rodenticide use, road-related mortalities, and mortalities associated with water pipes and tanks.
>
> Avoid or remediate habitat modifications that unnaturally increase marten susceptibility to predation.
>
> Emphasize vegetation treatments in focus landscapes (10,000 to 80,000 acres in size) to move terrestrial ecosystems toward desired conditions and increase resilience of old forest habitat, while limiting impacts to California spotted owl, Pacific fisher and Sierra marten.

Alternative B adds fine-filter plan components for the Sierra Nevada bighorn sheep (SPEC-SHP-STD-01; SPEC-SHP-GDL-01) to more clearly direct management emphasis on protecting habitat for this species. There is also the following potential management approach:

> If reintroduced bighorn sheep establish themselves in drainages outside the reintroduction sites, take advantage of opportunities to extend bighorn sheep range, consistent with other resource activities. (Inyo National Forest)

The desired condition for the Sierra Nevada bighorn sheep emphasizes the structure, composition, and heterogeneity of habitat that supports this species as well as the risk of disease transmission on the Inyo National Forest (SPEC-SHP-DC-01). This fine-filter desired condition can better enable managers to propose projects that emphasize improving habitat for this species and manage grazing to avoid spreading disease to Sierra Nevada bighorn sheep on the Inyo National Forest. Currently, the Sierra and Sequoia National Forests do not issue permits for domestic sheep grazing and do not propose to permit such activities during the life of their plans. Although this species is relatively less abundant and widespread on these national forests, the lack of this desired condition in those forest plans could translate to reduced habitat condition and increased risk of disease transmission over time (new agency staff may not be aware of the informal policy to avoid issuing new grazing permits in allotments in bighorn sheep habitat and the limited ability to build habitat for this species into restoration projects).

Consequences Specific to Alternative C

Overall, treatments to increase upper montane heterogeneity and resilience, and improve conditions for whitebark pine under this alternative have a greater potential than alternative A but less than B to improve habitat condition for terrestrial wildlife species because of limited treatment rates. Habitat under this alternative would continue to be at risk to large, high-intensity wildfire similar to alternative A. Although alternative C emphasizes prescribed fire and wildfire managed to meet resource objectives, techniques that are most likely to be used in the wildfire maintenance and general wildfire zones, this alternative proposes fewer total acres of treatment than alternative B. There is additional area in recommended wilderness, increasing the proportion of upper montane and subalpine zones in areas with limited management (wilderness, wild and scenic river corridors, and inventoried roadless areas) from 74 to 79 percent of the upper montane zone as compared to alternative A. With 98 percent of the subalpine and alpine zone already in

less managed areas, these combined areas would provide for more extensive connecting area for wide-ranging species like Sierra marten.

Alternative C also has less ability than alternatives A, B, and D to use mechanical techniques that could better reassert Jeffrey pine trees as the dominant tree type in these forests and promote overall heterogeneity and structural diversity. This alternative also does not treat at the landscape scale like alternative B. Landscape treatments (focus landscapes) have a greater potential to restore resilience. This alternative would result in lower climate change resilience than alternative B due to the lower treatment rates. It would have slightly better climate change resilience than alternative A by focusing some treatment to improve conditions for whitebark pine. Overall this alternative is not as able as alternative B to improve habitat condition for at-risk terrestrial wildlife species.

Consequences Specific to Alternative D

Effects to the condition of habitats that support at-risk terrestrial wildlife species under this alternative are the same as described under alternative B but the increased pace and scale of restoration under this alternative is anticipated to more rapidly achieve resilience, heterogeneity, structural complexity, and composition than alternative B (chapter 2, Table 6 through Table 8). This alternative is also anticipated to have the greatest resilience to climate change, and large high-intensity fires (followed by alternative B) because of the faster restoration rates and more acres treated (see “Fire Trends” and “Terrestrial Vegetation Ecology” sections). More short-term (implementation-related) impacts could occur to habitat as a result of the faster pace and scale of restoration treatments. But as described under alternative B, these potential impacts are intended to improve long-term habitat condition and reduce the risk of loss from the landscape. Such impacts would be project- and site-specific and would be evaluated during project development.

Cave, Cave-like, and Cliff Habitat

The amount of cliff, cave, and cave-like habitat is not expected to change under any alternative because management activities would not substantially affect cliff, cave, or cave-like structures. Structures such as adits or buildings that support cave-associated species could be altered or removed by project-level decisions but this potential action would not differ by alternative and is beyond the scope of this programmatic analysis. New plan components have been drafted that improves overall direction for managing habitat for species dependent on these areas.

The following species are supported by cave, cave-like, or cliff habitat:

- American peregrine falcons nest and roost primarily in remote cliffs that are near aquatic habitat such as rivers, streams, or lakes.
- Pacific fringe-tailed bats roost in caves and cave-like structures such as mines, rock crevices, and structures.
- Townsend’s big-eared bats roost almost exclusively in caves and cave-like habitat (such as mines, adits, and structures.
- Pseudoscorpions are strongly associated with caves.

Consequences Specific to Alternative A

Under this alternative, vegetation management (including prescribed fire and managed wildfire) is not anticipated to have an adverse effect on cliff condition since this habitat is generally not vegetated. The condition of caves and cave-like structures for bats and pseudoscorpions can be

adversely affected during vegetation management activities where nearby vegetation removal alters climate conditions inside these habitats and/or where smoke from prescribed fire and unmanaged and managed wildfire engulfs these habitats, particularly adits and above ground cave-like structures. However, these activities would be evaluated on a project level where measures to protect such resources would be incorporated into project design.

Under this alternative, there are no fine-filter plan components for protecting habitat for at-risk terrestrial wildlife species from vegetation management or from recreation impacts on bats. Many of these species are highly sensitive to human disturbance. Under this alternative, peregrine nesting areas may be closed to recreation by a Forest Order as needed to protect nesting sites from disturbance. There is no formal direction related to bat roost protection from vegetation treatments or recreation but some of the caves and abandoned mines in the planning area are currently gated and closed to the public to prevent disturbance.

Consequences Specific to Alternative B

This alternative incorporates more fine-filter plan components than alternative A to provide habitat for species that use cliffs, caves, cave-like structures. For example, there is a new desired condition that the landscape has a mosaic of structures that provide habitat, movement, and connectivity for bats that use caves and cave-like structures (TERR-FW-DC-04). This desired condition provides more opportunity to incorporate protections for these habitats in project design. Other desired conditions for special habitats are aimed at the persistence of these habitats and conditions on the landscape (TERR-SH-DC-01 to 02). This alternative also includes plan components to consider special habitat in project design (TERR-SH-STD-01) and to install bat gates at entrances of caves and mines when bat hibernacula or maternity colonies may be adversely affected by various types of activities (SPEC-BAT-GDL-01). All of these fine-filter components more aptly recognize the value of these habitats to at-risk terrestrial wildlife species than alternative A and are expected to protect long-term habitat condition and quantity.

The increased pace and scale of restoration under this alternative could incur more short-term impacts to the habitat of terrestrial wildlife species, particularly where vegetation management activities directly disturb bat roosts from noise, vibration, and general human presence or alter climate conditions. However, these activities would be evaluated during a project-level analysis where measures to protect such resources could be incorporated into project design.

Consequences Specific to Alternative C

The types of effects on habitat for these species are similar to those described under alternative B. However, this alternative proposes less overall vegetation treatments which could incur fewer short-term effects to bat roosts and cave and cave-like structures for bats and pseudoscorpions. Although this alternative emphasizes the use of prescribed fire and managed wildfire more than any other alternative, which could affect caves and cave-like structures through smoke impacts, there is a high uncertainty about the feasibility of treating landscapes with fire under this alternative without the use of mechanical treatment to prepare the landscape (reduce fuels) for the safe application of fire.

Consequences Specific to Alternative D

The specific effects to habitat condition under this alternative are the same as those described under alternative B but the increased pace and scale of restoration has a greater potential for incurring those effects as a result of vegetation treatments, all of which would be evaluated at a project level.

Aquatic Habitat (meadows, lakes and ponds, riparian vegetation)

All alternatives would retain riparian conservation areas and critical aquatic refuges that would protect aquatic habitat, including habitat that supports at-risk terrestrial wildlife species. All alternatives would continue to implement priority watershed restoration as funding permits. All alternatives would allow hand treatments in aquatic habitat. The following species are supported by aquatic habitat and/or specific aquatic habitat elements:

- Valley elderberry longhorn beetle relies on elderberry shrubs primarily in riparian woodlands and savannahs.
- Least Bell's vireo persists in riparian and willow dominated habitat that has a dense shrub and understory component.
- Southwestern willow flycatcher prefers riparian and wetland habitat with a dense mosaic of trees and shrubs with high canopy cover and dense foliage.
- Western yellow-billed cuckoo is supported by large blocks of riparian woodlands and cottonwood habitat with a strong willow component.
- Invertebrates (butterflies) are associated with meadows, and vegetation around lakes and ponds.
- Willow flycatcher (species of conservation concern subspecies) depend on dense willow thickets in large wet meadows.
- Kern red-winged blackbirds are associated with freshwater cattail and tule marshes, riparian forests near wetlands and wet pastures.
- Tricolored blackbirds breed in freshwater marshes.
- Greater sage-grouse in the bi-state distinct population segment depend on wet meadows and riparian areas as foraging habitat for young.
- Sierra marten and Sierra Nevada Red fox use riparian stringers within mature forests.
- Bald eagles roost and nest near and forage in large waterbodies.
- American peregrine falcons nest and roost primarily in remote cliffs that are near aquatic habitat such as rivers, streams, or lakes.
- Great gray owls forage in meadows.
- Pacific fringe-tailed bats forage in a variety of habitats that are near an open water source.
- Townsend's big-eared bats, foraging generalists, are known to use riparian corridors and other bodies of water to capture prey.
- Kern Canyon slender salamander is found near streams in shaded, narrow canyons, and on ridges and hillsides, particularly in narrow ravines.

All alternatives would continue to implement the current protection of great gray owls, including foraging habitat and key prey species. Therefore, the ability of these fine-filter plan components to provide foraging habitat that supports the persistence of the species is not compared among the alternatives.

This section focuses solely on riparian and aquatic habitat elements that support terrestrial wildlife species and not on habitats or habitat elements that support fish, reptiles, or amphibians which are the topic of the aquatics section (see aquatic and riparian ecosystems section).

Therefore, when the word "aquatic" is used in this evaluation, it is intended to represent the vegetation within and surrounding riparian woodlands and forests, meadows, marshes, and lakes and ponds.

Consequences Specific to Alternative A

Risks to the amount and condition of aquatic habitat are greatest under this alternative due to treatment restrictions, limited acres of habitat proposed for maintenance or improvement, and inadequate desired conditions related to climate change. This alternative does not substantially improve the resilience of the overall landscape to wildfire given the limited amounts of treatment. Therefore, under this alternative, the amount and condition of aquatic habitat is anticipated to be adversely influenced by the increasing trend in large, high-intensity wildfire, climate-related stressors (drought), encroaching conifers, invasive species, and legacy impacts from past management (such as water diversion).

The proposed number of meadows and acres of riparian habitat maintained or improved is the lowest of all alternatives. This alternative has some of the most restrictive constraints on use of restoration tools. Direct fire ignitions are prohibited in this alternative within the riparian conservation areas, which reduces the ability of fire managers to reintroduce fires safely in these landscapes and create a patchy mosaic of fire effects with an overall low risk of high-severity burn areas. There is less control of fire intensity and spatial pattern of fires when they back into riparian areas and meadows compared to when fire managers are allowed to directly use ignition patterns to more closely control the fire behavior. Mechanical treatment to remove large conifers that are out-competing native trees in riparian areas and encroaching on wet meadows is also generally constrained. These limitations are predicted to result in a continued trend toward a decrease in heterogeneity and condition of hardwoods and other native species. Conifers and invasive species would continue to encroach and out-compete native species. Meadows would continue to be lost or degraded by further conifer ingrowth.

Without restoration and maintenance, the condition of aquatic habitat would continue to deteriorate from stressors. There could be a loss of structural heterogeneity and species diversity where invasive species or encroaching conifers move in and replace native species that typically support terrestrial wildlife species. Large high-intensity wildfire may completely remove large swaths of riparian and meadow vegetation or adjacent forests. Continued drought stress compounded by denser forests from previous fire suppression may lead to widespread loss of trees and shrubs from wildfires or insects.

Where limited maintenance, improvements, or enhancements occur in riparian habitat and meadows under this alternative, benefits may be short-lived because these treatments are largely limited to hand tools, which may only be able to temporarily suppress a stressor rather than remove it all together. Hand tools may not be able to remove large seed source conifers encroaching in meadows or riparian woodlands like mechanical equipment can. Removal of some smaller trees with hand tools may temporarily relieve competition with native plants for limited resources (such as space, light, nutrients, and water) but this relief would be short lived without the ability to remove larger trees.

Lack of direct fire ignitions in this habitat restricts the ability of fire managers to control how the fire behaves and create a patchy mosaic of low and moderate severity fire effects. Without the ability to use mechanical treatments to prepare the landscape for prescribed fire, restoration and maintenance activities cannot adequately reduce fuel volumes in riparian ecosystems to safely incorporate prescribed fire or reduce the threat of wildfire spread. Although managed wildfire is

considered a tool under this alternative, the unnaturally dense conditions of aquatic habitats and adjacent uplands make the use of this tool for the benefit of biological resources somewhat unrealistic.

This alternative has the least potential to build adaptive capacity to climate change, which makes native species less able to compete against conifers and invasive species for limited resources and makes these systems more vulnerable to wildfire outside the natural range of variation (see the "Climate, Ecological Vulnerability and Adaptation" section). The desired conditions under the current management approach do not specifically consider climate change or climate-related stressors. Without addressing climate change stressors and the influence of various adjacent ecosystems on a larger (landscape) spatial scale, this alternative presents a relatively greater risk for protecting and improving the condition of riparian habitat.

Although high elevation (upper montane, subalpine, and alpine) meadows and riparian areas are generally not prioritized for maintenance or improvement under any alternative, the focus on wildland-urban intermix treatments under this alternative (as opposed to landscape-level treatments under alternative B) makes it even more difficult to treat high elevation meadows and riparian areas that are used by many at-risk terrestrial wildlife species.

Consequences Specific to Alternative B

In alternative B, most of the riparian, meadow, and aquatic plan components are the same as in alternative A (see chapter 2). However, there are more specific ecological desired conditions and specific objectives to restore riparian and aquatic ecosystems (MA-RCA-DC-02 to 03, -11, -13, -15; RCA-MEAD-DC-02 to 03, -05, -07; RCA-LPP-DC-01; RCA-SPR-DC-01 to 03; RCA-MEAD-OBJ-01; MA-RCA-OBJ-01). Riparian and meadow vegetation restoration under this alternative would be for the purpose of moving vegetation toward the desired conditions and would be intended primarily to restore native species composition, heterogeneity, resilience, and reduce the ingrowth of conifers where appropriate. The end result of the treatments under this alternative would generally be improved riparian hardwood composition and structure and increased herbaceous density, vigor, and structural complexity.

Alternative B proposes to designate 16 additional critical aquatic refuges on the three national forests and this translates into more land designated for the protection of aquatic habitat. Plan components (desired conditions, standards, and guidelines) are similar across alternatives B, C, and D and primarily represent those plan components carried forward from the current direction for critical aquatic refuges. Although additional designation is a benefit, more critical aquatic refuges do not necessarily translate into improved habitat condition throughout these designated areas. For example, if treatments are needed in these areas to remove encroaching conifers, control invasive plants, or increase structural diversity and habitat heterogeneity, even well-intended restrictions on treatments may incur indirect adverse consequences by the inability to remove these stressors.

The management approach under alternative B proposes to maintain, enhance, or improve more acres of riparian habitat and more meadows than alternative A and with a greater variety of restoration tools (mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives). Overall this alternative allows for flexibility to use more prescribed burning and where necessary, mechanical and hand treatments that would prepare these areas for burning (MA-RCA-STD-18b). This includes the following potential management approach:

> At either the landscape or project-scale, determine if the ecological conditions within riparian conservation areas are outside of the natural range of variation for the vegetative

> community including age class, structural diversity, composition, and cover of riparian vegetation. Include consideration of the ecological role of fire. If conditions are outside the natural range of variation, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem, using fire, hand or mechanical treatments.

Alternative B allows for direct ignition during prescribed fires in riparian areas, which is predicted to greatly improve the resilience of this habitat because it introduces fire spread and intensity that is controlled with a greater ability to achieve a desirable mosaic. All restoration that results in a reduction of upland conifers in riparian areas would restore riparian vegetation composition and structure. This would increase sunlight for riparian hardwoods and shrubs that are often shaded out by upland trees and shrubs. Prescribed fire and wildfire managed primarily for resource benefit would improve the condition, vigor and health of most native riparian plants that support forage and nesting habitat for a variety of species. Increased structural diversity of these habitats would favor use by a variety of species strongly associated with complex understory and overstory. Increased fire would result in increased sprouting, health, condition, and vigor of hardwood and understory plants, including host plants for a variety of invertebrates. The trend in composition and structural heterogeneity of native species would increase.

Alternative B is anticipated to improve habitat condition at the landscape scale. Riparian habitats would be treated where they are adjacent to upland habitat that is being restored. The synergistic benefit of restoring neighboring riparian and upland habitats can benefit species that use both habitat types to meet life history requirements. In addition, treating these features in the upland and riparian areas can reduce the ingrowth of conifers and invasive species in both these habitats. Removal of some of these conifer species in aquatic habitats, particularly lodgepole pine, can increase the water table and provide better wet meadow and marsh habitat condition for species like willow flycatcher, kern red-winged blackbird, and tricolored blackbird. Increased standing water in meadows can both improve the vegetation structure and complexity and also prevent nest predation.

This alternative would move the landscape from a low to a moderate resilience to large high-intensity wildfire (See the “Terrestrial Ecosystem Processes and Functions” section). Warming trends and drought conditions can cause a variety of stressors for many habitats, but particularly aquatic habitats. These habitats have suffered directly from drought and warming conditions but also indirectly by the ability of many invasive species to move into aquatic habitats, outcompeting native species for space, water, sunlight, and nutrients that support many terrestrial wildlife species. Using treatments to set the trajectory of these habitats toward their natural range of variation would relieve competitive pressure on aquatic vegetation (such as willow, aspen, and cottonwood) that provide specific habitat elements needed for communities of wildlife species. This perceived benefit is based on the assumption that restoration would not only improve physical habitat elements such as vegetation diversity and structural complexity but also achieve restoration of natural processes that help ecosystem functions and maintain wildlife habitat over the long term. The restoration of riparian vegetation facilitates the major functions of riparian habitats such as physical filtering of water, stabilization of banks and floodplains, and water storage, all of which benefit wildlife species (George and Zack 2001).

Although treatments are expected to have a variety of long-term benefits, there is potential for short-term effects during and immediately following project implementation. In general, manipulating more habitat under this alternative as opposed to alternative A would translate into more potential for disturbance to individuals and temporary disturbance to habitat condition from

the use of equipment and fire, until the habitat recovers. Although mechanical equipment use in riparian habitat could occur under this alternative, these treatments would be for the purpose of preparing the area to allow the use of prescribed fire. Overall, over the long term, these restoration actions are anticipated to provide more productive site conditions, which would result in improved habitat conditions.

Although all alternatives propose to maintain, enhance, or restore a certain number of meadows and acres of riparian vegetation, no alternative proposes to restore all aquatic habitat during the next 10 to 15 years, which would be infeasible given funding levels and other limitations. In recognition of this, alternative B includes an increased emphasis on partnerships to accomplish meadow restoration. Under this alternative, there is also greater potential for stewardship funding to address meadow and riparian restoration work. In the montane zone, much of the aquatic habitat is threatened by large fires with high-severity effects, overcrowding by conifers, homogeneity of vegetation structure and composition, and the continued spread of invasive species. These areas would experience more treatments than other zones, although treatment intensity would be relatively light. In the upper elevations like upper montane, subalpine, and alpine zones, treatments of upland habitat are not prioritized and therefore aquatic habitat would receive fewer treatments. The habitat in this area is not as far outside of the natural range of variation as some areas, and therefore stressors that could be alleviated by vegetation treatment are not as crucial as those lower elevation habitats. Much of these high elevation zones are in designated wilderness or have limited access.

Under alternatives B, C, and D, nests of bald eagles are protected from vegetation management activities. The changes in plan components for these species from alternative A are anticipated to continue to protect these species that either have very specific habitat requirements or are sensitive to disturbances.

Consequences Specific to Alternative C

Alternative C proposes to designate 37 additional critical aquatic refuges on the three national forests. Therefore, there would be more emphasis on protection of aquatic habitat in these designated areas than under alternatives A and B. As described under alternative B, restrictions on treatments in these areas could unintentionally prevent needed restoration work that removes or mitigates stressors within these systems.

This alternative proposes to maintain, improve, or enhance the most meadows on the Inyo and Sequoia National Forests and the second most meadows on the Sierra National Forest of any alternative. More restoration is proposed because hand equipment, prescribed fire, and managed wildfire may more rapidly treat smaller meadows with less severe conifer encroachment, invasive species, and issues related to water retention. In contrast, alternatives B and D may tackle larger meadows with more complex issues because these alternatives can use mechanical equipment as a precursor to burning. This alternative emphasizes the use of prescribed fire and managed wildfire to accomplish restoration and proposes to use more prescribed fire and managed wildfire than alternative A. Therefore, the treatments under this alternative have a greater potential than alternative A, but less than B, to restore structural conditions.

However, the use of prescribed fire under alternative C to reduce stand density and create more open, safe burning conditions would be constrained because of the species-specific protections and inability to prepare the landscape with mechanical treatments first. This alternative does not treat at the landscape scale, which would make patches more vulnerable to a variety of stressors adjacent to this habitat as well as upstream and downstream of this habitat, including loss of

habitat elements from wildfire, ingrowth of conifers in adjacent upland units, and spread of invasive species. Because this alternative has a lower ability than alternative B to move the landscape toward resilience to climate change and large high-intensity wildfire, aquatic habitat under this alternative would be at a greater risk to degradation from unabated stressors and large-scale disturbances. The long-term effects may be more negative if fire destroys vegetation that supports specialized species (like butterflies), and the availability of nest trees and shrubs. Fewer landscape treatments may require more suppression of wildfires, which could allow conifers to grow into meadows.

Alternative C includes the same increased emphasis on partnerships as alternatives B and D. However, there may be fewer opportunities for stewardship funding under this alternative due to the fewer acres of upland vegetation to be treated. Funding of meadow maintenance, enhancement, or improvement may be a substantial constraint under this alternative.

Although there is less potential for short term, implementation-related impacts under this alternative, the long-term negative impacts on habitat conditions because of the treatment limitations and lack of a landscape scale approach under this alternative could be greater than under the other alternatives.

Consequences Specific to Alternative D

By increasing the amount of ecological restoration overall under this alternative, more opportunities exist for implementing watershed restoration projects than any other alternative. Alternative D would maintain, enhance or improve more meadows than alternatives A and B (except on the Inyo where B and D propose the same number) and more meadows than alternative C on the Sierra National Forest. More treatment within watersheds should reduce the acreage that wildfire burns at high severity, move the landscape to a greater resiliency to climate change, and more rapidly achieve improvements to structure, composition, and heterogeneity than any other alternative.

Similar to alternatives B and C, alternative D also includes an increased emphasis on partnerships. Therefore, this alternative (followed by B) should have the most funding to improve aquatic habitat condition and at a landscape scale.

The tradeoff of increased pace and scale of restoration, including the use of mechanical equipment, is the potential for more short-term impacts than any other alternative. For example, this alternative has the greatest potential to spread invasive species as a result of more acres treated. As with all alternatives, the potential short-term impacts of treatment proposed under this alternative would be evaluated on a project-specific basis as projects are developed.

Cumulative Effects

The proposed management approaches under each of the four alternatives are generally consistent with management of other lands within the cumulative effects analysis area. Although the alternatives vary in their ability and pace to achieve the desired conditions and some alternatives present more risk than others, it is not expected that the management approach under any alternative, combined with actions on other lands, would have an adverse cumulative effect on terrestrial wildlife habitat within the analysis area.

The majority of the land within the analysis area is managed by Federal agencies, primarily Forest Service, National Park Service (west side), and Bureau of Land Management (east side) and these agencies have individual resource management plans or shared, collaborative programs

in place to guide the protection of natural resources, particularly in the face of changing climate conditions and large, high-intensity wildfires. The new focus of the 2012 Planning Rule on ecosystem integrity, resilience, and diversity is in close alignment with new direction for the National Park Service, which is to build ecosystem resilience for coping with changing climates. Park units are now obligated to consider climate change adaptation and manage for climate-resilient forests. The "Strategic Framework for Science in Support of Management in the South Sierra Nevada Ecoregion" was developed collaboratively by Federal land managers in the Southern Sierra Nevada ecoregion (including the Sierra and Sequoia National Forests and Giant Sequoia National Monument) to help mitigate impacts from, and adapt to, climate change (Nydick and Sydorlak 2011a, 2011b). The framework contains four goals: understanding where and why changes occur, anticipating possible futures, developing tools required to take effective action, and providing easy access to and delivery of information to target audiences. The framework will be carried out by the Southern Sierra Conservation Cooperative, a collaborative group of Government agencies and nonprofit organizations in the Southern Sierra Nevada Ecoregion. Sequoia and Kings Canyon National Parks, Sequoia National Forest, and Giant Sequoia National Monument are the first group of resource managers working together under the framework to carry out a pilot project to develop the capacity to manage fire under a "new lens" and to revise fire management objectives, tools, and methods. Therefore, given that the majority of the land in the analysis area is managed by Federal agencies and guided by individual resource management plans, as well as stronger, more relevant multi-agency partnerships, these strong consistencies in management direction are expected to provide for landscape-level resilience.

Large, high-intensity wildfires pose the most significant threat to wildlife habitat in the analysis area and many Federal agencies in this Southern Sierra Nevada ecoregion are working in partnership (and separately) to improve landscape resiliency to climate change and wildfires. The National Park Service uses managed wildfire and prescribed fire as resource tools where feasible and safe. The National Park Service has worked with the Sequoia National Forest in the past to manage wildfires for resource benefit, resulting in a high level of restoration (and lessened fire risk) in the area where the national forest meets the national park. The Inyo National Forest has an interagency fire program with the Bureau of Land Management in which staff from both agencies participate in the planning of vegetation projects because of the proximity of lands, especially in the wildland-urban intermix.

Although each of the four alternatives attempts to reduce the spread of large, high-intensity wildfires, improved resilience to such wildfires is anticipated to be achieved under some but not all alternatives. Under alternatives A and C, wildfires are anticipated to have an increasing trend in burned area, fire size, and fire intensity. Although alternative C places a heavy emphasis on the use of fire to achieve vegetation restoration, resilience to fire over much of the plan area would remain at the same low and very low resilience because of the more limited areas where fuels are reduced lowering the risks of managing wildfires or the complexity of conducting prescribed burns. The Endangered Species Act defines "cumulative effects" as the "effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." The National Environmental Policy Act gives "cumulative impacts" a broader meaning, which includes the impact of the action when added to other past, present, and future actions, regardless of the agency or person undertaking the action. Therefore, while alternatives A and C might provide less benefit to resilience than alternatives B and D, they do not constitute adverse conditions under either the Endangered Species Act or the National Environmental Policy Act simply from a lack of action.

Vegetation management activities are conducted on land managed by Bureau of Land Management, National Parks, and some State-managed lands. Both mechanical treatments and prescribed fire are used as management tools as they are on National Forest System lands. However, in national parks, the primary treatment methods include prescribed fire and managed wildfire; mechanical treatments are limited. Relatively fewer vegetation management projects are undertaken on county and privately owned land. The pace of restoration under alternatives B and D in treating both upland and aquatic systems may be more aggressive than those undertaken on other land ownerships in the analysis area but are expected to help more rapidly set the trajectory for a positive trend in ecosystem resilience (especially alternative D). Conversely, under alternatives A and C there is a greater risk of not being able to achieve desired conditions in a timely manner for ecosystem integrity, resiliency, and diversity of upland and aquatic systems because of the limit on tools that can be effectively used and constraints on habitat modifications related to canopy cover and large trees in upland systems and the use of mechanical equipment in aquatic systems.

Climate change resulting in higher temperatures, greater moisture evaporation, and prolonged drought will continue to affect ecosystems that support terrestrial wildlife species throughout the analysis area. Unlike alternatives B, C and D that formally provide direction to manage the landscape and various ecosystems and watersheds for resilience to climate change, alternative A presents the greatest risk to the ability of habitat within the analysis area to sustain wildlife habitat as climate conditions change. Alternative A recognizes the need to address density of forests to reduce the risk of trees dying due to stresses related to prolonged droughts but this alternative is limited in the ability to treat terrestrial habitat at a rapid and large enough pace to substantially reduce the risk. Furthermore, the desired conditions for aquatic and riparian ecosystems in alternative A that support many terrestrial wildlife species and their prey do not specifically consider the change in temperature and precipitation related to climate change and other climate stressors to these systems. Management under this alternative could put more pressure on adjacent lands to support resilient habitat or influence habitat in adjacent lands where widespread climate-induced changes (such as massive tree mortalities, meadow desiccation, or large high-intensity wildfires) spread beyond the borders of the three national forests.

In contrast, alternatives B, C, D include desired conditions that emphasize improving watershed resilience to wildfire and climate change by treating vegetation and reducing fuels over larger areas, and mitigating and restoring impacts from unmaintained roads when they impair watershed function. These alternatives also include direction to manage for an increased risk of insects and diseases and changed fire patterns and cycles, and include desired conditions that recognize climate stressors on aquatic and riparian systems. These alternatives all consider and incorporate at least some recommendations from various climate vulnerability assessments and adaptation strategies and as a result have a better ability than alternative A (which supports fewer climate assessments and strategies) to build adaptive capacity into the climate change approach on National Forest System lands in the analysis area.

For various species strongly associated with certain plants for foraging or nesting habitat (like butterflies, valley elderberry longhorn beetle, Kern red-winged blackbird, tricolored blackbird, willow flycatcher [three subspecies], least Bell's vireo, or yellow-billed cuckoo) the spread of invasive plant species threatens this habitat. Management direction under any alternative is not expected to have an adverse cumulative effect on the existence or spread of invasive species in the analysis area, but alternatives B, C and D have specific plan components that address the prevention, control, and possible eradication of terrestrial invasive species more formally than the current plans. However, alternative D has the greatest indirect risk of spreading invasive species

because of the increase in acres treated, particularly acres mechanically treated. Nonetheless, the spread of invasive species is not anticipated to have an adverse cumulative effect in the analysis area because of mitigation required under each of the three alternatives. Both Bureau of Land Management and National Park Service also conduct invasive weed treatments. Invasive species exist on State, county and privately owned land and treatments there are varied.

Within the analysis area, grazing is permitted on lands managed by the Forest Service and Bureau of Land Management, and county and private lands. Grazing can be a management tool used for restoring habitats such as grassland important to various species (such as some invertebrates) but also has the potential to reduce habitat quantity and condition for other associated species. Some domestic sheep transmit life-threatening diseases to various native bighorn sheep. Allotments on National Forest System lands are managed following Forest Service utilization standards and this management direction does not vary by alternative. However, alternatives B, C, and D more formally incorporate an implementation plan on the Inyo National Forest that focuses on reducing the risk of transmission of disease among domestic and native sheep. Domestic sheep and goats are found on private and county-managed lands adjacent to occupied Sierra bighorn sheep and therefore the risk of disease transmission in these areas is high regardless of management on National Forest System lands. In this way, under all alternatives, but especially B, C and D, grazing on National Forest System lands is not expected to have an adverse cumulative effect on habitat or disease transmission elsewhere in the analysis area.

The entire analysis area receives a great deal of recreational use. Recreation can have varying degrees of adverse impacts on terrestrial wildlife such as habitat loss, degradation, and fragmentation; disruption of behavior (such as foraging or reproduction); reduction or change in supply and availability of food and cover; direct physical harm to individuals and offspring (eggs or young); and increased garbage, human food sources, noise, and pet presence. Roads and trails can be particularly problematic where they traverse otherwise undisturbed or minimally disturbed habitat, are unmaintained so they degrade habitat or inadequately contain users, or where a variety of user-created trails exist. Although recreation and access can adversely affect terrestrial wildlife and their habitat, the recreation approaches described under any of the alternatives are not likely to have an adverse cumulative impact on wildlife habitat in the analysis area. The approaches proposed under the various alternatives focus on addressing deferred maintenance (such as retrofitting existing sites to accommodate need, maintaining existing system trails) rather than creating new development or trails. Addressing deferred maintenance could improve wildlife habitat condition where sites or trails are degrading habitat (like passing through a meadow or wetland) and are upgraded or moved to higher capability lands. All alternatives continue to protect at-risk species from known threats associated with recreation. For example, all alternatives contain plan components to prevent nesting raptors from being disturbed from a variety of activities, including recreation activities.

Cumulative Effects under the Endangered Species Act. There are no foreseeable cumulative effects identified for federally listed or candidate species as well as critical habitat at this time. Those effects are not the same as how cumulative effects are defined under the National Environmental Policy At. Cumulative effects under the Endangered Species Act will be addressed fully in the biological assessment prepared for consultation with the U.S. Fish and Wildlife Service prior to issuing a decision on the proposed forest plans.

Analytical Conclusions

Alternatives A and C have the most limited ability to mitigate the continuing increase in large, high-intensity wildfires and build adaptive capacity of ecosystems to climate change, although

alternative C is better than alternative A at addressing climate change. Large wildfires with expansive areas of high-severity impacts are a major threat to many at-risk terrestrial wildlife species because they completely remove important habitat elements from a large portion of the landscape (like large living trees, dense canopy cover, down woody debris, riparian vegetation, and structural complexity). Climate change is influencing all species and their habitats in far more complex ways. Therefore, alternatives A and C present a greater risk to the quantity and condition of habitat to contribute to the recovery of threatened and endangered species, conservation of proposed species, and support the persistence of species of conservation concern.

Although alternatives B, C, and D all focus on moving the vegetation types toward desired conditions, alternatives B and D are better positioned to achieve these desired conditions in a shorter timeframe because they focus on restoring resilience at a large landscape scale using a variety of tools that effectively decrease the expected amount of crown fire and large patches of high-severity fire effects toward the levels expected in the natural range of variation. The treatment pace and scale under alternative B is assumed to move the landscape to a moderate fire resilience within the first 10 years of plan adoption. The pace and scale of restoration proposed under alternative D is expected to surpass alternative B in the ability to move the landscape to a more resilient position. These alternatives are also better than alternative A and slightly better than alternative C in building adaptive capacity of the ecosystems to climate change.

Alternative B represents a balance between alternatives A and C in that it proposes to restore ecosystems toward their natural range of variation faster and more effectively than alternatives A and C because of the landscape level approach, more acres proposed for treatment, and a wider variety of restoration tools that can be applied. Alternative B provides a more cautious approach than alternative D by tempering the pace of restoration and implementing more fine-filter plan components, including more stringent limited operating periods, to protect reproducing individuals and habitat for at-risk terrestrial wildlife species in the short term. Ultimately, though, habitat for at-risk terrestrial wildlife species under alternative B continues to be at risk of loss due to large, high-intensity wildfires. Alternative D would more quickly achieve resilience of the landscape to large-scale disturbances (such as insect outbreaks, high-severity wildfire effects, and drought-related tree mortality), thereby providing a greater long term benefit to terrestrial wildlife habitat quantity and condition. However the management approach has greater potential for short-term impacts to achieve improved habitat condition. The evaluation of such a tradeoff for both alternatives would best be evaluated over time by a robust monitoring program.

Federally Listed Endangered, Threatened, and Candidate Wildlife Species Determinations

For all threatened and endangered species, we have determined that the management approach under all alternatives at the programmatic level of the plans *may affect but is not likely to adversely affect* the Valley elderberry longhorn beetle, least Bell's vireo, southwestern willow flycatcher, western yellow-billed cuckoo, California condor, and Sierra Nevada bighorn sheep.

For the Sierra Nevada red fox, a candidate for listing, we have determined that management approaches under all alternatives at the programmatic level of the plans *may affect individuals, but are not likely to contribute to the need for Federal listing or result in a loss of viability in the forest plan areas.*

Critical habitat has been designated for the California condor, southwestern willow flycatcher, and Sierra Nevada bighorn sheep, and proposed for the yellow-billed cuckoo. We have

determined that *none of the alternatives are likely to result in destruction or adverse modification of that critical habitat.*

Wildlife Species of Conservation Concern Outcomes

Adjustments to emerging ecosystem plan components, additional species-specific plan components, or both, when carried out, would provide the necessary ecological conditions to maintain a viable population of ALL species of concern in the plan areas with the exception of Nelson's desert bighorn sheep. Differences in the effects of alternatives suggests minor to major differences as to which would favor a particular species or group of species under the different alternatives. This determination depends upon the assumptions of treatments reducing the rate of habitat loss from large, high-intensity wildfires while providing for sufficient ecological conditions to meet the short-term needs of at-risk species. All determinations rely upon an adaptive approach to learning and making appropriate changes over time.

Due to circumstances that are neither within the authority of the Forest Service nor consistent within the inherent capability of the land, the plan area is unable to provide the ecological conditions necessary to maintain a viable population of the Nelson's desert bighorn sheep. The reasons for this are that there is no authorized livestock grazing or permitting of uncontrolled domestic goats or sheep that are known to be in contact with the White Mountain bighorn sheep herd. The California Department of Fish and Wildlife has documented co-mingling of stray domestic goats with this bighorn population on private property (CDFW 2015b). Because of this, the potential for population die-off is not caused by actions and cannot be addressed under Forest Service authority.

At-risk Aquatic Species

Background

This section summarizes current conditions of at-risk aquatic vertebrate and invertebrate species on the Inyo, Sequoia, and Sierra National Forests, and the consequences to at-risk species of implementing the draft forest plans or the alternatives.

The sections above on "Aquatic and Riparian Ecosystems" and "Terrestrial Vegetation Ecology" cover the general ecological integrity of the ecosystems upon which aquatic at-risk species depend.

This evaluation was completed by examining conditions of and threats to individual at-risk aquatic species, and also by examining the collective distribution patterns of at-risk aquatic species within the planning area, by watershed and by ecosystem. This approach assisted in understanding the broad relationship between a programmatic land management plan and the desired conditions identified for the at-risk species in the planning area. Desired conditions for at-risk aquatic species emphasize habitat that supports self-sustaining populations, precluding the need for listing, and improving conditions for these species (Forestwide SPEC-FW-DC 01, 02, 03).

Analysis and Methods

This analysis uses the same coarse-filter and fine-filter approach as the "At-risk Terrestrial Wildlife" analysis to assess the alternatives' potential for providing the habitat characteristics to support wildlife diversity and the persistence of native species in the plan area. The coarse filter approach assumes that diversity is broadly dependent upon the integrity of the function,

composition, and structure of the forest's terrestrial, riparian, and aquatic ecosystems to provide the ecological conditions that support the abundance, distribution, and long-term persistence of native species. This analysis compares the current abundance and condition of various habitats with ecological reference conditions (natural range of variability) based on the dynamic nature of ecosystems, recognizing they are not static (Landres et al. 1999). It recognizes that disturbances or processes (fire, flooding, insects, and disease) and responses to those are part of the natural processes. However, because integrity of whole ecosystems does not necessarily address all species' needs, additional fine filter analyses were conducted to ensure that persistence is provided for at-risk a species.

The analysis area includes all National Forest System lands within the Inyo, Sequoia, and Sierra National Forests. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, indicator measures and threat information from within the analysis area were used in making conclusions. Because of differences in available biological and threat information to federally recognized threatened, endangered, proposed, and candidate species versus species of conservation concern, and because the Forest Service Handbook outlines different procedures to identify plan components necessary to provide for the two groups of species, different approaches were used in their analyses.

Assumptions

- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions). However, there may be implications, or longer term environmental consequences, of managing the forests under this programmatic framework. As a result, all effects discussed in this section are considered indirect effects.
- Site-specific projects and activities will be planned and implemented consistent with relevant and applicable plan components.
- All project activities that will be implemented under all alternatives that may affect threatened, endangered or proposed species will require separate, site-specific evaluations and consultation under section 7 of the Endangered Species Act, following agency procedures.
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the plan monitoring program and any broader-scale monitoring will occur and the land management plan will be amended, as needed during the life of the plan.
- There will be a general increase in recreational demand as the human population size increases.
- Funding levels will be similar to the past 5 years.

Species Evaluated

Federally listed, Candidate, and Proposed Aquatic Species

The following table shows at-risk federally listed aquatic species on the three national forests, providing common name, scientific name, listing status (threatened or endangered) and the national forests where it is known to occur or has habitat. There are no proposed or candidate aquatic species.

Table 85. At-risk federally listed aquatic species on the Inyo, Sequoia, and Sierra National Forests

Common Name	Scientific Name	Status	National Forest
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	Threatened	Inyo, Sierra
Paiute cutthroat trout	*Oncorhynchus clarki seleniris*	Threatened	Inyo, Sierra
Little Kern Golden trout	*Oncorhynchus aquabonita whitei*	Threatened	Sequoia
Owens tui chub	*Gila bicolor snyderi*	Endangered	Inyo
California red-legged frog	*Rana aurora draytonii*	Threatened	Sierra
Yosemite toad	*Anaxyrus canorus*	Threatened	Inyo, Sierra
Sierra Nevada yellow-legged frog	*Rana sierrae*	Endangered	Inyo, Sierra
Northern distinct population segment mountain yellow-legged frog	*Rana muscosa*	Endangered	Inyo, Sequoia

Critical Habitat

There is only one aquatic species, the Little Kern golden trout on the Sequoia National Forest, for which critical habitat is designated.

Aquatic Species of Conservation Concern

For the coarse-filter approach, we grouped species by coarse-scale ecosystems described in the "Aquatic and Riparian Ecosystems" section on page 263. The environmental consequence findings of that section also compared existing and foreseeable future conditions of ecosystems to desired conditions, and this comparison was used as the basis of the coarse-filter evaluation. This coarse-filter approach assumes that viability of species of conservation concern is broadly dependent upon the integrity of the ecosystems where they currently occur. However, because integrity of whole ecosystems does not necessarily ensure persistence of all species of conservation concern, particularly those with very limited distribution, we conducted additional fine-filter evaluations (species-specific and by special habitat) to ensure persistence is provided for all aquatic species of conservation concern.

The fine-filter evaluation was conducted by analyzing (1) special habitats that support suites of some species of conservation concern on the national forests, and (2) known threats to each individual species of conservation concern. We grouped species by fine-scale habitats where possible, to enable a fine filter look at ecological conditions that affect populations. We also discussed documented threats that influence species trends in distribution and viability.

There are 15 aquatic species of conservation concern across the three national forests with some species occurring on more than one national forest. Table 86 lists aquatic amphibian species, Table 87 lists fish species, and Table 88 lists aquatic invertebrate species. Note that terrestrial amphibian and invertebrate species are discussed in the "At-risk Terrestrial Wildlife" section.

Table 86. Aquatic amphibian species of conservation concern

Common Name	Scientific Name	Applicable National Forest
Black Toad	*Anaxyrus exsul*	Inyo
Relictual Slender Salamander	*Batrachoseps relictus*	Sequoia
Kern Plateau Salamander	*Batrachoseps robustus*	Inyo, Sequoia
Foothill Yellow-legged Frog	*Rana boylii*	Sierra, Sequoia

Table 87. Fish species of conservation concern

Common Name	Scientific Name	Applicable National Forest
California Golden Trout	*Oncorhynchus mykiss aguabonita*	Inyo, Sequoia
Kern Brook Lamprey	*Lampetra hubbsi*	Sierra
Central Valley Hitch	*Lavinia exilicauda exilicauda*	Sierra, Sequoia
Hardhead	*Mylopharodon conocephalus*	Sierra, Sequoia
Kern River Golden Trout	*Oncorhynchus mykiss gilberti*	Sequoia

Table 88. Aquatic invertebrate species of conservation concern

Common Name	Scientific Name	Applicable National Forest
Western Pearlshell Mussel	*Margaritifera falcata*	Inyo, Sequoia, Sierra
Denning's Cryptic Caddisfly	*Cryptochia denningi*	Inyo
An Isopod	*Calasellus longus*	Sierra
California Sallfly	*Sweltsa resima*	Inyo
Wong's Springsnail	*Pyrgulopsis wongi*	Inyo
Owens Valley Springsnail	*Pyrgulopsis owensensis*	Inyo

Indicators and Measures

For all at-risk aquatic species, we chose the extent and condition of habitat as indicators because they are direct measures of ecological conditions needed to contribute to the recovery of federally listed species and support the persistence of species of conservation concern by maintaining viable populations within the plan area. A viable population is defined as (36 CFR 219.19):

> A population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.

Furthermore, for most species, evaluation of the extent and condition of habitat typically constitute the best available scientific information indicating whether such populations will continue to persist with sufficient distribution in the planning area. Finally, we selected extent and condition of habitat as indicators because relative differences among alternatives could be readily compared.

We made qualitative, rather than quantitative, comparisons. To evaluate extent and condition of habitat, we relied upon findings for environmental consequences from the “Aquatic and Riparian Ecosystems” section. In other words, the extent and condition of each ecosystem or special type served as the habitat indicator for individual species, and for assemblages of at-risk species and overall diversity. However, the ecosystem types outlined in the “Aquatic and Riparian Ecosystems” section are roughly, but not exactly aligned with watershed characteristics to which at-risk aquatic species populations are often associated. Therefore, we also discussed the extent and condition of the watershed characteristics to reflect the habitat indicators.

The amount of habitat provides a relative quantitative measure of habitat condition and extent to maintain species viability and is also an appropriate measure for a programmatic-level analysis. The condition of habitat is used as an indicator only when it can be estimated adequately at the programmatic-level, such as assessing not only the amount of impact from wildfire but also the type of fire and the resulting effects on habitat quality. These estimates of habitat quality are derived from the analyses in the “Terrestrial Vegetation Ecology” and “Fire Trends” sections.

Affected Environment

Aquatic ecosystems include standing waterbodies such as lakes, ponds, tarns, springs and reservoirs, and flowing waterbodies such as rivers, creeks, and streams. Meadows and riparian areas are also important features of aquatic ecosystems.

The El Niño Southern Oscillation is partially responsible for approximately a decade long inter-annual precipitation pattern in the southern Sierra Nevada. Drought years alternate with normal and extremely wet years during these decade-long oscillations. In recent years, the pattern has increased in variability. Within the same year, the Mediterranean climate may have long dry summer periods and highly seasonal winter precipitation.

The following sections describe the aquatic environment of each national forest, as well as the topography, climate, and other factors that influence the aquatic ecosystems and habitats found there.

Rivers and Streams

Inyo National Forest: The eastern side of the Sierra Nevada lies in the rain shadow of these mountains, which reach their highest elevations on the Inyo National Forest. This has created a dry, precipitation-dependent and precipitation-driven aquatic system. Streamflow is dependent on total precipitation and timing of snowmelt. Water flows can vary greatly from one year to the next, depending on precipitation levels. Some years, streams can be completely dry. Climate change is likely to magnify these shifts in two ways: with decreasing precipitation resulting in more dry years, and with earlier snowmelt and shifts in seasonal timing of flows (Hunsaker and Long 2014). The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season. Rivers in valleys usually provide a consistent, abundant flow of water throughout the year, and support more complex faunal ecosystems.

Large rivers are predominately absent from the eastern Sierra Nevada mountains. There are several along valley bottoms including the upper Owens River, the South Fork of the Kern River, and the San Joaquin River. There are many larger and smaller, sometimes seasonally flowing streams. Larger streams include Pine Creek, Bishop Creek, Big Pine Creek, and Rock Creek. An estimated 1,640 miles of perennial streams are on the Inyo National Forest.

Many of the stream systems on the Inyo National Forest were fishless prior to stocking of non-native trout, except the South Fork Kern River and Golden Trout Creek and their tributaries, which are the native range of the California golden trout. Native species found in these systems include a variety of stream-dwelling macro-invertebrates (the aquatic life-cycle stage of many aquatic insects), such as caddis flies, mayflies, and stone flies.

Sequoia National Forest: The three rivers that produce the most water from the Sequoia National Forest, the Kern River, Tule River, and White River produce approximately 835,000 acre feet of water per year on average. The variability in flows from year to year makes it difficult to detect whether the quantity of water flowing from the Sequoia is outside the natural range of variation. In the past, the snowpack stored part of the winter precipitation into the drier summer months. A well-documented shift toward earlier runoff in recent decades has been attributed to a decreasing trend in snow precipitation and earlier snowmelt (Hunsaker et al. 2014). The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season.

Eleven fish species were native historically but most waters were barren of fish prior to transplanting activities starting in the late 19th Century. Much of the west slope of the Sierra Nevada range above 5,000 feet was historically fishless due to glaciation during the Pleistocene and due to steep topography (Moyle 2002). However, it is noted that trout may have occurred up to 7,200 feet in the Middle Fork of the Kings River (Moyle et al 1996). Habitats are characterized as having more riffle than pools, with water temperatures seldom exceeding 70 degrees Fahrenheit. Elevations less than 2,500 feet are generally part of the pikeminnow-hardhead-sucker assemblage which occurred within Sierra Nevada foothill streams (Moyle 2002). Water temperatures within this transitional area may exceed 70 degrees Fahrenheit during the summer, especially during "dry and critically dry" water years. Trout species may persist within these areas, but water temperatures limit the populations and introduced centrarchids (sunfish family) are better adapted to these habitat conditions.

Sierra National Forest: The water that originates on the Sierra National Forest drains to the San Joaquin River system via the Merced, Chowchilla, Fresno and Kings Rivers, along with the mainstem San Joaquin River. Aquatic habitat includes an estimated 2,000 miles of perennial streams and rivers. The Sierra National Forest aquatic systems provide habitat for 31 species of fish, with approximately 1,580 miles of stream occupied by fish. Perennial waters also provide potential habitat for a variety of amphibian and reptile species, as well as benthic macroinvertebrates.

Review of 40 benthic aquatic invertebrate datasets during the Forest Watershed Condition Assessment indicated 29 samples represented "functioning properly," 9 indicated "functioning at risk," and 2 indicated "impaired" aquatic systems. There are 155 miles of stream on the Sierra National Forest subject to minimum in-stream flows downstream of hydroelectric dams, which can impair habitat for aquatic invertebrates.

Lakes and Ponds

Historically the lakes of the high Sierra Nevada were fishless and supported native fauna such as amphibians, aquatic insects, abundant zooplankton and phytoplankton. The mountain yellow-legged frog was an abundant resident of these lakes, with a life cycle that accommodated the seasons of ice in the high country (Knapp et al. 2007). Currently, many of the high-elevation lakes support introduced trout species of brook, brown, rainbow and golden trout, which has had an impact on frog populations (Knapp et al. 2007; Knapp and Matthews 2000a, Knapp and Matthews 2000b). The historic introduction of trout into lakes throughout the Sierra Nevada mountain range has had the effect of eliminating the mountain yellow-legged frog from over 95 percent of its historic range (Vredenburg et al. 2007). The introduction of trout into these lakes has also altered the life cycle and reduced the population numbers of macro-invertebrates and zooplankton within the lake (Knapp 2005, Schindler et al. 2001). This reduction or elimination also affects the intensity of insect hatches, which has been shown to affect bird migration patterns. The trout are popular for recreational use, which is an important source of economic sustainability in the area. Climate change is expected to disrupt habitat for lake associated species. Mountain yellow-legged frog populations are impacted by the fungal pathogen commonly referred to as chytrid fungus (Briggs et al. 2005, Rachowicz et al. 2006, Reeder et al. 2012) in addition to introduced trout, climate change and other stressors (Bradford et al. 2011, Davidson and Knapp 2007).

Ponds and other small waterbodies, such as tarns and pools, occur throughout the higher elevations within the Sierra Nevada Mountains. For the purpose of this discussion, waterbodies less than 2 acres were identified as ponds, of which there are 1,372 on the Inyo National Forest,

with a total of 662 acres. Due to the shallow nature of these waterbodies, they are characteristically warmer during the summer months than lakes or streams. These features provide breeding habitat for the Yosemite toad and Pacific chorus frogs, which prefer meadow edges without deep water or adjacent steep terrain (Davidson and Fellers 2005). Most ponds occur in wilderness areas in the Sierra Nevada portion of the forest. Little to no information is available on their condition or trend. Impacts have been observed, but not measured systematically, from recreation, grazing, or pack stock.

Inyo National Forest: Lakes on the eastern side of the Sierra Nevada Mountains range in size from one acre to hundreds of acres. No lakes occur in the White Mountains, Inyo Mountains or Glass Mountains. Approximately 479 lakes larger than 2 acres occur on the Inyo National Forest, totaling about 46,000 acres.

Sequoia National Forest: The Sequoia National Forest has only a few natural lakes and all of them are in wilderness. These are Maggie Lakes, Weaver Lake, Silver Lake and Coyote Lake. Some lakes, such as Silver Lake, have remained with no introduced fish. These lakes provide a last refuge for the mountain yellow-legged frog. In previously fishless lakes, the effects of introduced fish caused the loss of frogs from the area. In addition, air pollution from the Central Valley or metropolitan areas may influence water chemistry. Lake Isabella provides reservoir fisheries.

Sierra National Forest: There are 11 large reservoirs (greater than 150 acres), and 21,550 acres of lakes distributed across the Sierra National Forest providing a variety of angling opportunities. The Sierra provides reservoir fisheries, high mountain lake fisheries, and both warm and coldwater fisheries. Lakes above approximately 2,500 feet elevation are generally considered “coldwater” fisheries (water temperatures less than 70 degrees Fahrenheit), where anglers may catch rainbow trout, golden trout, brown trout, or eastern brook trout.

Reservoir fisheries exist where dams established as part of hydroelectric power development or flood control has created lakes. Kokanee salmon are popular at several large reservoirs above this elevation. However, both Bass and Shaver Lakes develop temperature thermoclines over the course of the summer, which provide temperatures suitable for species from the bass/sunfish (centrarchid) and catfish families.

Forest waters less than 2,500 feet in elevation are considered “transitional” or “warmwater” fisheries and are more likely to be occupied by fish from the bass/sunfish and catfish families, although stocked Chinook salmon may be caught on Pine Flat Reservoir, along with occasional brown or rainbow trout at other sites below 2,500 feet. Angler experience and success may be affected by the time of year since stream and lake levels may be influenced by spring runoff of snowmelt, low summer/fall flows, drought, or drawdown of hydroelectric and flood control reservoirs in the fall.

Meadows, Seeps, and Springs

Meadows, seeps, and springs in the drier southern Sierra Nevada Mountains provide important habitat diversity and habitat for plants and animals.

Wet meadows are wetland habitats associated with groundwater seeps, stream and lake edges, and margins of seasonal drainages. This plant community is dominated by grass and grass-like species growing with varying combinations of herbaceous perennials and intermixed with the other habitat types noted in this section. Meadows play important roles in hydrology, erosion control,

nutrient cycling, wildlife habitat, and recreation. Meadows are also important in maintaining hydrological processes downstream, conserving stream flows, channel erosion, and nutrient loads. Fens are continually wet areas where soils rich in organic material form.

Springs are small areas of water that come to the surface, and are fed by groundwater (Sada and Pohlmann 2002). Their water temperature is relatively constant and provides the only water over vast areas. Because of this, they are usually biodiversity hotspots, supporting many species that only occur there.

Meadows, seeps and fens are dependent on snowpack to sustain the water throughout the long dry period of summer. There is little information about the current trends for springs. As the rain-snow interface changes, lower elevation meadows and fens will be increasingly at-risk. Restoration of these systems holds great potential to provide multiple ecological and social benefits, despite their small share of the landscape. Evaluating the role of natural processes such as wildfire and management practices such as watershed restoration, on a larger, watershed scale, could aid the design of more effective strategies to promote long term resilience of these valuable systems.

Inyo National Forest: The Inyo National Forest has over 25,000 acres of meadows larger than 1 acre. Meadows on the Inyo National Forest are experiencing increasing conifer densities and canopy cover over the past several decades that likely exceed the natural range of variability (Gross and Coppoletta 2013). Researchers sampled 10 randomly selected meadows on the Inyo National Forest as part of a Sierra Nevada study (Fryjoff-Hung and Viers 2013). This study found vegetation cover and bare ground cover ranged from natural condition to moderately or heavily altered, depending on location. Encroachment (the ingrowth of trees) was the most common impact, with 60 percent moderately impacted and 10 percent slightly impacted.

Unpublished Inyo National Forest data indicate that all stream reaches through meadows in grazed and rested allotments fell within expected values for width and width-to-depth ratios, except for Monache Meadow, which showed that widths were wider and depths shallower than they should be for a functioning hydrologic system. In the past 20 years, much restoration work has been completed in meadows on the Inyo, especially the Kern Plateau. Observations by national forest staff suggest that, even in allotments that remain open to livestock grazing, restoration and changes in grazing management appear to have improved stream and meadow condition overall (USDA FS 2013a).

Little information is available on springs and seeps on the Inyo National Forest. Springs are scattered throughout the national forest, throughout different habitats. Existing information indicates that there are approximately 1,472 springs on the national forest. Stressors on these systems include spring development, recreation use, concentrated livestock grazing use, diversions and unauthorized off-highway-vehicle use. Groundwater pumping can affect springs even miles away from the pumping source, causing springs to cease flowing. Many springs have been fenced from livestock use, and this is expected to improve function and condition of these springs. Even with predicted decrease in water throughout the area as a result of climate change, it is expected that springs will persist, but they may be the only water sources available for animals. Springs could receive additional impacts from species such as mule deer, burros, wild horses, and other animals as other stream sources dry, especially in the White and Inyo Mountains and Pizona area.

Sequoia National Forest: There are an estimated 556 meadows on the Sequoia National Forest. Currently, biodiversity indicators such as fish and amphibians indicate some meadows are not in

good condition and would benefit from restoration (Frissell et al. 2012, Moyle and Randall 1998, Purdy et al. 2012, USFWS 2015, Viers and Rheinheimer 2011, Vredenburg et al. 2007).

Sierra National Forest: Meadows on the Sierra National Forest range from extremely large to tiny meadows around springs. Large diverse meadow complexes are found in the wetter areas of the national forest and also the drier portions, because of persistent snowpack and extensive shallow groundwater systems. There are an estimated 15,750 acres of meadow on the Sierra National Forest (USDA FS 2001, 2004).

Riparian Ecosystems

Riparian ecosystems are a critically important component of biodiversity, supporting a higher concentration of species diversity than most terrestrial ecosystems. They serve in part as a link between aquatic and terrestrial ecosystems, and play numerous important roles within the broader landscape (such as providing for wildlife habitat including habitat corridors, nutrient cycling, and proper watershed function). Because they are cool and moist in the hot summer, they are also attractive for many uses such as grazing, camping, fishing, and hydropower production. Despite their importance Kattelmann and Embury (1996) estimated that riparian vegetation currently makes up less than 1 percent of the Sierra Nevada bio-region.

Riparian ecosystems are formed by the interacting effects of flooding, soil wetness, water table level, proximity to streams, height above water level, sediment, and ice scouring. Meadows are areas where grasses, sedges and rushes are dominant and flowering plants common. Willows, alders, cottonwoods and other woody vegetation dominate non-meadow riparian ecosystems, but flowering plants, sedges, and grasses are often present. Aspen is often present in riparian ecosystems.

Riparian habitat is associated with the margins of seasonal and perennial drainages, and with seeps and wet meadow margins at scattered locations in the three national forests. Riparian habitat is dominated by willows including Lemmon's willow (*Salix lemmonii*), Sierra willow (*S. eastwoodii*), Scouler's willow (*S. scouleriana*), and mountain alder (*Alnus incana spp. tenuifolia*), with occasional quaking aspen (*Populus tremuloides*).

Riparian areas consist of vegetation commonly associated with standing or flowing water, such as willows, alders, aspen, and meadows (Manley et al. 2000). Riparian areas have an exceptionally high value for many wildlife species. However, many of the montane riparian communities in the three national forests are currently grown in with conifers. Riparian areas provide water, thermal cover, migration and movement corridors and diverse nesting and feeding opportunities for many species (Grenfell 1988).

The aquatic ecosystem types shown in Table 77 give an overview of the distribution of diversity in the planning area and assisted with a broad, qualitative analysis by applying a coarse filter approach of grouping species by aquatic habitat types they are most commonly associated with. All at-risk species occur in at least one of the ecosystems and many occur in two or more. Many species do not have a strict affinity to the ecosystem types as designated below; precise adherence to ecosystem type associations is not possible to determine and species may occupy multiple and additional ecosystem types.

Table 89. Aquatic at-risk species by ecosystem type

Common and Scientific Name	Ecosystem types
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	Rivers and streams
Paiute cutthroat trout (*Oncorhynchus clarki seleniris*)	Rivers and streams
Little Kern golden trout (*Oncorhynchus aquabonita whitei*)	Rivers and streams, lakes, ponds
Owens tui chub (*Gila bicolor snyderi*)	Rivers and streams, seeps, springs
California red-legged frog (*Rana aurora draytonii*)	Rivers and streams
Yosemite toad (*Anaxyrus canorus*)	Meadows
Sierra Nevada yellow-legged frog (*Rana sierrae*)	Rivers and streams, lakes, ponds, seeps, springs, riparian areas
Northern DPS mountain yellow-legged frog (*Rana muscosa*)	Rivers and streams, lakes, ponds, riparian areas
Black toad (*Anaxyrus exsul*)	Seeps, springs
Relictual slender salamander (*Batrachoseps relictus*)	Seeps, springs
Kern Plateau salamander (*Batrachoseps robustus*)	Seeps, springs, riparian areas
Foothill yellow-legged frog (*Rana boylii*)	Rivers and streams
California golden trout (*Oncorhynchus mykiss aguabonita*)	Rivers and streams
Kern brook lamprey (*Lampetra hubbsi*)	Rivers and streams
Central Valley hitch (*Lavinia exilicauda exilicauda*)	Rivers and streams, lakes, ponds
Hardhead (*Mylopharodon conocephalus*)	Rivers and streams, lakes, ponds
Kern River golden trout (*Oncorhynchus mykiss gilberti*)	Rivers and streams
Western pearlshell mussel (*Margaritifera falcate*)	Rivers and streams
Denning's cryptic caddisfly (*Cryptochia denningi*)	Rivers and streams, seeps, springs
An isopod (*Calasellus longus*)	Seeps, springs
California sallfly (*Sweltsa resima*)	Rivers and streams, seeps, springs
Wong's springsnail (*Pyrgulopsis wongi*)	Seeps, springs
Owens Valley springsnail (*Pyrgulopsis owensensis*)	Seeps, springs

Environmental Consequences to At-risk Aquatic Species

Consequences Common to all Alternatives

Currently, major drivers of aquatic ecosystems include climate change, shifting hydrologic patterns and increasingly dense and unhealthy forest conditions. Climate change is expected to alter the overall hydrologic regime in the Sierra Nevada by decreasing surface flows and increasing water temperatures. Warming air temperatures will bring about less snowfall, more intermittent snowpack at all but the highest elevations, more rain-on-snow events, reduced spring snowmelt, earlier and likely lower peak spring runoff, and higher evapotranspiration rates for vegetation (Podolak et al, 2015). The higher evapotranspiration rates over large landscapes will reduce percolation into shallow groundwater storage and reduce baseflow in streams that are groundwater dependent (Bales et al, 2011). Climate changes may alter riparian habitats substantially (Perry et al. 2015), especially those that have deviated from natural ranges of variation.

All alternatives provide direction for aquatic ecological restoration and attempt to mitigate effects of climate change at varying scales across the three national forests. All alternatives include removal of vegetation through hand thinning, mechanical treatments, prescribed fire, and wildfire managed to meet resource objectives as a means to improve the resilience of vegetation to stressors and move vegetation and ecosystem functions toward the natural range of variation. Two key water quality indicators critically important to aquatic species and functioning aquatic systems are water temperature and fine sediment delivery. All alternatives seek to mitigate these effects through restoration to maintain or reduce water temperatures and prevent erosion for the benefit of at-risk aquatic species.

All alternatives would retain riparian conservation areas and critical aquatic refuges that protect aquatic habitats by providing guidance for ground-disturbing management activities in riparian and upland areas. Projects developed under all alternatives would be guided by desired conditions and would implement standards and guidelines for these management areas, including equipment limitations closest to water and riparian vegetation. In addition, established best management practices to protect water quality would be applied to all ground-disturbing projects (USDA FS 2011, 2013). Based on results of past monitoring, best management practices are expected to reduce both short- and long-term adverse impacts from non-point source pollution to less than significant levels. Staff at the three national forests would continue to follow agency direction to implement an annual best management practices evaluation and adaptive management program, following established agency monitoring protocols. Riparian areas are high in biodiversity due to the water, relative humidity, cooler temperatures and complex cover provided. They also serve as important corridors for species dispersal.

All alternatives would promote priority watershed restoration focused on maintaining or improving watershed conditions using the Watershed Condition Framework as funding permits. The Inyo, Sequoia, and Sierra National Forests and their partners are actively implementing restoration actions to reduce erosion on roads, trails, dispersed camping areas, grazed areas, and other developed and dispersed recreation sites. These efforts are expected to continue, resulting in improved water quality and improved aquatic habitat conditions by reducing erosion. Managers at the three national forests have identified priority watersheds to focus restoration work that results in overall benefits to a watershed, rather than restoring separate unconnected locations across the national forests. The three national forests have developed water restoration action plans for all priority watersheds. The water restoration action plans identify essential projects to restore legacy erosion sites, and degraded aquatic and riparian habitats (including streams and meadows) and are

designed to improve overall aquatic habitat conditions. Additionally, restoration of aquatic ecosystems is a regional priority for the three national forests following the "Ecological Restoration Leadership Intent" established by the Regional Forester.

All alternatives would maintain the same level of livestock grazing as the current plans (alternative A) and each national forest proposes to manage grazing similar to current practices. Specific decisions on the numbers, types, seasons, and level and intensity of livestock grazing are made during site-specific allotment management planning. Alternative D proposes a new site-specific system to determine appropriate management strategies in areas occupied by the Yosemite toad during the breeding and rearing season.

Operations of various hydropower facilities and other dams and diversions on the three national forests would continue under all alternatives. Hydropower operations have recently undergone relicensing from the Federal Energy Regulatory Commission and have changed some operating procedures, including maintaining downstream baseline flows to support aquatic ecosystems. Higher flows from these dams, especially where the stored water is cooler than the ambient stream water, can help maintain cooler water temperatures for the benefit of at-risk aquatic species. All alternatives would minimize the effects of stream diversions or other flow modifications on at-risk species for Federal Energy Regulatory Commission, State and other authorized water use planning, water rights, and relicensing on the national forests.

All alternatives would include Forest Service participation in the development of total maximum daily loads and total maximum daily loads implementation plans for waters designated as Clean Water Act section 303(d) "water quality limited" to improve water quality.

Consequences Common to Alternatives B, C, and D

Nonnative invasive aquatic species are a serious threat to all aquatic habitats. Non-native fish and bullfrogs are present within the planning area and their presence has been detrimental to native species, especially amphibians (Schwartz et al. 2013). The New Zealand mud snail is established in the Owens River watershed and has been found to cause significant disruptions in stream food chains throughout the western states (Moore et al. 2012). It is anticipated that aquatic invasive species will continue to spread throughout streams, rivers, and reservoirs in the San Joaquin valley on boats, fishing equipment, and other water sports gear (CDFG 2008).

When a new aquatic invasive species invasion occurs in a locality, it often requires research and observation time before reliable inferences can be made regarding spread patterns, specific effects, and potential containment strategies. A baseline often is lacking to predict how an aquatic invasive species from another region or continent will respond when introduced into a new environment. Since a local environment contains a unique assemblage of thousands of interconnected components and processes, the results in one area can vary slightly or significantly from previously infected areas.

If an aquatic invasive species becomes established, elimination may be nearly impossible and efforts for containment can be very difficult, time consuming, and expensive. Thus, preventing invasions is of paramount importance in land and natural resource management. This involves recognizing the ways the invasive species is introduced to an area and how it spreads and implementing safeguards or resource protection measures to minimize and prevent its transmission and establishment. An example of something that could introduce an aquatic invasive species is the use of pumps and other fire equipment that come into contact with water. This equipment is increasingly used and transported globally between projects. Microbes, spores,

planktonic larval and adult stages, and plant materials can easily be spread on this and other equipment, introducing invasive species to water. Requiring effective sanitation and inspection measures would be appropriate resource protection measures.

For alternatives B, C, and D, there are forestwide desired conditions to control, or eradicate when possible, and prevent establishment of new populations of aquatic invasive species (INV-FW-DC-01 to 02). There are also similar riparian conservation area desired conditions including direction to work with State and Federal wildlife agencies to reduce impacts of invasive species to native aquatic species populations (MA-RCA-DC-01). In addition, all alternatives include the forestwide standard to clean equipment when moving from waterbodies with known aquatic invasive species (INV-FW-STD-01).

Plan Components Developed for Aquatic At-risk Species

Table 90 lists the threats and principal habitats for each aquatic at-risk species and the primary applicable plan components that provide for the ecological conditions necessary to ensure persistence of the species. While many other plan components may also provide generally for ecological conditions that would benefit a species, only the primary plan components are identified. The plan components are generally the same between each of the draft forest plans; however, some plan components are identified by national forest where needed for clarity.

Table 90. Plan components addressing the identified potential threats to at-risk aquatic species

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	Hybridization and competition with introduced trout species; alteration in stream channels and morphology; loss of spawning habitat due to pollution due to sediment inputs from a variety of sources (wildfires, logging, mining, and livestock grazing); changes in hydrologic connectivity, and concentrations of chemical components in lakes and demands of over fishing.	Perennial, cold water streams and rivers.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animals and plants (SPEC-FW): DC: 02; GDL: 04; Sierra GDL: 07 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 02-06 Fire (FIRE-FW): DC: 03; GDL: 05 Range (RANG-FW): DC: 02-03; STD: 01-02; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-16; STD: 01-02, 04-14; GDL: 01-10 Rivers and Streams (RCA-RIV): DC: 01-02 Critical aquatic refuges (MA-CAR): DC: 01-03
Paiute cutthroat trout (*Oncorhynchus clarki seleniris*)	Limited distribution increase vulnerability. Destruction or modification of habitat and input of sediment into habitat, disease or predation, over fishing, and introgression with both rainbow and Lahontan cutthroat trout.	Perennial, cold water streams and rivers	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animals and plants (SPEC-FW): DC: 02; GDL: 04 Invasive species (INV-FS): DC: 01-02; STD: 01; GDL: 02-06 Fire (FIRE-FW): DC: 03; GDL:05 Range (RANG-FW): DC: 02-03; STD: 01-02; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-16; STD: 01-02, 04-14; GDL: 01-10 Rivers and Streams (RCA-RIV): DC: 01-02 Critical aquatic refuges (MA-CAR): DC: 01-03
Little Kern golden trout (*Oncorhynchus aquabonita whitei*)	Introduction of non-native species and hybridization with non-native fish species; climate change; degradation of stream, meadow, and upland riparian habitats from land uses.	Cold streams, rivers and lakes.	Watershed conditions (WTR-FW): DC: 01-05; STD: 01 Animal and plant species (SPEC-FW): DC: 02-03; GDL: 04 Invasive species (INV-FW-DC): 01-02; STD: 01; GDL: 02-05 Fire (FIRE-FW): GDL: 05, 07, 10 Range (RANG-FW): DC: 02-03, 05; STD: 01 Wilderness (MA-WILD): DC: 02, 05; GDL: 01, 03 Riparian conservation areas (MA-RCA): DC: 01-08, 10-15; STD: 01-02, 04-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Lakes, Pools, Ponds (RCA-LPP): DC: 01 Critical aquatic refuges (MA-CAR): DC: 01-02

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Owens Tui chub (*Gila bicolor snyderi*)	Habitat loss and alteration, predation, disease, competition, inbreeding depression, genetic drift, hybridization, population loss from stochastic events, and climate change.	Currently restricted to six sites, all of which have been artificially created. Prefers slow-moving water, with submerged vegetation and cover (rocks, undercut banks).	Watershed conditions (WTR-FW): DC: 01-05; STD: 01; GDL: 01 Animal and plants (SPEC-FW): DC: 02-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 02 -06 Fire (FIRE-FW): DC: 03; GDL: 05 Range (RANG-FW): DC: 02-03; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-03, 05, 07-16; STD: 01-02, 04-07, 09-10, 13-14; GDL: 01-07 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03
California red-legged frog (*Rana aurora draytonii*)	Degradation of habitat from land development and use activities; habitat invasion by non-native aquatic species such as bull frogs, and centrarchid fishes.	Cold-water ponds and stream pools with overhanging vegetation such as willows, as well as emergent and submergent vegetation. Breeding habitat includes pools, backwaters with streams and wetlands.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 02-05 Fire (FIRE-FW): DC: 03; GDL: 05 Range (RANG-FW): DC: 02-04; STD: 01-05, 10-11 Wild and scenic river (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-15; GDL: 01-08 Meadows (RCA-MEAD): DC: 02 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03
Yosemite Toad (*Anaxyrus canorus*)	Degradation of meadow hydrology resultant from land uses, encroachment of meadow habitats, disease factors, and climate change.	Associated with wet meadow habitats and lakeshores, surrounded by forests ranging from 6,400 to 11,000 feet in elevation.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC:01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03 Yosemite toad (SPEC-YT): GDL: 01-02

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Sierra Nevada yellow-legged frog (*Rana sierra*)	Introduction of non-native fish, habitat fragmentation, disease, climate change, and the effects of small isolated populations.	Streams, ponds, pools, springs, lakes, and riparian wetlands.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 02-05 Fire (FIRE-FW): DC: 03; GDL: 05 Range (RANG-FW): DC: 02-04; STD: 01, 03-07 Wild and scenic river (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refuges (MA-CAR) DC: 01-03
Mountain yellow-legged frog, northern distinct population segment (*Rana muscosa*)	Introduction of non-native fish, habitat fragmentation, disease, climate change, and the effects of small isolated populations.	Streams, ponds, pools, lakes, and riparian wetlands.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): DC: 03; GDL: 05, 08 Range (RANG-FW): DC: 02-03, 05; STD: 01-03 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-13, 18-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and Streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refugees (MA-CAR): DC: 01-03
Black Toad (*Anaxyrus exsul*)	Potential threats are water table alteration.	Watercourses/marshes (grass, sedge, dwarf bulrush, and watercress), formed by springs, surrounded by desert with low bushes. Short plant cover and unobstructed access to still or slowly flowing water. Rodent burrows in winter. Breeds in shallow marsh and pond waters.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC:01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Relictual slender salamander (*Batrachoseps relictus*)	Fire, timber harvest, any direct or indirect ground or water disturbing impacts to habitat.	Associated with downed logs and bark rubble in moist conifer forest, frequently near seepages and springs where surface moisture persists through the summer. At elevations of 1,675–2,130 m.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Terrestrial ecosystems (TERR-FW): DC: 01-04; GDL: 01-2, 04-05 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02 Fire (FIRE-FW): DC: 03; GDL: 05, 08 Range (RANG-FW): DC: 02-03, 05; STD: 02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-06 Rivers and Streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refugees (MA-CAR): DC: 01-03
Kern Plateau salamander (*Batrachoseps robustus*)	Road construction, timber harvesting activities, or forest fire suppression efforts. Habitat degradation through capping of springs or alterations of spring water or habitat. Prolonged drought and climate change could alter habitat.	Restricted to areas of permanent or seasonal surface moisture.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02 Fire (FIRE-FW): DC: 03; GDL: 05, 08 Range (RANG-FW): DC: 02-03, 05; STD: 02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-06 Rivers and Streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refugees (MA-CAR): DC: 01-03
Foothill yellow-legged frog (*Rana boylii*)	Adversely affected by seasonal pulse flows; large physical barriers (highways); and invasive species.	Small to mid -sized streams with some shallow, flowing water.	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-05; GDL: 01 Animals and plants species (SPEC-FW): DC: 01-03; GDL: 04-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): DC: 03; GDL: 05, 08 Range (RANG-FW): DC: 02-03, 05; STD: 01-03 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-14, 17-19; GDL: 01-08 Rivers and Streams (RCA-RIV): DC: 01-02 Springs and seeps (RCA-SPR): DC: 01-03 Critical aquatic refugees (MA-CAR): DC: 01-03

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
California golden trout (*Oncorhynchus mykiss aquabonita*)	Introduction of non-native species and hybridization; climate change; historic livestock grazing; connectivity disrupted by water diversions. Hybridization with non-native fish species. Catastrophic events due to drought, fire, over-fishing.	Cold, clear streams	Watershed conditions (WTR-FW): DC: 01-05; STD: 01-05; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): GDL: 05 Range (RANG-FW): DC: 02-03, 05; STD: 01 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-02, 04- 19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC:01 Critical aquatic refuges (MA-CAR): DC: 01-03
Kern Brook lamprey (*Lampetra hubbsi*)	Has declined proportionally with habitat loss, degradation, fragmentation, and potentially impacts from non-native fish predators. Trend over the past 10 years or three generations is uncertain, but distribution and abundance are declining.	Cool streams, rivers	Watershed conditions (WTR-FW): DC: 01-05; STD: 01-05; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): GDL: 05 Range (RANG-FW): DC: 02-03, 05; STD: 01 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-02, 04-19; GDL: 01-08 Rivers and streams (RCA-RIV): DC: 01-02
Central Valley hitch (*Lavinia exilicauda exilicauda*)	Many dams on rivers fragment watersheds and often create unfavorable conditions below them, either because of too little water or too much cold water. High predation by centrarchid fishes (bass and sunfish) may be a problem.	Warm lowland streams, sloughs lakes	Watershed conditions (WTR-FW): DC: 01-05; STD: 01-05; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): GDL: 05 Range (RANG-FW): DC: 02-03, 05; STD: 01 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-02, 04- 19; GDL: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC:01 Critical aquatic refuges (MA-CAR): DC: 01-03

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Hardhead (*Mylopharodon conocephalus*)	Dams and diversions have eliminated habitat and left many populations isolated and vulnerable to local extinction due to unsuitable stream temperatures and flows. Centrarchid fishes (bass and sunfish) threaten if not eliminate populations in foothill streams and reservoirs.	Cool streams, rivers	Watershed conditions (WTR-FW): DC: 01-05; STD: 01-05; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): GDL: 05 Range (RANG-FW): DC: 02-03, 05; STD: 01 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15 Meadows (RCA-MEAD): DC: 01-08; STD: 01-02, 04- 19; GDL: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC:01 Critical aquatic refuges (MA-CAR): DC: 01-03
Kern River golden trout (*Oncorhynchus mykiss gilberti*)	Hybridization with non-native fish. Other threats include dams, reservoirs, diversions, aqueducts or ditches (many off-Forest) influencing aquatic organism passage and connectivity. Historical or more recent impacts have included grazing, logging, road building, floods, fires and drought.	Cold, clear streams	Watershed conditions (WTR-FW): DC: 01-05; STD: 01-05; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 05 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 01-05 Fire (FIRE-FW): GDL: 05 Range (RANG-FW): DC: 02-03, 05; STD: 01 Wild and scenic rivers (MA-WSR): DC: 01-02; STD: 01-02; GDL: 01-03 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-02, 04- 19; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC:01 Critical aquatic refuges (MA-CAR): DC: 01-03
Western pearlshell mussel (*Margaritifera falcate*)	Changing hydrology, increasing stream temperatures.	Rivers and large streams with trout or salmon	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Denning's cryptic caddisfly (*Cryptochia denningi*)	Water quality, increased water temperature, increased sedimentation. Species is highly specific to water temperature, velocity, dissolved oxygen levels and substrate characteristics.	Streams, springs	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC:01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03
An Isopod Invertebrate (*Calasellus longus*)	Channel modification; changes in water quantity or quality; habitat loss; competition and predation from invasive species.	Cold dark water spring/Shaver lake	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC:01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03
California sallfly (*Swelta resima*)	Poor water quality, increasing water temperatures	Streams, springs	Watershed conditions (WTR-FW): DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC: 01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03
Wong's springsnail (*Pyrgulopsis wongi*)	Climate change effects of springs and small streams	Watercress (Roripaa) beds Perennial seeps and small to moderate sized spring-fed streams. Owens Valley, Conway Summit, Pine Creek in White Mountains, locally abundant at a few sites.	Watershed conditions (WTR-FW) DC: 01-04; STD: 01-03; GDL: 01 Animal and plant species (SPEC-FW): DC: 01-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01 Fire (FIRE-FW): DC: 03 Range (RANG-FW): DC: 02-04; STD: 01, 04-09 Riparian conservation areas (MA-RCA): DC: 01-15; STD: 01-18; GDL: 01-08 Meadows (RCA-MEAD): DC:01-08 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, and ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03

Species	Known Threats to Persistence	Principal Habitats	Primary Associated Plan Components Addressing Known Threats
Owens Valley springsnail (*Pyrgulopsis owensensis*)	Habitat modification, water diversion and ground water pumping, excessive livestock grazing	Isolated springs along escarpments of the White and Inyo Mountain. Typically on watercress (Rorippa), travertine deposits and or stones, restricted distribution but locally abundant.	Watershed conditions (WTR-FW): DC: 01-05; STD: 01; GDL: 01 Animal and plant species (SPEC-FW): DC: 02-03; GDL: 03-06 Invasive species (INV-FW): DC: 01-02; STD: 01; GDL: 02 -06 Fire (FIRE-FW): DC: 03; GDL: 05 Range (RANG-FW): DC: 02-03; GDL: 01-02 Riparian conservation areas (MA-RCA): DC: 01-03, 05, 07-16; STD: 01-02, 04-07, 09-10, 13-14; GDL: 01-07 Rivers and streams (RCA-RIV): DC: 01-02 Lakes, pools, ponds (RCA-LPP): DC: 01 Springs and seeps (RCA-SPR): DC: 01-03

Consequences Specific to Alternative A

In alternative A, management would continue to follow the current forest plans of the Inyo, Sequoia and Sierra National Forests, as amended by the 2004 Sierra Nevada Forest Plan Amendment (USDA FS 2004).

Rivers and Streams, Lakes and Ponds

Risks to the amount and condition of aquatic habitat are greatest under this alternative due to limited acres of habitat proposed for maintenance or improvement, and treatment restrictions within riparian conservation areas and critical aquatic refuges. Improvement of aquatic habitat conditions is primarily related to mitigating the effects of roads and addressing hydrologic connectivity. While hydrologic connectivity is addressed under this alternative, maintenance of aquatic habitat connectivity was only emphasized for some aquatic species. Restoration of aquatic habitat connectivity by improving road crossings or mitigating water diversions would be expected to occur at a slow pace. Under this alternative, the limited implementation of restoration is expected to leave many areas containing native at-risk aquatic species untreated. Critical aquatic refuges would remain unchanged, protecting areas around some, but not all, rare species.

Direction under this alternative has allowed for improvements to stream habitats by reducing erosion risk with actions such as decreasing trail and road density in riparian areas and meadows and removing or mitigating effects of dispersed camping from the edges of meadows and streams. These actions, along with best management practices, have helped to protect most stream habitats from non-point source pollution including accelerated fine sediment delivery. Additionally, this alternative would continue to provide direction for priority watershed restoration as funding permits with goals to decrease or eliminate sediment sources and other non-point pollution sources, and goals to improve aquatic habitat conditions.

This alternative does not substantially improve the resilience of the overall landscape to wildfire given the limited amounts of fuel reduction treatment. The burned area under this alternative is predicted to increase two to four times and much of the change would be in increasingly larger fires that are predicted to have large patches of high-intensity and high-severity fire (see the “Fire Trends” section), which is more likely to remove large areas of riparian vegetation (Elliot et al. 2010). High-severity fire can dramatically increase overland water flow and peak flows, triggering severe flooding and erosion (DeBano et al. 1998, Neary et al. 2005). High-severity wildfires increase runoff and erosion rates by two or more orders of magnitude (Elliot et al. 2010). Therefore, under this alternative, more acres of aquatic habitat and the condition of that habitat is anticipated to be adversely affected by the increasing trend in large, high-intensity wildfire and the resulting increases in surface erosion and sediment delivery to aquatic habitats.

The desired conditions under the current management approach do not specifically consider climate change or climate-related stressors. Without addressing climate change stressors and the influence of various adjacent ecosystems on a larger landscape scale, this alternative presents a relatively greater risk for protecting and improving the condition of riparian habitat. This alternative is also least able to adapt to changing climate conditions.

Alternative A does not include standards for the prevention of aquatic invasive species or measures to prevent new infestations or control of aquatic invasive species.

Meadows, Seeps, and Springs

Alternative A proposes the fewest number of meadows maintained, enhanced or improved and has some of the most restrictive constraints on use of restoration tools. There would continue to be limited restoration of meadow riparian vegetation and few areas would have conifers removed to restore riparian vegetation where conifers have grown into meadow habitats, a condition that is outside the natural range of variation. This alternative also has the least potential to build adaptive capacity to climate change, which makes native aquatic species less able to compete against conifers and aquatic invasive species for limited resources, and makes meadow, seep, and spring habitats more vulnerable to high-intensity wildfire.

Mechanical treatment to remove large conifers that are out-competing native trees in riparian areas and encroaching on wet meadows is also generally constrained. Where maintenance, improvements or enhancements do occur in meadows under this alternative, benefits may be short-lived because treatments are largely limited to the use of hand tools. Removal of smaller trees with hand tools may temporarily reduce competition with native plants for limited resources like space, light, nutrients, and water. Large seed source conifers are difficult to remove by hand; thus, hand treatments may only be able to temporarily suppress that stressor rather than remove it. These limitations are predicted to result in a continued trend toward a decrease in heterogeneity and condition of hardwoods and other native species. Conifers and invasive species would continue to grow into on meadow habitats and out-compete native species. Meadows would continue to be lost or degraded as conifers continue to grow in.

Although high-elevation meadows and riparian areas are generally not prioritized for maintenance or improvement under any alternative, the focus on wildland-urban intermix treatments under this alternative (as opposed to landscape-level treatments under alternative B) makes it even more difficult to treat high elevation meadows and riparian areas that are used by many at-risk aquatic species.

This alternative has standards and guidelines that exclude livestock grazing within occupied areas during Yosemite toad breeding and rearing seasons. Livestock exclusion from these areas can be waived with a site-specific management plan incorporated into allotment plans and relevant special use permits.

Riparian Ecosystems

The proposed number of acres of riparian habitats maintained or improved is the lowest under this alternative. There would continue to be limited restoration of riparian vegetation. The aquatic management strategy would continue to be used to manage riparian habitats according to the riparian conservation objectives to maintain the ecology of riparian areas to buffer sediment from entering aquatic habitats. Standards and guidelines in the current plans emphasize protecting water quality and protecting riparian conservation areas by limiting active management within a variable buffer distance around riparian features. There is some ability to restore riparian vegetation structure and composition in alternative A but it is limited by restritions on mechanical treatments within riparian conservation areas.

Restrictions on mechanical treatments also limit the ability to adequately reduce fuel volumes in riparian conservation areas to safely incorporate prescribed fire and reduce the threat of wildfire spread in riparian habitats. Additionally, prescribed fire restrictions in riparian areas limit direct fire ignitions, which reduces the ability of fire managers to create a patchy mosaic within riparian areas to lower the risk of riparian vegetation burning at high intensity during wildfires. There is less control of fire intensity and spatial burn patterns when fire is only allowed to back down into

riparian areas compared to fire managers using direct ignition methods to more closely control the fire burn patterns and fire behavior. Lack of direct fire ignitions in this habitat restricts the ability of fire managers to control how the fire behaves and create a patchy mosaic of low and moderate-severity fire effects. Although managed wildfire is considered a tool under this alternative, the unnaturally dense vegetation conditions of riparian habitats and mechanical treatment restrictions make the use of this tool for the benefit of riparian habitat improvement unrealistic.

Consequences Specific to Alternative B

Rivers and Streams, Lakes and Ponds

Alternative B is anticipated to improve aquatic habitat conditions at the landscape scale. The increased pace and scale of restoration under this alternative, along with a focus on landscape-level improvements and an emphasis on prescribed fire and wildfire managed to meet resource objectives is predicted to result in forest landscapes with a stronger resilience to large, high-intensity fires. The ability to use more mechanical treatments and natural fire tools under this alternative translates into a greater ability to adapt to climate change than alternative A. The focus on a landscape treatment approach, combined with riparian conservation area direction, is designed to reduce the negative effects of wildfire on aquatic habitats more effectively than the scattered treatment approach of alternative A and the limited treatment approach of alternative C.

Although treatments are expected to have a variety of long-term benefits, there is potential for short-term effects during and immediately following project implementation. In general, manipulating more habitat under this alternative as opposed to alternative A would translate into more potential for disturbance to aquatic species and temporary disturbance to aquatic habitat conditions from the use of equipment and fire, until the habitat recovers. Treatments to improve fire resilience in both upland and riparian ecosystems over the long term would be guided by desired conditions, standards and guidelines that protect water temperature, riparian vegetation and other components that provide quality habitat for aquatic species over the short term.

Alternative B proposes to designate 11 additional critical aquatic refuges on the Sierra National Forest and one additional critical aquatic refuge on the Inyo National Forest to protect additional at-risk aquatic species habitats. The direction for managing critical aquatic refuges is similar to Alternative A. Although additional designation may be a benefit, more critical aquatic refuges do not necessarily translate into improved aquatic habitat conditions within the designations. Restrictions on treatment options and constraints on the use of restoration tools would continue to limit restoration opportunities and reduce the potential to build adaptive capacity to climate change for some at-risk species.

Species-specific proposed plan direction for Yosemite toad is similar to existing plans under Alternative A for the Inyo National Forest and the Sierra National Forest. Yosemite toad is not located on the Sequoia National Forest.

Meadows, Seeps, and Springs

Alternative B proposes to maintain, enhance or improve more meadows than Alternative A, a similar number of meadows as Alternative D, and fewer meadows than Alternative C. Riparian and meadow vegetation restoration under this alternative would be for the purpose of moving vegetation toward desired conditions and would be intended primarily to restore native species composition, heterogeneity, resilience, and reduce the ingrowth of conifers. Removal of conifer species in meadow habitats, particularly lodgepole pine, can increase the water table and provide better wet meadow, seep and spring habitat conditions. Increased standing water in meadow

habitats would improve the vegetation structure and complexity, thereby improving habitats for at-risk aquatic species. The end result of the treatments under this alternative would generally be improved riparian hardwood composition and structure, increased herbaceous density, vigor and structural complexity, and increased amounts of surface water.

Alternative B includes an increased emphasis on partnerships to accomplish meadow restoration. Under this alternative there is also greater potential for stewardship funding to address meadow and riparian restoration work.

Riparian Ecosystems

This alternative manages the same riparian conservation areas as alternative A and uses the full suite of plan components (desired conditions, standards and guidelines, goals, and potential management approaches) to better move riparian ecosystems toward resilience to fire and climate change. The management approach under alternative B proposes to maintain, enhance, or improve more acres of riparian habitat than alternative A and with a greater variety of restoration tools including mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives.

Alternative B modifies direction in Alternative A by allowing more flexibility to use prescribed burning and more mechanical and hand treatments to improve riparian resilience to fire, drought and climate change. Although mechanical equipment use in riparian habitat could occur under this alternative, these treatments would be for the purpose of reducing high fuel loads to prepare riparian areas to be treated by prescribed fire methods. Overall, over the long term, these restoration actions are anticipated to result in providing more productive site conditions, which would result in improved aquatic habitat conditions.

Alternative B also allows for direct ignition of prescribed fire in riparian areas which is predicted to greatly improve the resilience of riparian habitats because fire is introduced back onto the landscape in a controlled and purposeful way. All restoration that results in a reduction of upland conifers in riparian areas would restore riparian vegetation composition and structure. This would increase sunlight for riparian hardwoods and shrubs that are often shaded out by upland trees and shrubs. Prescribed fire and wildfire managed to meet resource objectives would improve the condition, vigor and health of most native riparian plants that support a variety of riparian system functions. Increased structural diversity of these habitats would enhance use by a variety of species strongly associated with complex understory and overstory. Increased fire would result in increased sprouting of native vegetation, and improved health, condition, and vigor of hardwood and understory plants, including host plants for a variety of invertebrates. The trend in composition and structural heterogeneity of native species would increase under this alternative.

Consequences Specific to Alternative C

Rivers and Streams, Lakes and Ponds

Alternative C proposes to reduce high-intensity fire risk by increasing the use of prescribed fire and wildfire managed to meet resource objectives instead of mechanical treatments. The pace and scale of treatments are not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, overall watershed function would decline under alternative C (see “Fire Trends” section).

Similar to Alternative A, this alternative does not substantially improve the resilience of the overall landscape to wildfire given the limited amounts of fuel reduction treatment. This alternative treats only a small proportion of the lands needing treatment to substantially reduce the risk of large-scale high-intensity wildfires. The burned area under this alternative is predicted to increase and result in increasingly larger fires with large patches of high-intensity and high-severity fire (see "Fire Trends" section). This is more likely to remove large areas of riparian vegetation (Elliot et al. 2010), dramatically increase overland water flow and peak flows, and potentially trigger severe flooding and erosion. Therefore, under alternative C, more acres of aquatic habitat and the condition of that habitat is anticipated to be adversely affected by the increasing trend in large, high-intensity wildfire and the resulting increases in surface erosion and sediment delivery to aquatic habitats.

Although there is less potential for short-term, implementation-related impacts under this alternative because of fewer mechanical treatments, there could be long-term negative impacts on habitat conditions because of the treatment limitations and lack of a landscape scale approach compared to the other alternatives.

Alternative C proposes to designate 37 additional critical aquatic refuges on the three national forests; 8 on the Inyo National Forest, 2 on the Sequoia National Forest, and 27 on the Sierra National Forest. Therefore, there would be protection of more aquatic habitat in these designated areas than under alternatives A and B. Overall this is viewed as a positive improvement over alternatives A and B but not without potential consequences. As described under alternative B, restrictions on treatments in these areas could unintentionally prevent needed restoration work that removes or mitigates stressors within these systems.

Meadows, Seeps and Springs

This alternative proposes to maintain, improve, or enhance the most meadows. More restoration is proposed because hand equipment, prescribed fire, and wildfire managed to meet resource objectives may more rapidly treat smaller meadows with less severe conifer encroachment, invasive species, and issues related to water retention. In contrast, alternative B may treat larger meadows with more complex issues because mechanical treatments can be used as a precursor to burning. Alternative C emphasizes the use of prescribed fire and wildfire managed to meet resource objectives to accomplish restoration and proposes to use more prescribed fire and managed wildfire than alternative A. Therefore, the treatments under this alternative have a greater potential than alternative A, but less than B to restore or improve meadow habitat conditions.

Since alternative C does not limit watershed restoration and could use additional sources of funding and assistance through partnerships to address aquatic habitat conditions, the pace and scale of meadow restoration may increase as new opportunities and funding sources develop. However, where meadow and other aquatic restoration activities would remain at their current pace and scale, surface water would increase only where meadow restoration has been completed and there would generally be a decline of meadow habitats.

Species-specific proposed plan direction for Yosemite toad is similar to existing plans under Alternative A for the Inyo National Forest and the Sierra National Forest. Yosemite toad is not located on the Sequoia National Forest.

Riparian Ecosystems

Alternative C does not modify direction to allow flexibility to use more prescribed burning, mechanical treatments, or hand treatments for riparian resilience to fire, drought, and climate change. Under this alternative, the use of prescribed fire to treat riparian areas would be constrained because of species-specific protections (not a landscape approach) and excessive fuel loading in riparian areas that could not be treated with mechanical treatments before using prescribed fire. This alternative has the most area with a passive management approach and uses repeated prescribed fire treatments in riparian areas. This alternative does not treat at the landscape scale, making habitat patches more vulnerable to a variety of stressors adjacent to riparian zones, including loss from wildfire, ingrowth of conifers from adjacent upland units, and spread of invasive species. This alternative has a lower ability than alternative B to move the landscape toward resilience to climate change and continues to have a low resiliency to large high-intensity wildfire. As a result, aquatic habitat under this alternative would be at a greater risk to degradation from untreated stressors and large-scale disturbances.

Riparian and aquatic restoration work to help offset impacts of climate change on stream temperatures and availability of water would likely be limited to existing and new priority watersheds and to completing essential projects within those watersheds. The riparian element would not likely change in the short term but would decline over the long term due to the limited pace and scale of ecological restoration of adjacent uplands, except where restoration of riparian structure and native species occurs.

Consequences Specific to Alternative D

Alternative D proposes to double ecological restoration across the three national forests compared to alternative B. Similar to alternative B, this alternative uses a landscape approach, which is expected to be more effective at improving aquatic habitat conditions over the long term than a scattered treatment approach. This alternative best achieves landscape scale reductions to the risk of high-severity wildfire and provides the greatest resilience to the effects of climate change.

Rivers and Streams, Lakes and Ponds

By increasing the amount of ecological restoration overall under this alternative, more opportunities exist for implementing watershed restoration projects than any other alternative. More treatment within watersheds should reduce the acreage that wildfire burns at high severity, would make the landscape more resilient to climate change, and in the long term, achieve the greatest improvements to aquatic habitats than any other alternative.

The long-term potential for indirect impacts of sediment flows to streams from wildfire is lower than all other alternatives considered in detail (See “Fire Management” section). The emphasis on low- and medium-intensity fires across the landscape including within the riparian areas limits the accumulation of fuels, and encourages healthy functioning aquatic habitats.

Similar to alternatives B and C, alternative D also includes an increased emphasis on partnerships. By increasing the amount of ecological restoration overall, more opportunities exist for implementing watershed restoration projects than alternatives B or C. Therefore, this alternative (followed by alternative B) should have the most funding to improve aquatic habitat conditions and at a landscape scale.

Under this alternative, critical aquatic refuges would be similar to alternative B.

Meadows, Seeps, and Springs

Under alternative D, water quality and aquatic habitats would be improved where restoration of watersheds occurs, especially in meadows and associated riparian areas. This alternative would provide the most improvements to groundwater storage, base flows, and surface water due to slightly higher infiltration rates across the landscape. This in turn would result in lower water temperatures during the dry season. Encouraging shallow groundwater storage potentially mitigates some of the impacts from climate change by increasing aquatic ecosystem resilience, providing more stable stream flows, and benefitting aquatic species dependent on springs. Alternative D would maintain, enhance, or improve more meadows than alternatives A and B (except on the Inyo where alternatives B and D propose the same number) and more meadows than alternative C on the Sierra National Forest.

Alternative D proposes a new system to determine appropriate management strategies for livestock grazing in areas occupied by the Yosemite toad during the breeding and rearing season. Known occupied sites or an occupancy probability model are used with existing meadow habitat conditions to guide a matrix of grazing management strategies ranging from no grazing to grazing standards in alternative A. Since this approach would require a site-specific evaluation to determine appropriate management strategies, it would be expected to provide equivalent or better management for the ecological conditions needed to contribute to the recovery of the Yosemite toad.

Riparian Ecosystems

Increased use of mechanical equipment in the riparian conservation areas would be designed to improve conditions of riparian areas, especially to restore fire within the landscape and riparian areas. Alternative D would reduce the risk of uncharacteristically large wildfires, thus reducing the risk of undesirable short-term impacts to aquatic habitats from high-intensity wildfire while still allowing for the historically beneficial role of fire to be expressed. Restoration and protection of aquatic habitat would improve resilience as in alternatives B and C but on an increased number of acres under alternative D. Increased fire resilience would result in long-term benefits to watersheds and riparian areas more than all other alternatives.

An increase in ecosystem restoration could have short-term negative consequences to aquatic species, particularly where mechanized treatments are used to restore riparian vegetation. This alternative may have short term impacts for aquatic species habitats from ground-disturbing activities. These short-term consequences on riparian species diversity are balanced favorably against the long-term benefits of creating more sustainable landscapes that have more resilience to changes from wildfire, climate change, and other stressors.

Cumulative Effects

As stated previously, the analysis area on the three national forests are part of the greater southern Sierra Nevada ecosystem and are administered or owned by the several Federal agencies, the State of California, water and power utilities, several Native American tribes, and thousands of private landowners. The present and foreseeable actions of these public land management agencies and private landowners will determine the cumulative consequences to aquatic habitat conditions.

The majority of the land within the analysis area is managed by the Federal land management agencies, which have individual resource management plans or shared, collaborative programs in place to guide the protection of natural resources, particularly in the face of changing climate

conditions and large, high-intensity wildfires. The focus of the 2012 Planning Rule on ecosystem integrity, resilience, and diversity is in close alignment with new direction for the National Park Service, which is to build ecosystem resilience for coping with changing climates. The "Strategic Framework for Science in Support of Management in the South Sierra Nevada Ecoregion" was developed collaboratively by Federal land managers in the Southern Sierra Nevada ecoregion (including the Sierra and Sequoia National Forests and Giant Sequoia National Monument) to help mitigate impacts from, and adapt to, climate change (Nydick and Sydorlak 2011a, 2011b). The framework contains four goals: understanding where and why changes occur, anticipating possible futures, developing tools required to take effective action, and providing easy access to and delivery of information to target audiences. The framework will be carried out by the Southern Sierra Conservation Cooperative, a collaborative group of government agencies and nonprofit organizations in the Southern Sierra Nevada Ecoregion.

The Forest Service will continue to work with the states in developing total maximum daily load strategic action plans for the 303(d) listed streams. If sources of impairment are identified related to Forest Service management, the total maximum daily loads plans may identify mitigation strategies including implementation of best management practices, maintenance or decommissioning of facilities, roads, and trails, implementation of currently planned restoration projects, and removal of existing stressors. The operators of the various dams associated with rivers in the analysis area adapt their operations to meet Federal Energy Regulatory Commission relicensing requirements and to address effects of climate change on runoff and baseflows. All alternatives minimize the effects of stream diversions or other flow modifications on at-risk species for Federal Energy Regulatory Commission, State and other authorized water use planning, water rights, and relicensing on the national forests. The Federal Energy Regulatory Commission and the power companies in conjunction with the Forest Service will need to continue working collaboratively to address issues as they arise in the future.

The proposed management approaches under each of the four alternatives are generally consistent with management of other public lands within the cumulative effects analysis area. Although the alternatives vary in their ability and pace to achieve the desired conditions and some alternatives present more risk than others, it is not expected that the management approach under any alternative would have an adverse cumulative effect on aquatic habitats on other lands within the analysis area. Therefore, given that the majority of the land in the analysis area is managed by Federal agencies and guided by individual resource management plans as well as stronger, more relevant multi-agency partnerships, these strong consistencies in management direction are expected to provide for landscape-level resilience.

Analytical Conclusion

The alternatives considered in detail outline different approaches to achieving the same overall set of goals for maintaining and enhancing aquatic habitats and watershed health. This section summarizes how well these alternatives are expected to achieve these goals expressed in terms of the quality and quantity of aquatic habitats.

To the extent possible, the coarse-filter plan components (broad ecosystem desired conditions) provide for the broad ecosystem fabric that supports a sufficient distribution of the minimum number of reproductive individuals of species of conservation concern and their habitat so that species remain viable. In other words, species distribution is partially provided for by the fact that plan components aim to maintain or restore the diversity and connectivity of ecosystems and habitat types throughout the plan area. Fine-filter (special habitat-specific) plan components complement that direction by maintaining individuals of species that rely on smaller scale

habitats or have very limited distribution. Finally, when necessary, project-level protections are an option. As a result, each threat in each ecosystem for each species of conservation concern identified has been addressed or mitigated in at least one plan component in the respective plan, so that the persistence of each species is provided for.

If, during the life of a plan, it is found that plan components are not sufficient to ensure the persistence of species of conservation concern, the monitoring program developed for the plan should detect this and changes to the plan components would be considered to address the issue.

Rivers and Streams, Lakes and Ponds

The area burned by wildfires under alternatives A and C is predicted to increase and result in increasingly larger fires with large patches of high-intensity and high-severity fire. This is expected to remove large areas of riparian vegetation, increase overland water flow and peak flows, and potentially trigger severe flooding and erosion. The pace and scale of restoration treatments under these two alternatives are not considered sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Therefore, under alternatives A and C, more acres of aquatic habitat and the condition of that habitat is anticipated to be adversely affected by the increasing trend in large, high-intensity wildfire and the resulting increases in surface erosion and sediment delivery to aquatic habitats.

The focus on landscape treatment approaches under alternatives B and D, combined with the riparian conservation area direction, is designed to reduce the long-term negative effects of wildfire on aquatic habitats more effectively than the scattered and limited approaches of alternatives A and C. While the negative effects of large-scale wildfires are expected to be significantly reduced, the increased pace of treatments under alternative B and the most treatments proposed under alternative D, translates into a higher risk of short-term disturbance to aquatic species and temporary disturbance to aquatic habitat conditions from mechanical and prescribed fire treatment actions until the habitat recovers. In the long term both these alternatives substantially improve the resilience of the overall landscape to wildfire, result in more long-term beneficial effects to aquatic species, and better promote the long-term sustainability of aquatic habitats and greater ability of these habitats to adapt to climate change.

Meadows, Seeps, and Springs

Alternative A proposes the fewest number of meadows maintained, enhanced or improved and has some of the most restrictive constraints on use of restoration tools. Few areas would have conifers removed to restore more open meadow habitats. This alternative leaves meadow, seep, and spring habitats more vulnerable to wildfire outside the range of natural variability.

Alternatives B, C and D propose to maintain, enhance or improve more meadows than alternative A and would move vegetation toward desired conditions and reduce the ingrowth of conifers. Removal of conifer species in meadow habitats can increase the water table and provide better wet meadow, seep, and spring habitat conditions and increase amounts of surface water in meadow habitats. Alternatives B and D would reduce evapotranspiration at a landscape scale, provide improvements to ground water storage, base flows, and surface water, and would likely increase the opportunities for infiltration across many watersheds.

Riparian Ecosystems

Alternative A proposes the lowest number of acres of riparian habitats maintained or improved. Alternative C does not modify direction to allow more prescribed burning, mechanical treatments,

or hand treatments in riparian areas to promote resilience to fire, drought and climate change. Under Alternatives A and C, there would continue to be limited restoration of riparian vegetation and limited ability to adequately reduce fuel volumes in riparian conservation areas. As a result, aquatic habitat under these alternative would be at a greater risk to degradation from untreated stressors and large-scale disturbances.

Alternative B proposes to maintain, enhance, or improve more acres of riparian habitat than alternatives A and C and with a greater variety of restoration tools including mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives. Alternative D proposes to treat the most amount of acres with increased use of mechanical treatments designed to improve riparian habitat conditions. Alternatives B and D also allow for direct ignition of prescribed fire in riparian areas, which is predicted to greatly improve the resilience of riparian habitats because fire is introduced back onto the landscape in a controlled and purposeful way. The increased fire resilience under alternatives B and D is expected to result in long-term benefits to riparian areas and watersheds that are more resilient to changes from wildfire, climate change, and other stressors.

Federally Listed Endangered and Threatened Aquatic Species Determinations

For all threatened and endangered species, it is determined that the management approach under all alternatives at the programmatic level of the plan *may affect but is not likely to adversely affect* the Lahontan cutthroat trout, Paiute cutthroat trout, Little Kern golden trout, Owens tui chub, California red-legged frog, Yosemite toad, Sierra Nevada yellow-legged frog, and the northern distinct population segment of the mountain yellow-legged frog.

Critical habitat has been designated for the Little Kern golden trout. It is determined that *none of the alternatives are likely to result in destruction or adverse modification of that critical habitat*.

Aquatic Species of Conservation Concern Outcomes

Adjustments to emerging ecosystem plan components, additional species-specific plan components, or both, when carried out in alternatives B and D, would provide the necessary ecological conditions to maintain a viable population of: black toad, relictual slender salamander, Kern Plateau salamander, foothill yellow-legged frog, California golden trout, Kern brook lamprey, Central Valley hitch, hardhead, Kern River golden trout, western pearlshell mussel, Denning's cryptic caddisfly, an isopod (*Calasellus longus*), California sallfly, Wong's springsnail, and Owens Valley springsnail. This outcome is supported by the long-term improved resilience to large, high-intensity fire and climate change and the associated monitoring program that would occur in these alternatives.

Adjustments to emerging ecosystem plan components, additional species-specific plan components, or both, when carried out in alternatives A and C, may be less successful than alternatives B and D at providing the necessary ecological conditions to maintain a viable population of: black toad, relictual slender salamander, Kern Plateau salamander, foothill yellow-legged frog, California golden trout, Kern brook lamprey, Central Valley hitch, hardhead, Kern River golden trout, western pearlshell mussel, Denning's cryptic caddisfly, an isopod (*Calasellus longus*), California sallfly, Wong's springsnail, and Owens Valley springsnail, due to the low resilience to large high-intensity fire and climate change that threatens the long-term persistence of enough habitat of sufficient condition to support these species. This outcome is due to the slower pace and smaller scale of restoration that would occur, which delays achieving the long-term improved resilience to large, high-intensity fire and climate change and leaves more areas at risk of large and high-intensity fires over the plan period.

At-risk Plant Species

Background

This section summarizes current conditions of at-risk plant species on the Inyo, Sequoia, and Sierra National Forests, and the consequences to at-risk plants of implementing the draft forest plans or the alternatives.

The sections on "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" covers the ecological integrity of the ecosystems upon which at-risk species depend and also evaluate the consequences of implementing the draft forest plans or its alternatives on various taxa[30] by integrating an analysis of wildlife, aquatic, invertebrate, and plant species.

This evaluation was completed by examining conditions of and threats to individual at-risk species, and also by examining the collective distribution patterns of at-risk flora within the planning area, by biogeographic region and by ecosystem. This approach assists in understanding the broad relationship between a programmatic land management plan and the desired conditions identified for at-risk species in the planning area. Desired conditions for at-risk plants emphasize habitat that supports self-sustaining populations, precluding the need for listing, and improving conditions for these species (SPEC-FW-DC-01 to 03).

Analysis and Methods

The analysis area includes all National Forest System lands within the Inyo, Sequoia, and Sierra National Forests. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, we used indicator measures and threat information from within the analysis area in making conclusions. Because of differences in available biological and threat information to federally recognized threatened, endangered, proposed, and candidate species versus species of conservation concern, and because the Forest Service Handbook outlines different procedures to identify plan components necessary to provide for the two groups of species, we used different approaches in their analyses.

Assumptions

- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions). However, there may be implications, or longer term environmental consequences, of managing the national forests under this programmatic framework. As a result, all effects discussed in this section are considered indirect effects.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities.
- Plan components will be followed when planning or implementing site-specific projects and activities.
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the plan monitoring program and any broader-scale monitoring will occur and the land management plan will be amended as needed during the life of the plan.

[30] Groups or ranks in a biological classification into which related organisms are classified.

- Relevant considerations to the analysis that are common to all alternatives include (1) existing wilderness will continue to be managed as such, (2) there will be a general increase in recreational demand as the human population size increases, (3) weeds and weed seeds will continue to be deposited and spread onto and within the planning area, and (4) climate change trends will continue as projected, with warming temperatures and reduced snowpack.
- Funding will be available to implement restoration measures proposed, including non-native invasive plant treatments.

Indicators and Measures

For all at-risk plant species, we identified the extent and condition of habitat as indicators because they are direct measures of ecological conditions needed to maintain viable populations. Furthermore, for most species, extent and condition of habitat typically constitute the best available scientific information indicating whether such populations will continue to persist with sufficient distribution in the planning area (2012 Rule Sec. 219.19). Finally, we selected extent and condition of habitat as indicators because relative differences among alternatives could be readily compared.

We made qualitative, rather than quantitative, comparisons. To evaluate extent and condition of habitat, we relied strongly upon the findings for environmental consequences in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections. In other words, the extent and condition of each ecosystem or special type served as the habitat indicator for individual species, and for assemblages of at-risk species and overall floristic diversity. However, the ecosystem types outlined in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections are roughly, but not exactly aligned with floristic geographic subdivisions (Baldwin et al. 2012), to which at-risk plant populations are often associated. Therefore, the extent and condition of floristic geographic subdivisions themselves were also discussed to reflect the habitat indicators.

For whitebark pine, an at-risk plant species that is also a candidate species for federal listing, an additional indicator, population trend, was also evaluated. For this species, where trend information related to management activities has been documented in the plan area, quantitative, species-specific information was available for analysis.

Determinations for each species consisted of a viability evaluation, which examined whether plan components provide ecological conditions necessary to maintain a viable population of each species of conservation concern in the plan area (see the Botany supplemental report).

The viability evaluation was conducted using both a coarse filter and a fine filter approach, again using habitat extent and condition as indicators. For the coarse filter approach, species were grouped by coarse-scale ecosystems described in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections, and discussed below. The environmental consequence findings of those sections also compared existing and foreseeable future conditions of ecosystems to desired conditions, and this comparison was used as the basis of the coarse filter evaluation. This coarse filter approach assumes that viability of species of conservation concern is broadly dependent upon the integrity of the coarse ecosystems where they currently occur. However, because integrity of whole ecosystems does not necessarily ensure persistence of all species of conservation concern, particularly those with very limited distribution, we conducted additional fine filter analyses (by special habitat and species-specific) to ensure that persistence is provided for all plant species of conservation concern.

The fine filter viability evaluation was conducted by analysis of (1) special habitats that support suites of some species of conservation concern on the three national forests, and (2) known threats to each individual species of conservation concern. Species were grouped by fine-scale habitats where possible, to enable a fine filter look at ecological conditions that affect populations. Documented threats that influence species trends in distribution and viability were also given. The Botany supplemental report lists each species' ecosystem, NatureServe rank, threats, and the number of occurrences. Known threats to species of conservation concern were compared qualitatively by alternative.

Finally, for species that were previously listed as Forest Service sensitive species for the Pacific Southwest Region, but which were not identified as at-risk species under the 2012 Planning Rule, the rationale for this determination and an overview of those species are presented in the Botany supplemental report.

Affected Environment

Floristic Diversity

The flora of the planning area is notably diverse, reflecting the area's complex geology, topography, and climate. The close juxtaposition of such variable habitats has created opportunities for genetic isolation and subsequent evolution. As a result, the area has an exceptionally high level of endemic species (unique to a place or region) relative to other regions of the United States (CNPS 2015). The planning area is situated at the intersection of California's three major floristic provinces (Baldwin et al. 2012): California Floristic Province, Great Basin, and Desert (Table 91).

Because many species of conservation concern have a greater affinity for floristic geographic subdivisions (like provinces) than for ecosystems, some detail is provided here on the subdivisions, which assisted in the evaluation of habitat condition and extent. The three major provinces and their respective regions that occur in the planning area host relatively distinct floras. However, the transitions are not necessarily abrupt, resulting in some overlap, particularly where mountain passes or drainages support connectivity.

Figure 40 and Table 91 show the floristic geographic subdivisions represented in the planning area (Baldwin et al. 2012). Spatial datasets are used with permission from the Jepson Herbarium (Jepson Flora Project 2015). The Sierra Nevada region, which occupies the majority of the planning area is characterized by primarily igneous geology. The Sierra Nevada Foothills subregion borders the Great Central Valley region to the west, and is characterized by blue-oak/foothill-pine woodlands and chaparral. It contains some serpentine areas, but is mainly differentiated from the rest of the Sierra Nevada by its distinct flora, rather than climate or geology (Baldwin et al. 2012). The High Sierra Nevada subregion is topographically complex, spanning nearly 10,000 feet in elevation. Vegetation may be dominated by ponderosa pine, mixed conifer, Jeffrey pine, red fir, lodgepole pine, mountain hemlock, whitebark pine, foxtail pine, or western white pine. Treeless alpine areas, meadows, and riparian areas, are also common. The southern High Sierra Nevada subregion supports some pinyon pine and sagebrush.

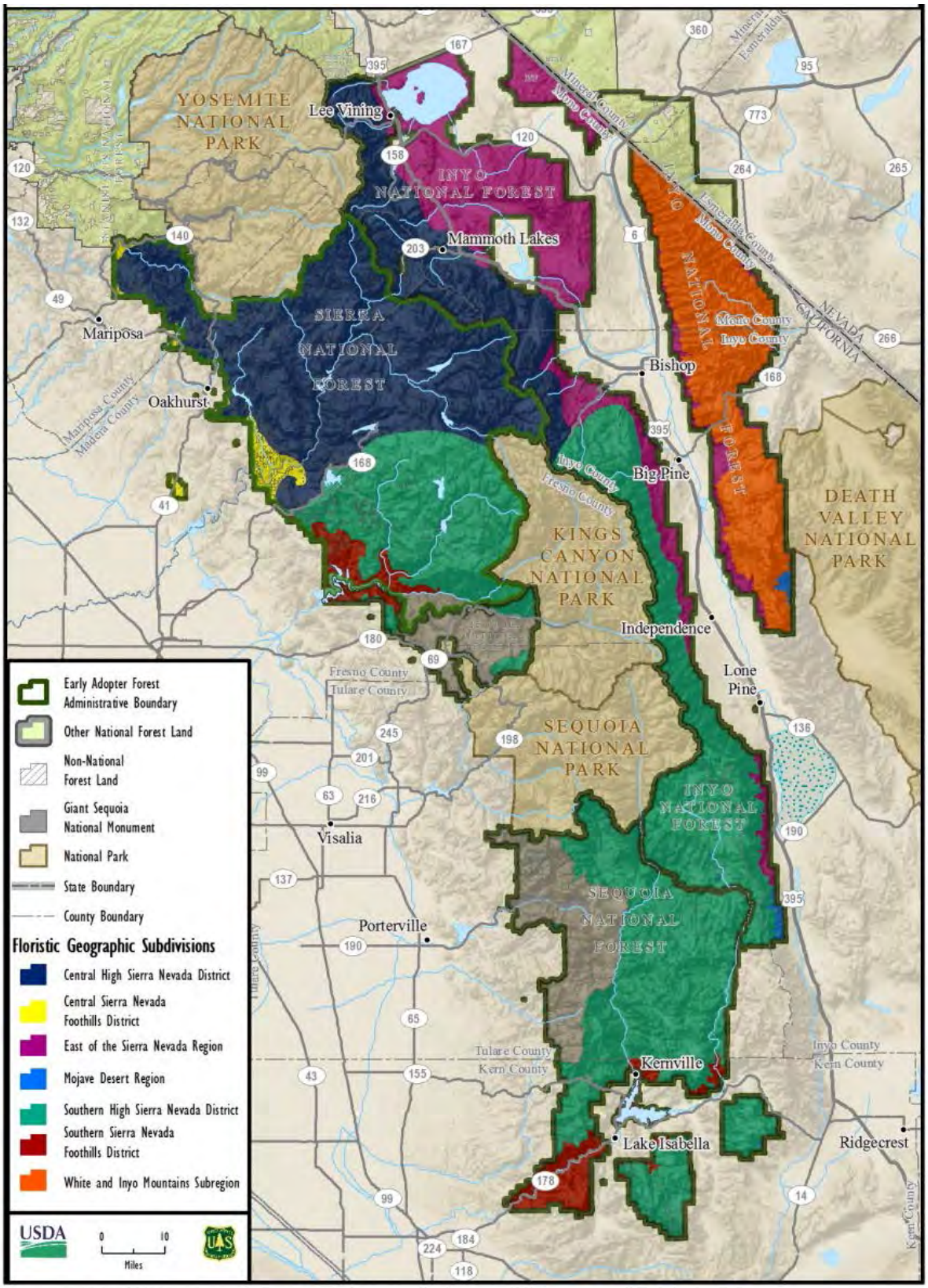

Figure 40. Floristic geographic subdivisions in the planning area

Table 91. Floristic geographic subdivisions represented in the planning area (Baldwin et al. 2012)

Province	Region	Subregion[1]	No. Plant Species in CNDDB	Area (acres)	National Forest
California Floristic Province	Sierra Nevada	High Sierra Nevada (Central or Southern)	168	3,145,457	Inyo, Sequoia, Sierra
California Floristic Province	Sierra Nevada	Sierra Nevada Foothills (Central or Southern)	45	251,225	Sequoia, Sierra
Great Basin	Eastern Sierra Nevada	White and Inyo Mountains	78	471,017	Inyo (also includes Nevada portions of Inyo)
Great Basin	Eastern Sierra Nevada	Other Eastern Sierra Nevada (Mono Basin, Glass Mts., Eastern escarpment)	59	665,889	Inyo (also includes Nevada portions of Inyo)
Desert	Mojave Desert	Mojave Desert (exc. Desert Mts.)	3	14,787	Inyo

CNDDB = California Natural Diversity Database (CNDDB, 2014).

1. Spatial dataset used with permission from the Jepson Herbarium (Jepson Flora Project 2015).

In the Eastern Sierra Nevada Region, the 10,000-foot elevation gradient is abrupt, creating rapid transitions from desert and sagebrush vegetation at the lowest elevations, to pinyon pine woodlands, coniferous forests, and alpine areas. The region includes most conifers found on the west side of the Sierra Nevada, but mixed conifer is relatively uncommon. This region is geologically complex, with significant volcanic, sedimentary, and metamorphic bedrock and soils represented. The White and Inyo Mountains subregion is situated in the rain shadow of the Sierra Nevada, and receives less precipitation, as evident in the arid-adapted vegetation, including pinyon-juniper, mountain mahogany, sagebrush, bristlecone and limber pine, and large expanses of high alpine areas.

At-risk Plant Species

A total of 177 at-risk plant species were identified on the Inyo, Sequoia, and Sierra National Forests, including two federally listed (one threatened and one endangered) species and one candidate species (Table 92), and 174 species of conservation concern (Table 96). Ramshaw Meadows abronia (*Abronia alpina*) was recently removed from consideration as a candidate species by the U.S. Fish and Wildlife Service,[31] but due to the concern for its persistence in the plan area, has been added to the list of species of conservation concern considered on the Inyo National Forest.

Although some hotspots of diversity can be identified on the three national forests (like the high alpine of the White Mountains on the Inyo National Forest, or the Merced River Canyon metamorphic soils and subalpine carbonate soils on the Sierra National Forest), at-risk plant species can be found in all floristic geographic subdivisions, and in all ecosystem types. The special habitats, or ecosystem types called out in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections can sometimes host a number of at-risk plant species, though this is not always the case.

[31] Federal Register: 80 FR 60834, Oct. 8, 2015

Table 92. At-risk federally listed and candidate plant species in the planning area

Scientific Name	Common Name	Status	National Forest
Pinus albicaulis	Whitebark pine	Candidate	Inyo, Sequoia, Sierra
Opuntia basilaris var. *treleasii*	Bakersfield cactus	Endangered	Sequoia
Calyptridium pulchellum	Mariposa pussy-paws	Threatened	Sierra

Federally Listed Plant Species

Two federally listed species are found within the plan area: the endangered Bakersfield cactus on the Sequoia National Forest and the threatened Mariposa pussy-paws on the Sierra National Forest. Two other species were examined but found to not meet the criteria for being considered at-risk species. The threatened Springville clarkia, occurs only within the Giant Sequoia National Monument. Therefore, it was not included as an at-risk plant species in this analysis for the Sequoia National Forest because it is managed under the 2012 Monument management plan. Designated critical habitat for Keck's checkerbloom occurs just outside the Sierra National Forest, but no plants are known to occur in the plan area. Therefore, Springville clarkia and Keck's checkerbloom will not be discussed further in this analysis.

Bakersfield cactus is a beavertail cactus that occurs in blue oak woodlands and riparian woodlands on the Sequoia National Forest. Its primary threats are habitat loss, hydrologic alterations, off-road vehicle use and non-native invasive plants. Approximately one-third of the historical occurrences of Bakersfield cactus have been eliminated, and the remaining populations are highly fragmented. Conservation measures have focused on habitat acquisition through land transfers. The population on the Sequoia National Forest occurs in a steep rocky canyon, and is largely excluded from effects of land management activities, although there may be some trampling or soil compaction resulting from recreational activities.

Mariposa pussy-paws is an annual plant that occurs in chaparral or woodland vegetation in the southern Sierra Nevada foothills (Guilliams and Clines 2012). Major threats include habitat loss due to development and off-highway vehicle use, competition from non-native plant species, and possibly atmospheric nitrogen deposition. Two populations occur on national forest lands. One population (element occurrence 6) has fluctuated about a mean number of individuals of 329, with a minimum of 23 and a maximum of 770 in 1992. This population has been fenced to protect it from livestock trampling. With a recent population count of 513 in 2011, the long-term potential viability of this element occurrence is considered good. The other population (element occurrence 10) has been monitored less frequently, with an apparent downward trend. Measures to address threats to this population have included invasive plant treatment, installing and improving fencing to exclude cattle, and soil stabilization to prevent erosion on adjacent areas (Guilliams and Clines 2012).

Candidate Plant Species

Candidate species are plants and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. No plant species in the plan area are proposed for listing under the Endangered Species Act.

Whitebark pine occurs in the plan area on each of the three national forests and is the only at-risk candidate plant species (Table 92). A full species account with literature citations was provided

during the assessment phase for forest plan revision and is included in the project record (USDA FS 2013). A brief summary is given here. As noted above, Ramshaw Meadows abronia was removed from consideration as a candidate species by the U.S. Fish and Wildlife Service since the time that the assessment was conducted.

Whitebark pine is known to occur in the western mountains of the United States and Canada. In California, it occurs in the Klamath Ranges, High Cascade Range, Warner Mountains, and the Sierra Nevada. It is a slow-growing, long-lived conifer that tolerates poor soils, steep slopes, and windy exposures and is found at treeline and subalpine elevations throughout its range. The plan area hosts approximately 44 percent of the extent of whitebark pine in California, with a majority on the Inyo National Forest (Table 93; Slaton et al. 2014).

Across the plan area, approximately 88 percent of whitebark pine occurs within wilderness (Table 93). The remaining 12 percent occurs primarily either within ski areas, near high elevation reservoirs where day use activities are popular (Lake Sabrina, Saddlebag Lake, South Lake), or at the lower elevations of the whitebark pine zone, where campgrounds and trailheads are often found (such as Onion Valley, Bishop Creek, and Rock Creek developed recreation sites on the Inyo National Forest).

Table 93. Distribution of whitebark pine in the planning area and California

Region	Acres
Inyo National Forest	138,829
Sequoia National Forest	2,285
Sierra National Forest	24,472
Planning Area - Total	165,586
In Wilderness within Planning Area – Total	145,403
California - Total	372,035

Whitebark pine serves a number of important ecological functions, including snow retention, runoff regulation, soil temperature moderation, early colonization of disturbed sites, and forage and habitat for birds and mammals (Meyer 2013). There are several major threats to whitebark pine, including bark beetle attack, climate change, fire suppression, and white pine blister rust (Meyer 2013). Although each threat individually is problematic, the combined impacts pose a significant threat to species viability. To date, the whitebark pine in the plan area has been relatively resistant to invasion by white pine blister rust, especially on the east side of the Sierra Nevada crest.

Plant Species of Conservation Concern

There are 174 plant species of conservation concern across the three national forests, with some species occurring on more than one national forest (Table 94). A complete list of species, by national forest is shown in Table 96, and is also in the Botany supplemental report, and the respective draft forest plans.

Table 94. Numbers of plant species of conservation concern, by national forest and by life form

National Forest	Number of flowering plants	Number of ferns	Number of mosses	Number of lichens	Number of conifers	Total number of plants
Inyo	97	5	2	1	0	105
Sierra	28	5	5	0	0	38
Sequoia	61	3	5	0	1	70

The floristic geographic subdivisions shown in Table 91 give an overview of the distribution of diversity in the planning area and assisted with a broad, qualitative analysis. For further detailed analysis, plant species were aligned with ecosystem types classified in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections. This coarse-filter approach of grouping species is displayed in Table 95. All species of conservation concern occur in at least one of the ecosystems and many occur in two or more.

Table 95. Summary of the number of plant species of conservation concern that occur in each ecosystem type

Ecosystem Type	Number of species, Inyo National Forest	Number of species, Sequoia National Forest[1]	Number of species, Sierra National Forest[1]
Alpine	24	1	0
Aquatic/Riparian	0	2	12
Black oak	0	2	1
Blue oak-Interior live oak woodland	0	11	6
Chaparral-Live Oak	0	8	15
Complex Early Seral Habitat	0	0	1
Jeffrey Pine	3	1	0
Lodgepole pine	1	2	0
Meadow	16	10	0
Mixed conifer	1	8	0
Montane	0	13	21
Montane chaparral	0	2	0
Mountain mahogany	4	0	0
Pinyon-juniper	21	17	0
Red fir	0	2	0
Sagebrush	39	2	0
Special type	24	24	15
Subalpine	46	8	8
Upper montane	0	8	22
Xeric shrub/blackbrush	10	3	0

1. Many species do not have a strict affinity to the ecosystem types as outlined above; therefore, precise adherence to the ecosystem list was not possible. As examples, montane on the Sierra National Forest includes both montane chaparral and other montane vegetation; Jeffrey pine on the Sequoia may occur in dry or moist mixed conifer; in those cases, plan direction for all applicable types would apply.

Table 96. Plant species of conservation concern for Inyo, Sequoia, and Sierra National Forests

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Eriastrum tracyi	Tracy's eriastrum	Sequoia, Sierra	Invasive species, fuels treatments	Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak
Carpenteria californica	Tree-anemone	Sequoia, Sierra	Invasive species, fuels treatment, altered fire regime, roads, climate change	Chaparral-Live Oak, Black oak, Montane
Viburnum ellipticum	Oval-leaved viburnum	Sequoia, Sierra	Rarity, fuels treatment, invasive species, roads, fire suppression activities	Chaparral-Live Oak, Montane (Ponderosa Pine, Black Oak)
Mimulus gracilipes	Slender-stalked monkeyflower	Sequoia, Sierra	Recreation (OHV), roads, climate change, invasive species, fuels management	Rock Outcrop, Complex Early Seral Habitats, Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak, Montane
Calochortus striatus	Alkali mariposa lily	Sequoia	Urbanization, grazing, trampling, roads, hydrologic alterations, horticultural collecting, invasive species	Alkali Spring/Meadow, Xeric shrub and blackbrush
Cryptantha circumscissa var. *rosulata*	Rosette cushion cryptantha	Inyo, Sequoia	Grazing, recreation	Alpine, Subalpine, Dry Forb
Symphyotrichum defoliatum	San Bernardino aster	Sequoia	Roads, invasive species	Aquatic/Riparian
Bruchia bolanderi	Bolander's bruchia	Inyo, Sequoia, Sierra	Grazing, hydrologic alteration, roads, trails, restoration projects	Aquatic/Riparian, Montane, Upper Montane, Subalpine
Brodiaea insignis	Kaweah brodiaea	Sequoia	Grazing, development	Blue oak savanna
Mimulus pictus	Calico monkeyflower	Sequoia	Grazing, recreation, recreation (OHV), trail maintenance, invasive species	Blue-Oak Interior Live Oak Woodland
Fritillaria striata	Striped adobe-lily	Sequoia	Non-native plants; grazing; fire suppression activities; vehicles; road maintenance	Blue-Oak Interior Live Oak Woodland
Mielichhoferia shevockii (Schizymenium shevockii)	Shevock's copper moss	Sequoia, Sierra	Rarity	Rock Outcrops, Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak
Layia heterotricha	Pale-yellow layia	Sequoia	Recreation, horticultural collection	Blue-Oak Interior Live Oak Woodland
Heterotheca shevockii	Shevock's golden aster	Sequoia	Roads, recreation	Blue-Oak Interior Live Oak Woodland

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
California macrophylla	Roundleaf stork's bill	Sequoia	Urbanization, roads, feral pigs, invasive species, grazing	Blue-Oak Interior Live Oak Woodland
Mimulus norrisii	Kaweah monkeyflower	Sequoia, Sierra	Rarity, invasive species	Rock Outcrop, Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak
Iris munzii	Munz's iris	Sequoia	Roads, grazing, recreational development, fire suppression	Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak
Leptosiphon serrulatus	Madera leptosiphon	Sequoia, Sierra	Invasive species, roads, livestock overuse	Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak, Montane
Deinandra mohavensis	Mojave tarplant	Sequoia	Grazing, hydrologic alteration, recreation, roads	Chaparral
Lewisia congdonii	Congdon's lewisia	Sequoia, Sierra	Mining, roads	Chaparral-Live Oak, Montane, Upper Montane
Ribes menziesii var. ixoderme	Canyon gooseberry	Sierra	Fire suppression, fuel reduction, invasive plants	Foothill chaparral, oak woodland
Dicentra nevadensis	Sierra bleeding heart, Tulare County bleeding heart	Sequoia	Developed recreation, road maintenance	Lodgepole Pine, Depressions
Astragalus lentiginosus var. *kernensis*	Kern Plateau milk-vetch	Inyo, Sequoia	Vehicles, roads, grazing	Subalpine, Lodgepole, Dry Forb, Meadows
Calochortus westonii	Shirley Meadows star-tulip, mariposa lily	Sequoia	Logging, roads	Meadow, Mixed Conifer, Black oak
Meesia uliginosa	Meesia moss	Sierra, Sequoia	grazing, hydrologic alteration	Aquatic/Riparian, Meadows, Montane, Upper Montane
Navarretia peninsularis	Baja navarretia	Sequoia	Roads, recreation	Meadows, Montane, Montane Chaparral
Nemacladus twisselmannii	Twisselmann's nemacladus	Sequoia	grazing, fire suppression activities, fuels treatments	Mixed conifer
Fritillaria brandegeei	Greenhorn fritillary	Sequoia	Logging, grazing	Mixed Conifer, Black oak
Erythronium pusaterii	Hocket Lakes fawn lily, Kaweah Lakes fawnlily	Sequoia	Rarity, climate change	Montane
Horkelia tularensis	Kern Plateau horkelia	Sequoia	Recreation, roads, infrastructure (campgrounds)	Montane

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Githopsis tenella	Tube flower bluecup	Sequoia	Ground disturbance; grazing; fire suppression	Montane Chaparral
Astragalus shevockii	Little Kern or Shevock's milk-vetch	Sequoia	Grazing, recreation, fire suppression	Montane Jeffrey Pine
Botrychium minganense	Mingan moonwort	Inyo, Sequoia, Sierra	Hydrologic alteration, trampling, recreation (OHV)), grazing, trails, climate change	Aquatic/Riparian, Meadows, Upper Montane, Subalpine
Botrychium crenulatum	Scalloped moonwort	Inyo, Sequoia, Sierra	Hydrologic alteration, trampling, recreation (OHV), severe soil disturbance, grazing, recreation (livestock trampling), climate change	Aquatic/Riparian, Meadows, Upper Montane, Subalpine
Botrychium montanum	Western goblin or mountain moonwort	Sequoia, Sierra	Grazing, hydrologic alteration, conifer encroachment, recreation, trails, climate change	Aquatic/Riparian, Meadows, Montane, Upper Montane, Subalpine
Opuntia treleasei (O. basilaris treleasei)	Bakersfield cactus	Sequoia	Rarity	Outcrops, Blue-Oak Interior Live Oak Woodland
Orthotrichum spjutii	Spjut's bristle moss	Sequoia	Recreation, grazing	Outcrops, Pinyon-juniper
Erigeron aequifolius	Hall's daisy, Hall's fleabane	Sequoia	Fuels treatment	Pinyon-juniper
Nemacladus calcaratus	Chimney Creek nemacladus	Sequoia	Recreation, grazing	Pinyon-juniper
Astragalus ertterae	Walker Pass milk-vetch	Sequoia	Recreation, trails, grazing	Pinyon-juniper
Streptanthus cordatus var. piutensis	Piute Mountains jewel-flower	Sequoia	Roads, recreation (OHV), fire suppression activities	Pinyon-juniper
Navarretia setiloba	Piute Mountains navarretia	Sequoia	Recreation, development	Pinyon-juniper, Blue-Oak Interior Live Oak Woodland
Hesperocyparis nevadensis	Piute cypress	Sequoia	Recreation, horticultural collection, fire suppression activities	Pinyon-juniper, Chaparral-Live Oak
Trifolium kingii ssp. dedeckerae (T. dedeckerae)	Dedecker's clover	Inyo, Sequoia	Grazing, invasive species	Alpine, Subalpine, Sagebrush, Montane
Phacelia nashiana	Charlotte's phacelia	Inyo, Sequoia	Grazing, mining, recreation (OHV), roads, very few populations	Xeric Shrub/Blackbrush, Pinyon-juniper, sagebrush
Mimulus shevockii	Kelso Creek monkeyflower	Sequoia	Rarity	Pinyon-juniper, Xeric Shrub and Blackbrush

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Cordylanthus eremicus ssp. *kernensis*	Kern Plateau bird's-beak	Inyo, Sequoia	Grazing, recreation	Alpine, Subalpine, Pinyon-juniper, Xeric Shrub and Blackbrush, Upper Montane
Boechera tularensis	Tulare rockcress	Inyo, Sequoia, Sierra	Grazing, climate change, extreme rarity	Rock Outcrop, Montane, Upper Montane, Subalpine, Meadow, Red fir
Oreonana purpurascens	Purple mountain-parsley	Sequoia	Grazing, recreation, development, trail maintenance	Red fir
Eriogonum nudum var. regirivum	King's River buckwheat	Sequoia, Sierra	Invasive species, trails	Rock Outcrop, Carbonate, Chaparral-Live Oak
Eriogonum breedlovei var. *breedlovei*	Breedlove's buckwheat, Piute buckwheat	Sequoia	Recreation (OHV)	Rock Outcrop, Carbonate, Mixed Conifer, Pinyon-juniper
Petrophyton acuminatum	Marble rockmat	Inyo, Sequoia	Very few populations, invasive species	Mountain mahogany, Subalpine, Pinyon-juniper, Rock outcrop, carbonate, montane
Streptanthus fenestratus	Tehipite Valley jewel-flower	Sequoia, Sierra	Trails, climate change, invasive species	Rock Outcrop, Chaparral-Live Oak, Montane, Upper Montane, Carbonate
Gilia yorkii	Boyden Cave gilia	Sequoia	Fire suppression activities	Rock Outcrop, Carbonate, Pinyon-Juniper
Eriogonum ovalifolium var. *monarchense*	Monarch buckwheat	Sequoia	Rarity, climate change	Rock Outcrop, Carbonate, Pinyon-juniper
Dudleya cymosa ssp. *costatifolia*	Pierpoint Springs dudleya	Sequoia	Fuels treatments, fire regime alteration, mining, horticultural collection	Rock Outcrop, Chaparral-Live Oak, Carbonate
Astragalus subvestitus	Kern County milk-vetch	Inyo, Sequoia	Grazing, livestock trampling, recreation (OHV)	Subalpine, Dry Forb, Rock outcrop, Jeffrey pine
Carlquistia muirii	Muir's tarplant	Sierra, Sequoia	Fuels treatment, recreation, roads, logging	Rock Outcrop, Montane, Upper Montane, Mixed Conifer
Boechera shevockii	Shevock's rockcress	Sequoia	Recreation (sport climbing)	Rock Outcrop, Mixed Conifer
Lewisia disepala	Yosemite lewisia	Sequoia, Sierra	Recreation (OHV), fuels treatment, recreation (trampling)	Rock Outcrop, Montane, Upper Montane
Allium shevockii	Spanish Needle onion	Sequoia	Renewable energy development	Rock Outcrop, Pinyon-juniper
Boechera evadens	Hidden rockcress	Inyo, Sequoia	Very few populations, recreation, mining	Pinyon-juniper, Mountain mahogany, Rock outcrop, sagebrush

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Camissonia integrifolia	Kern River evening primrose	Sequoia	Grazing; recreation (OHV); roads	Sagebrush
Monardella beneolens	Wweet-smelling monardella	Inyo, Sequoia	Recreation (trampling), grazing, very few populations, climate change	Alpine, Subalpine
Ivesia campestris	Field ivesia	Inyo, Sequoia	Grazing	Subalpine, Meadow
Helodium blandowii	Blandow's bog moss	Inyo, Sequoia	hydrologic alteration, grazing	Subalpine, Meadow
Hulsea brevifolia	Short-leaved hulsea	Inyo, Sequoia	Roads, recreation (trampling), logging	Mixed Conifer, Subalpine, Upper Montane
Eriogonum twisselmannii	Twisselmann's buckwheat	Sequoia	Fuels treatments, fire suppression, recreation, trail work	Upper Montane
Ribes tularense	Sequoia gooseberry	Sequoia	Rarity	Upper Montane
Calyptridium pygmaeum	Pygmy pusspaws	Inyo, Sequoia, Sierra	Climate change, recreation, trampling, very few populations	Rock Outcrop, Upper Montane, Subalpine, Alpine
Oreonana vestita	Woolly mountain-parsley	Sequoia	Grazing, recreation, trail maintenance	Upper Montane, Talus
Boechera tiehmii (Arabis t.)	Tiehm's rockcress	Inyo	Climate change	Alpine
Polemonium chartaceum	Mason's sky pilot	Inyo	Climate change, grazing, recreation	Alpine
Potentilla morefieldii	Morefield's cinquefoil	Inyo	Climate change, grazing, recreation (trampling)	Alpine
Carex tiogana	Tioga Pass sedge	Inyo	Climate change, recreation	Alpine
Draba sharsmithii	Mt. Whitney draba	Inyo, Sierra	Climate change, recreation (trampling)	Alpine
Astragalus ravenii	Raven's milk-vetch	Inyo	Climate change, very few populations	Alpine
Claytonia megarhiza	Fell-fields claytonia	Inyo	Climate change, very few populations	Alpine
Draba monoensis	White Mountains draba	Inyo	Climate change, very few populations	Alpine
Eriogonum microthecum var. *alpinum*	Alpineslender buckwheat	Inyo	Climate change, very few populations	Alpine
Carex stevenii	Steven's sedge	Inyo	Climate change, very few populations, hydrologic alteration	Alpine
Streptanthus gracilis	Alpine jewelflower	Inyo, Sequoia	Hydrologic alteration, climate change, recreation (trampling)	Alpine
Agrostis humilis	Alpine bentgrass	Inyo	Recreation (trampling) climate change	Alpine

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Tonestus eximius	Lake Tahoe serpentweed	Inyo	Very few populations, climate change	Alpine
Townsendia leptotes	Slender townsendia	Inyo	Very few populations, climate change	Alpine
Jamesia americana var. *rosea*	Fivepetal cliffbush	Inyo	Climate change	Alpine, Subalpine
Eriogonum wrightii var. *olanchense*	Olancha Peak buckwheat	Inyo	Very few populations, climate change	Alpine, Subalpine
Lupinus duranii	Mono Lake lupine	Inyo	Recreation (OHV), grazing	Jeffrey Pine, Sagebrush, Dry Forb
Astragalus monoensis	Mono milk-vetch	Inyo	Recreation (OHV), roads, grazing	Jeffrey Pine, Sagebrush, Dry Forb
Cuniculotinus gramineus (Chrysothamnus g.)	Panamint rock-goldenrod	Inyo	Mining, invasive species	Mountain mahogany, Subalpine, Carbonate
Allium atrorubens var. *atrorubens*	Great Basin onion	Inyo	Grazing, mining, very few populations	Mountain mahogany, Subalpine, Pinyon-juniper
Streptanthus oliganthus	Masonic mountain jewelflower	Inyo	Grazing, mining	Pinyon-juniper
Ranunculus hydrocharoides	Frog's-bit buttercup	Inyo	Hydrologic alteration	Pinyon-juniper
Astragalus cimae var. *sufflatus*	Inflated Cima milk-vetch	Inyo	Invasive species, extreme rarity	Pinyon-juniper
Phacelia monoensis	Mono phacelia	Inyo	Invasive species, roads, mining	Pinyon-juniper
Eriogonum mensicola	Pinyon Mesa buckwheat	Inyo	Mining, recreation, invasive species	Pinyon-juniper
Astragalus inyoensis	Inyo milk-vetch	Inyo	Mining, vehicles	Pinyon-juniper
Boechera bodiensis (Arabis b.)	Bodie Hills rockcress	Inyo	Very few populations	Pinyon-juniper
Physocarpus alternans	Nevada ninebark	Inyo	Invasive species, climate change	Pinyon-juniper, Carbonate
Populus angustifolia	Narrow-leaved cottonwood	Inyo	Hydrologic alteration	Pinyon-juniper, Sagebrush
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	Inyo	Roads, grading, mining	Pinyon-juniper, Sagebrush
Thelypodium integrifolium ssp. *complanatum*	Foxtail thelypodium	Inyo	Very few populations	Pinyon-juniper, Sagebrush
Mentzelia inyoensis	Inyo blazing star	Inyo	Very few populations, invasive species	Pinyon-juniper, Sagebrush

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Ericameria gilmanii	Gilman's goldenbush	Inyo	Very few populations, invasive species, mining	Pinyon-juniper, Subalpine
Hesperidanthus jaegeri	Jaeger's hesperidanthus	Inyo	Very few populations, climate change, limited habitat, invasive species	Pinyon-juniper, Subalpine, Carbonate
Carex petasata	Liddon's sedge	Inyo	Grazing, climate change	Pinyon-juniper, Subalpine, Meadow
Astragalus serenoi var. *shockleyi*	Shockley's milk-vetch	Inyo	Mining, grazing, invasive species	Pinyon-juniper, Xeric Shrub/Blackbrush
Delphinium purpusii	Rose-flowered Larkspur	Sequoia	Recreation, recreation (OHV)	Rock Outcrop, Carbonate, Pinyon-juniper, Chaparral-Live Oak
Polyctenium fremontii (williamsiae)	Williams' combleaf	Inyo	Climate change, limited habitat, grazing, recreation (OHV)	Sagebrush
Horkelia hispidula	White Mountains horkelia	Inyo	Grazing	Sagebrush
Stipa divaricata	Small-flowered rice grass	Inyo	Grazing	Sagebrush
Cymopterus globosus	Globose cymopterus	Inyo	Grazing, hydrologic alteration, very few populations	Sagebrush
Viola purpurea ssp. *aurea*	Golden violet	Inyo	Grazing, invasive species, roads	Sagebrush
Phacelia inyoensis	Inyo phacelia	Inyo	Grazing, roads, very few populations	Sagebrush
Goodmania luteola	Yellow spinecape	Inyo	Very few populations, grazing	Sagebrush
Physaria ludoviciana	Silver bladderpod	Inyo	Wild horses, very few populations	Sagebrush
Astragalus lemmonii	Lemmon's milk-vetch	Inyo	Grazing, hydrologic alteration, very few populations	Sagebrush, Alkali Flat
Crepis runcinata ssp. *hallii*	Hall's meadow hawksbeard	Inyo	Grazing, recreation (OHV), hydrologic alteration	Sagebrush, Alkali Flat
Ivesia kingii var. kingii	Alkali ivesia	Inyo	Grazing, recreation (OHV), hydrologic alteration	Sagebrush, Alkali Flat
Astragalus johannis-howellii	Long Valley milk-vetch	Inyo	Limited habitat, grazing	Sagebrush, Alkali Flat
Sphaeromeria potentilloides var. nitrophila	Fivefinger chickensage	Inyo	Vehicles, grazing	Sagebrush, Alkali Flat, Meadow
Potentilla pulcherrima	Beautiful cinquefoil	Inyo	Grazing, erosion, very few populations	Sagebrush, Alpine

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Draba californica	California draba	Inyo	Grazing, roads	Sagebrush, Alpine
Erigeron uncialis var. *uncialis*	Limestone daisy	Inyo	Very few populations	Sagebrush, Carbonate
Lupinus padre-crowleyi	Father Crowley's lupine	Inyo	Trampling, fire suppression	Sagebrush, Jeffrey Pine
Sphenopholis obtusata	Prairie wedge grass	Inyo	Grazing, hydrologic alteration	Sagebrush, Pinyon-juniper
Eriogonum alexandrae (E. ochrocephalum var. *ochrocephalum)*	Ochre-flowered buckwheat	Inyo	Very few populations, invasive species, wild horses	Sagebrush, Pinyon-juniper
Mentzelia torreyi	Torrey's blazing star	Inyo	Very few populations, invasive species, wild horses	Sagebrush, Pinyon-juniper
Erigeron compactus	Compact daisy	Inyo	Invasive species, climate change, limited habitat	Sagebrush, Pinyon-juniper, Carbonate, Alkali Flat
Chaetadelpha wheeleri	Wheeler's dune-broom	Inyo	Limited habitat, climate change	Sagebrush, Sand Dunes
Ladeania lanceolata (Psoralidium lanceolatum)	Lance-leaved scurf-pea	Inyo	Wild horse, grazing, very few populations	Sagebrush, Sand Dunes
Hackelia sharsmithii	Sharsmith's stickseed	Inyo	Climate change, very few populations	Sagebrush, Subalpine
Carex scirpoidea ssp. *pseudoscirpoidea*	Western single-spiked sedge	Inyo	Grazing, climate change	Sagebrush, Subalpine
Carex vallicola	Western valley sedge	Inyo	Hydrologic alteration, climate change	Sagebrush, Subalpine
Hackelia brevicula	Poison Canyon stickseed	Inyo	Hydrologic alteration, grazing	Sagebrush, Subalpine
Lomatium foeniculaceum ssp. *inyoense*	Inyo biscuitroot	Inyo	Limited habitat, very few populations, climate change	Sagebrush, Subalpine
Carex idahoa	Idaho sedge	Inyo	Grazing, climate change	Sagebrush, Subalpine, Meadow
Carex duriuscula	Spikerush sedge	Inyo	Grazing, hydrologic alteration	Sagebrush, Subalpine, Meadow
Aliciella triodon	Coyote gilia	Inyo	Grazing, invasive species	Sagebrush, Xeric Shrub/Blackbrush
Sclerocactus polyancistrus	Redspined fishhook cactus	Inyo	Horticultural collection, roads, recreation (OHV), grazing	Sagebrush, Xeric Shrub/Blackbrush
Grusonia pulchella	Beautiful cholla	Inyo	Very few populations, grazing	Sagebrush, Xeric Shrub/Blackbrush
Calochortus excavatus	Inyo County star-tulip	Inyo	Grazing, hydrologic alteration	Sagebrush, Xeric Shrub/Blackbrush, Meadow
Cryptantha roosiorum	Bristlecone cryptantha	Inyo	Climate change, rarity, grazing	Subalpine

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Astragalus kentrophyta var. *elatus*	Spiny-leaved milk-vetch	Inyo	Climate change, recreation, limited habitat	Subalpine
Taraxacum ceratophorum	Horned dandelion	Inyo	Grazing, climate change	Subalpine
Trichophorum pumilum	Little bulrush	Inyo	Hydrologic alteration, grazing	Subalpine
Dryopteris filix-mas	Male fern	Inyo	Very few populations	Subalpine
Solarina spongiosa	Fringed chocolate chip lichen	Inyo	Very few populations, roads	Subalpine
Boechera pinzliae	Pinzl's rockcress	Inyo	Very few populations, wild horse trampling	Subalpine
Abronia alpina	Ramshaw Meadows abronia	Inyo	Climate change, hydrologic alteration, conifer encroachment	Subalpine, Dry Forb
Oxytropis deflexa var. *sericea*	Blue pendant-pod oxytrope	Inyo	Grazing (currently not grazed), hydrologic alteration	Subalpine, Meadow
Carex praticola	Northern meadow sedge	Inyo	Grazing, climate change	Subalpine, Meadow
Carex davyi	Davy's sedge	Inyo	Hydrologic alteration, grazing	Subalpine, Meadow
Botrychium ascendens	Upswept moonwort	Inyo, Sierra	Hydrologic alteration, trampling, recreation (OHV)), severe soil disturbance, grazing, climate change	Aquatic/Riparian, Meadow, Upper Montane, Subalpine
Botrychium lineare	Common moonwort	Inyo, Sierra	Hydrologic alteration, trampling, recreation (OHV)), severe soil disturbance, grazing, recreation (livestock trampling), climate change	Aquatic/Riparian, Meadow, Upper Montane, Subalpine
Kobresia myosuroides (K. bellardii)	Seep kobresia	Inyo	Recreation (trampling), climate change, limited habitat	Subalpine, Meadow
Plagiobothrys parishii	Parish's popcornflower	Inyo	Climate change, rarity	Xeric Shrub/Blackbrush
Boechera shockleyi (Arabis s.)	Shockley's rockcress	Inyo	Mining, vehicles	Xeric Shrub/Blackbrush
Penstemon calcareus	Limestone beardtongue	Inyo	Invasive species, burros	Xeric Shrub/Blackbrush, Carbonate
Dedeckera eurekensis	July gold	Inyo	Mining, recreation (OHV), invasive species	Xeric Shrub/Blackbrush, Carbonate
Collomia rawsoniana	Flaming trumpet	Sierra	Altered fire regime, fuels treatment	Aquatic/Riparian (Rivers and Streams), All Montane
Fissidens aphelotaxifolius	Fissidens moss	Sierra	Extreme rarity, hydrologic alteration	Aquatic/Riparian, Montane, Upper Montane

Scientific Name	Common Name	Applicable National Forest	Known Threats to Persistence	Principal Habitats
Pohlia tundrae	Tundra pohlia moss	Sierra	Grazing, hydrologic alteration	Aquatic/Riparian (Meadows), Upper Montane, Subalpine
Trifolium bolanderi	Bolander's clover	Sierra	Grazing, hydrologic alteration	Aquatic/Riparian (Meadows), Upper Montane
Platanthera yosemitensis	Yosemite bog orchid	Sierra	Grazing, hydrologic alteration, invasive species	Aquatic/Riparian (Meadows), Montane, Upper Montane
Eriophyllum congdonii	Congdon's eriophyllum, Congdon's woolly sunflower	Sierra	Invasive species, mining, trails	Rock Outcrop, Chaparral-Live Oak
Camissonia sierrae ssp. *alticola*	Mono Hot Springs evening-primrose	Sierra	Invasive species, recreation (trampling), roads/trails	Rock Outcrop, Montane, Upper Montane
Clarkia biloba ssp. *australis*	Mariposa clarkia	Sierra	Invasive species, roads	Chaparral-Live Oak
Clarkia lingulata	Merced clarkia	Sierra	Invasive species, roads	Chaparral-Live Oak
Calyptridium pulchellum	Mariposa pussy-paws	Sierra	Livestock trampling; invasive plants, infrastructure maintenance	Blue-Oak Interior Live Oak Woodland
Cypripedium montanum	Mountain lady's slipper	Sierra	Rarity, climate change, fire regime alteration, logging, invasive species	All montane
Tauschia howellii	Howell's tauschia	Sierra	Rarity, infrastructure (communications site)	Rock Outcrop, Montane, Upper Montane
Erythronium pluriflorum	Shuteye Peak fawn lily, manyflower fawnlily	Sierra	Recreation (OHV)	Upper Montane, Subalpine
Lewisia kellogii ssp. *kelloggii*	Kellogg's lewisia	Sierra	Recreation (OHV)	Rock Outcrop, Montane, Upper Montane
Lupinus citrinus var. *citrinus*	Orange lupine	Sierra	Recreation (OHV), roads, climate change, invasive species	Rock Outcrop, Blue-Oak Interior Live Oak Woodland, Chaparral-Live Oak, Montane
Allium yosemitense	Yosemite onion	Sierra	Trails, invasive species, mining	Rock Outcrop, Chaparral-Live Oak, Montane, Upper Montane

Environmental Consequences to At-risk Plant Species

Consequences Common to all Alternatives

The suitability of lands for various uses (like livestock grazing, timber harvest, or recreation opportunity) are the same in all alternatives, and so will not be discussed further in this analysis. However, there are some variations in the amount of land suitable for each use due to differences in the areas administratively recommended for inclusion in the National Wilderness Preservation System. Where relevant to at-risk plant persistence, consequences that differ by alternative are discussed below.

Travel management and the authorized route system will be the same under all alternatives, and there will be no changes to the current direction for mining and grazing management practices.

Consequences Common to Alternatives B, C, and D

Floristic Biogeographic Subdivisions

Though none of the alternatives authorize specific actions that may affect individual species, the analysis takes an integrated look at potential effects to floristic biogeographic subregions and diversity that might be most affected by the alternatives. In addition, differences between alternatives in effects to special habitats that host at-risk plants are analyzed.

Compared to alternative A, the emphasis in the rest of the alternatives on increasing the pace and scale of restoration using fire may affect montane forests more strongly than other ecosystems, because ponderosa pine, mixed conifer, and Jeffrey pine forests are more strongly departed from desired conditions. These ecosystems, most common in the High Sierra Nevada floristic biogeographic region, host the greatest total number of at-risk plant species. However, because this region is also the largest in size, the density of at-risk populations is not high in comparison to other regions. Therefore, effects to floristic diversity in this region would not be disproportionately greater under alternatives B, C, and D.

Subalpine areas of the High Sierra Nevada and special habitats in all broad ecosystems (meadows, special soil types, etc.) also host particularly high densities of at-risk plant species. Among the threats identified to species in these ecosystems is climate change. Alternatives B, C, and D include plan components aimed at preventing loss of at-risk species viability in the face of climate change (SPEC-FW-DC 01). Each alternative also includes plan components designed to provide for the persistence of at-risk species in special habitats, and to provide for continued diversity in meadows and riparian areas. Plan components accomplish this by addressing specific threats to persistence, which were identified for at-risk species (Table 98 on page 451).

Because the plan components were developed with the intent of protecting special habitats as the ecological fabric to maintain viability of a large group of at-risk plant species, it is expected that alternatives B, C, and D would have minimal short-term negative effects to the habitat extent and quality for those at-risk species that depend on them. Restoration efforts under these alternatives, particularly in meadows and other herb-dominated communities, would likely have positive, long-term effects for the many at-risk plant species dependent upon these systems. Examples include species dependent on meadows and special habitats (such as moonworts, sedges, meesia moss, Mono Lake lupine, Mono milkvetch, King's river buckwheat, Monarch buckwheat, and Boyden Cave gilia). The full list of special habitat species, including scientific names and the national forest where each occurs is provided in the Botany supplemental report.

Under alternatives B, C, and D, dispersed and developed recreation are expected to increase to some degree due to increasing human populations and recreation demand. Some special habitats (meadows, riparian, rock outcrops), are often places where recreation is more frequent or intense. Consequent trampling (by people or packstock), increased vectors for invasive species, or habitat changes are all activities that can have direct negative effects to at-risk plant habitat extent or quality, or can have indirect negative effects through the introduction of invasive plants. Because special habitats may host at risk-plants, and because these areas may have especially high concentrations of recreational activities, plan components were developed to provide for the continued persistence of at-risk species that occur there. Examples for all three national forests include a guideline that fire suppression activities (like fire line construction and construction of helicopter landing sites) are to be avoided in special habitats (FIRE-FW-GDL-06), and a standard that special habitats are to be considered in project design (TERR-SH-STD-01).

Federally Listed Plant Species

Under alternatives B, C, and D, most identified threats to listed species would still exist, including threats from invasive species, climate change, and development. However, under each alternative, specific effects from management activities would be analyzed at the project level. At a broad scale, habitat restoration to control invasive species and to restore ecosystem structure and function would have beneficial effects for Bakersfield cactus and Mariposa pussy-paws. Plan components addressing climate change would benefit Mariposa pussy-paws in particular, but all species would benefit from potential restoration efforts aimed at maintaining native plant diversity and resilient ecosystems in the face of climate change.

Coarse filter plan components, along with direction to assess at-risk species at the project level for specific activities, were found to be sufficient to provide for the viability of these species.

Candidate Plant Species

Under alternatives B, C, and D, most known threats to whitebark pine would still exist (climate change, bark beetle, and white pine blister rust). Compared to alternative A, however, these three alternatives would reduce the threat of high-intensity fire, and to some degree other threats, because of the emphasis on ecosystem restoration though the use of prescribed and wildfire managed to meet resource objectives. The latter is especially beneficial for whitebark pine because this is the primary restoration treatment in wilderness areas where much of the whitebark pine occurs. As a result, there would be a positive effect to whitebark pine habitat quality and population trend to the extent that fire is restored within the natural range of variation.

Whitebark Pine

For each national forest, and under all three of these alternatives, desired conditions TERR-UPPR-DC-03 and TERR-ALPN-DC-03 provide for healthy whitebark pine, including resilience to moisture stress, drought, and bark beetles, and resistance to white pine blister rust (see Botany supplemental report a more detailed list of plan components). The desired condition TERR-ALPN-DC-04 provides for protection and conservation of genetic diversity through the maintenance of mature cone-bearing trees. A potential management approach is also included to develop a regional whitebark pine conservation and restoration strategy in collaboration with other Federal agencies, research organizations, and other partners. Another potential management approach is proposed to collect and archive seeds, and proactively manage or restore whitebark pine to improve resilience after disturbance. These are all in contrast to alternative A, which has general direction to protect the diversity of plant communities and seral stages, but has no

direction specific to whitebark pine. As a result, these three alternatives would have some positive short- and long-term effects to whitebark pine habitat extent and condition.

In addition to habitat extent and condition, whitebark pine population trend information was available for consideration. Work conducted on the Inyo National Forest in the vicinities of June Mountain and Rock Creek indicate that beetle attacks result in high mortality among medium- to large-diameter trees, but high survivorship among small trees (Meyer et al. 2014). As a result to date, while there has been a trend of changing stand structure in some whitebark pine stands, there has been no clear evidence of range retraction or expansion. Additional published findings show whitebark pine is continuing to regenerate following the death of older trees (Perkins 2015). Therefore, under alternatives B, C, and D, potentially greater acreage of wildfire managed to meet resource objectives may result in improved regeneration of whitebark pine. This factor and the adaptive management techniques outlined in the proposed management strategy are expected to result in a moderate, but site-specific upward trend in whitebark pine vigor and reproduction.

Plant Species of Conservation Concern

A total of 174 plant species of conservation concern were identified in the planning area (Table 96). The list is identical in alternatives B, C, and D, and differs from the current Forest Service sensitive plant list, which includes 132 plant species in the planning area. The species of conservation concern list includes most of the Forest Service sensitive plant species as under alternative A, but excludes some, either due to lack of information to support a substantial concern for the species persistence in the plan area, or due to recent detection of more populations of the species.

The proposed increased pace and scale of fuels treatments, especially where mechanical thinning would be used, is likely to have some site-specific negative effects to at-risk plant habitat extent and quality, particularly for species dependent on those ecosystems and floristic biogeographic subdivisions identified above as being most affected (mixed conifer and Jeffrey pine, in the High Sierra Nevada region). These negative effects can include soil erosion, soil compaction, or trampling. All these effects would be mitigated through design features at the project level, but mitigations may not eliminate effects altogether. Some examples of species that may be affected include Muir's tarplant (*Carlquistia muirii*) on the Sequoia and Sierra National Forests, and *Cypripedium montanum*, mountain lady's slipper on the Sierra National Forest. However, long-term, landscape restoration of forested ecosystems, including restoring fire regimes within the natural range of variation, would have positive effects to at-risk plant habitat and quality, including for short-leaved hulsea (*Hulsea brevifolia*) on the Inyo and Sequoia National Forests, and Father Crowley's lupine (*Lupinus padre-crowleyi*) on the Inyo National Forest. Meadow restoration would also provide benefit to species dependent upon those habitat, especially for those that have been negatively affected by hydrologic changes. A complete list of plant species potentially affected by fuels treatments, mechanical thinning, and other activities are identified in the Botany supplemental report, along with those species most likely to benefit from restored fire regimes. A summary is provided in Table 97.

Table 97. Known threats to plant species of conservation concern, as documented in best available scientific information

Threat	Number of Species Documented to be Affected by Threat
Change in fire regime/fire suppression	4
Climate change	48
Conifer encroachment	1
Development/urbanization	7
Fuels treatment or timber harvest	14
Grazing	74
Horticultural collection	5
Hydrologic alteration	30
Insects and disease**	1
Invasive plants	39
Mining	17
Motorized travel	24
Rarity*	50
Recreation	51
Recreation (trails, trampling)	14
Wild horses, burros, feral pigs	5

Note: Some species are affected by more than one threat.

*All species of conservation concern are considered rare to some degree, but those species associated with the rarity threat were considered to have such small populations or restricted ranges that a single unpredictable event at a project or landscape scale could threaten its persistence in the planning area.

**The insects and disease threat is only known to affect whitebark pine, which is an at-risk species, but not a species of conservation concern.

Alternatives B, C, and D would result in short-term and long-term increases in invasive plant species, due to increased vegetation management activity, and an increase in the use of fire, which creates habitat for several invasive species, including cheatgrass (*Bromus tectorum*) and yellow starthistle (*Centaurea solstitialis*). These increases would be offset to some extent by treatment actions proposed under each alternative, but it is not expected that treatments would result in total eradications during the lifetime of the plans. Invasive plant species compete with native plant species, and can change the fire regime in an area, leading to negative effects to some species of conservation concern. Although restoring the fire regime to the natural range of variation is generally beneficial to species of conservation concern, there is no historic proxy for a fire regime under the current condition of non-native invasive plant species infestation. Thus, it is unknown if restoring the fire regime would also result in less impact to native species from invasive species. Adaptive management would be essential to ensure that the increased use of fire does not result in negative effects to species of conservation concern from the indirect effects of invasive plant species introduction and spread.

Adaptive procedures under the 2012 Planning Rule provide for continued consideration of the species included on the species of conservation concern list, and revisions of that list if necessary. Under alternatives B, C, and D, if new information indicates that an additional species meets the criteria for being added as a species of conservation concern, the responsible official for the national forest where the species occurs may recommend the addition to the Regional Forester for the Pacific Southwest Region of the Forest Service and determine if a change in forest plan direction is needed. Likewise, new information on species of conservation concern may lead to

their removal from the list if there is no longer a substantial concern for its persistence in the plan area or the addition, removal, or changes in coarse or fine-filter plan components.

Many proposed plan components other than those specifically aimed at species of conservation concern would have potential effects to these species, primarily the plan components under revision topics of sustainable recreation and recreation designated areas, fire, ecological integrity, and designated areas (Table 98). Overall, alternatives B, C, and D have greater potential short-term negative effects to species of conservation concern compared to alternative A, due to the increased pace and scale of restoration, but they also have more potential for long-term positive effects due to restoration of resilience to ecosystems. However, there are some differences between individual alternatives with respect to effects of these plan components on species of conservation concern, which are discussed by alternative in Table 98.

Plan components specifically aimed at maintaining plant species of conservation concern viability are consistent across alternatives B, C, and D. The Botany supplemental report provides a more detailed list of all applicable plan components that provide for necessary ecological conditions for species of conservation concern. For example, all Forests have a Forest-wide desired condition reinforcing that ecological conditions support the persistence of species of conservation concern. In addition, many coarse-filter plan components provide for species dependent upon each ecosystem (such as mixed conifer, subalpine, sagebrush, and others). As an example, both the Inyo and Sequoia National Forests have a standard for xeric shrub/blackbrush, which states that projects must include design measures to minimize damage to biological soil crusts. The intent is to maintain areas resistant to non-native plant invasions, identified as a threat to many species of conservation concern that occur in this ecosystem.

For cases where the coarse filter components were not found sufficient to provide for species persistence, fine-filter plan components were included, which are shown in Table 99. These included desired conditions and guidelines for meadows, special type habitats, and for project-level work that may affect some species of conservation concern. For example, all three national forests have a desired condition for special habitats (such as limestone, alkali flats, and rock outcrops), which states that the composition, diversity, and structure of these habitats are resilient to disturbances such as recreation and grazing. Also, for cases where programmatic planning (like desired conditions for coarse or fine scale ecosystems) is not sufficient to ensure persistence of species of conservation concern, all three national forests have a guideline that states projects should protect species of conservation concern by considering them early in the project planning process. This is especially important for species with extremely limited distributions, for which a single management action has the potential to affect an entire population. Additional detail on special habitats is given above in the section titled “Floristic Biogeographic Subdivisions.”

Table 98. Overview comparing alternatives, with focus on identified potential threats to plant species of conservation concern

Topic	Alternative A	Alternative B	Alternative C	Alternative D
Fire	Wildland-urban intermix defense and threat zones	Four risk-based management areas: community and general wildfire protection zones; wildfire restoration and maintenance zones.	Keep wildland-urban intermix defense zone as alternative A, use maintenance zone as in alternative B, rest in general wildfire zone; minimize mechanical pre-treatment.	Same four risk-based management areas as alternative B; use prescribed fire and mechanical as much as possible; emphasize landscape treatment.
Ecosystems coarse filter	General diversity emphasis; eastside vegetation type direction absent.	Emphasize heterogeneity; eastside types recognized.	Emphasize heterogeneity, but avoid work in dense forest canopy cover; eastside types recognized.	Emphasize heterogeneity by focus on gap/group retention; eastside types recognized.
Ecosystems fine filter	132 sensitive plants recognized; management direction for meadows and riparian.	174 plant species of conservation concern recognized; management direction for all special habitats, including meadow/riparian areas.	174 plant species of conservation concern recognized; management direction for all special habitats, including meadow/riparian areas.	174 plant species of conservation concern recognized; management direction for all special habitats, including meadow/riparian areas.
Recreation	Existing recreation opportunity spectrum (ROS).	Update ROS; improved recreation opportunities due to vegetation management and watershed restoration.	Update ROS; improved recreation opportunities due to vegetation and watershed restoration.	Update ROS; greatest increase in rec opportunities due to vegetation management and watershed restoration.
Wilderness	No new recommended wilderness.	New recommended for Inyo National Forest only.	All national forests add recommended wilderness.	No new recommended wilderness.
Invasive plants	Invasive plants increasing as fire regime becomes more departed from desired condition.	Short-term increase as pace and scale is increased, but less in long-term as fire size and severity approach desired condition	Same as alternative B.	Similar to alternative B, but greater potential for short and long-term increase due to challenge of invasive species control keeping pace with ecosystem restoration.
Climate change	Not addressed.	Resilient ecosystems emphasized; monitoring strategy.	Similar to alternative B.	Similar to alternative B.

To provide an overview of the applicable plan components that provide for species of conservation concern persistence, Table 99 lists the threats addressed by each applicable plan component.

Table 99. Plan components addressing the identified potential threats to at-risk plants

Threat Addressed	Applicable National Forest	Plan Component
Altered fire regime	Inyo, Sequoia, Sierra	Terrestrial Ecosystems (TERR-FW): -OBJ 01
Altered fire regime	Sequoia	Black oak/canyon live oak (TERR-BLCK): DC-01 Ponderosa pine (TERR-POND): DC 01 Montane chaparral (TERR-MCHP): DC 01
Altered fire regime	Sierra	Black oak/canyon live oak (TERR-BLCK): GDL 01 (Inyo: TERR-OAK): GDL 01
Altered fire regime, hydrologic changes	Sequoia	Red fir (TERR-RFIR): DC 01
Altered fire regime, insects and disease, hydrologic changes, climate change	Sequoia	All montane veg. types (TERR-MONT): DC 01, 06 All upper montane veg types (TERR-UPPR): DC 01, 02
Altered fire regime, invasive species	Inyo, Sequoia	Pinyon-Juniper (TERR-PINY): DC 01, 02, 03, 04
Altered fire regime, invasive species	Inyo	Mountain mahogany (TERR-MOMA): DC 01, 02
Altered fire regime, timber harvest	Inyo	Montane Jeffrey pine (TERR-MJF): DC 01, 02, 03
Altered fire regime, timber harvest	Sequoia	Lodgepole pine (TERR-LDGP): DC 01, 02 Moist mixed conifer (TERR-MMC): DC 01
Climate change, hydrologic changes, insects and disease, altered fire regime	Inyo, Sequoia, Sierra	Subalpine and alpine (TERR-ALPN): DC 01, 02, 03, 04
Climate change, insects and disease, hydrologic changes	Sierra	All upper montane veg types (TERR-UPPR): DC 01, 03
Development and urbanization, rarity	Sequoia	Blue-oak interior live oak woodland (TERR-BLU): DC 01, 02, 03
Development and urbanization, rarity	Sierra	Blue-oak interior live oak woodland (TERR-BLU): DC 01, 03
Fuels treatment, invasive species	Inyo, Sequoia, Sierra	Terrestrial Ecosystems (TERR-FW): GDL-01,02
Fuels treatment, invasive species	Inyo, Sequoia	Xeric shrub/blackbrush (TERR-XER): STD-01,02
Fuels treatment, invasive species	Sierra	All montane veg types (TERR-MONT): DC-01,03, 04,06 Black oak/canyon live oak (TERR-BLCK): DC-01
Grazing	Inyo, Sequoia, Sierra	Range (RANG-FW): DC 01
Grazing	Inyo	Range (RANG-FW): STD 01
Grazing	Sequoia, Sierra	Range (RANG-FW): STD 01-11
Grazing, altered fire regime, invasive species, climate change, conifer encroachment	Inyo, Sequoia	Xeric shrub/blackbrush (TERR-XER): DC-01, 02, 03, 04

Threat Addressed	Applicable National Forest	Plan Component
Grazing, recreation, invasive species, climate change, conifer encroachment	Inyo, Sequoia	Sagebrush (TERR-SAGE): DC-01, 02, 03
Hydrologic changes, grazing, recreation	Inyo, Sequoia, Sierra	Watershed Conditions (WTR-FW): DC 01, 02, 03, 04
Hydrologic changes, recreation, rarity	Inyo, Sequoia, Sierra	Watershed Conditions (WTR-FW): STD 02
Invasive species	Inyo, Sequoia, Sierra	Invasive Species (INV-FW): DC 01, 02; GDL 01, 02, 03, 04, 05, 06, 07; OBJ 01
Invasive species, altered fire regime	Sequoia, Sierra	Chaparral-live oak (TERR-CHAP): DC-01,02
Invasive species, fuels treatment	Inyo	Pinyon-juniper (TERR-PNY): GDL-02
Invasive species, fuels treatment	Sequoia	Pinyon-juniper (TERR-PINY): GDL-01,03
Mining	Inyo, Sequoia, Sierra	Minerals and Geology (GEO-FW): GDL 02
Rarity, all threats	Inyo, Sequoia, Sierra	Animal and Plant Species (SPEC-FW): DC 01, 02, 03; GDL 03, 05, 06 Terrestrial Ecosystems (TERR-FW): DC 01, 02, 03, 04 Special Habitats (TERR-SH): STD 01
Rarity, development and urbanization, recreation	Inyo, Sequoia, Sierra	Special habitats (TERR-SH): DC-01,02
Timber harvest, altered fire regime	Inyo, Sequoia	Dry mixed conifer (TERR-DMC): DC-01
Wildfire management activities	Inyo, Sequoia, Sierra	Fire (FIRE-FW): GDL 06, 10

Ramshaw Meadows abronia

There is additional management guidance for Ramshaw Meadows abronia on the Inyo National Forest, the only national forest where it occurs. A conservation agreement between the Inyo National Forest and the Sacramento Office of the U.S. Fish and Wildlife Service was signed in 2015 for this species (USDA FS and USFWS 2015), and that agreement is currently in place and listed in appendix G of the draft Inyo National Forest Plan. Among the management actions in the agreement designed to protect the species are:

1. protection of the Ramshaw Meadow ecosystem,
2. management of adverse effects of camping and hiker and packstock trampling,
3. management of past and potential future livestock grazing (at the present date, livestock grazing is not permitted in the area),
4. management of conifer encroachment, and
5. study of climate change effects.

Regular species monitoring is an essential component of the agreement. As a result, these three alternatives would have positive short- and long-term effects to Ramshaw Meadows abronia habitat extent and quality.

Since 1985, species monitoring of Ramshaw Meadows abronia has occurred at least every 3 years, with total population estimates ranging from about 50,000 to 160,000 (USDA FS and USFWS 2015). No significant correlation has been detected between population trend and precipitation or potential threats identified to the species, although approximate 10-year cycles in peak population numbers are evident during this time period. As a result, alternatives B, C, and D are not expected to lead to a change in population trend.

Summary

To the extent possible, the coarse filter plan components (broad ecosystem desired conditions) provide for the broad ecosystem fabric that supports sufficient distribution of a minimum number of reproductive individuals of species of conservation concern and their habitat so that species would remain viable. In other words, species distribution is partially provided for by plan components that aim to maintain or restore the diversity and connectivity of ecosystems and habitat types throughout the plan area (FSH 1909.12.20.13). Fine filter plan components (special habitat-specific) complement that direction by maintaining individuals of species that rely on smaller scale habitats or have very limited distribution. Finally, when necessary, project-level protections are an option. As a result, each threat in each ecosystem for each species of conservation concern identified has been addressed or mitigated in at least one plan component in each of the respective plans, to provide for the persistence of each species.

If, during the life of the plans, new information indicates that plan components are not sufficient to ensure the persistence of species of conservation concern, changes to the plan components would be considered to address the issue.

Consequences Specific to Alternative A

Federally Listed Plant Species

As discussed above, there are no species-specific plan components for listed plant species in any alternatives. There would be no difference in short-term effects to at-risk listed species habitat extent and condition between alternatives, because activities would be analyzed and mitigated similarly at the project level during consultation with the U.S. Fish and Wildlife Service as required under the Endangered Species Act. However, because broad-scale restoration of ecosystem structure and function would be more limited under this alternative, there may be long-term negative effects to federally listed species under this alternative compared to the other alternatives.

Candidate Plant Species

Alternative A would have no plan direction specifically compelling restoration or conservation of whitebark pine. Without specific plan direction, implementation would be addressed at the project level with potentially variable results. Short-term effects would be minimal to whitebark pine, because small-scale restoration projects and species monitoring would continue to occur under this alternative. In comparison to the other alternatives, alternative A would least provide the ecological conditions necessary to conserve candidate species and to maintain or restore their habitats in the plan area which would contribute to preventing them from being federally listed.

Plant Species of Conservation Concern

Under alternative A, the three national forests would continue to manage a total of 132 Forest Service sensitive plant species (see Botany supplemental report). At the programmatic level, species management guides are developed for Forest Service sensitive species with

recommendations for management and monitoring. In general, avoidance, rather than restoration, of Forest Service sensitive species at the project level is emphasized. This alternative would consider fewer rare plants in the project planning process compared to the other alternatives. However, alternatives B, C, and D rely more strongly on the achievement of desired conditions at the ecosystem scale to maintain species viability, with project-level protections applied when necessary. Also under alternative A, there would be no specific management direction compelling the implementation of the Ramshaw Meadows abronia Conservation Agreement

Consequences Specific to Alternative B

Federally Listed Plant Species

Differences between alternative A and the other alternatives were outlined in Table 98 on page 451. Alternatives B and C would have very similar short- and long-term consequences for at-risk listed plant habitat extent and quality. Both alternatives would mitigate short-term negative effects to at-risk listed plants, because the effects to habitat from potential activities would be evaluated at the project scale. However, there would be some long-term positive effects resulting from broad-scale restoration of ecosystem structure and function, such as through the reintroduction of fire, or from watershed restoration.

Candidate Plant Species

In addition to the management strategy for whitebark pine proposed under alternatives B, C, and D, alternative B would allow for vegetation management in whitebark pine to improve habitat quality and stand structure, providing improved viability. Compared to alternative C, greater potential for mechanical pre-treatment would allow for more acreage to be treated and restored under alternative B (see chapter 2 for comparison). These areas are still relatively limited, but include some whitebark stands in the vicinity of ski areas and other nonwilderness, high-elevation sites. As a result, there would be some beneficial effects for habitat condition and population trend under this alternative.

Plant Species of Conservation Concern

Differences between alternative A and the other alternatives were outlined in Table 98 on page 451. Alternatives B and C would have very similar short- and long-term consequences for plant species of conservation concern habitat extent and condition. Both alternatives would result in some short-term negative effects to species of conservation concern habitat extent and condition, as a result of vegetation management and recreational activities. However, there would be some long-term positive effects resulting from restoration of ecosystem structure and function, such as through the reintroduction of fire, or from meadow restoration. The recommended wilderness on the Inyo under this alternative would provide benefit to some plant species of conservation concern that occupy these areas, such as species that occupy xeric shrub and blackbrush habitats (like Charlotte's phacelia), or the special carbonate habitat type (such as Nevada ninebark).

Consequences Specific to Alternative C

Federally Listed Plant Species

Differences between alternative A and the other alternatives were outlined above. Alternative C would have identical effects for at-risk listed plant species as described for alternative B.

Candidate Plant Species

Effects to at-risk candidate plant species would be very similar between alternatives B and C. Under alternative C, there may be slightly fewer opportunities for whitebark pine restoration using prescribed fire, because greater restrictions for mechanical pre-treatment may preclude the introduction of fire that would be safe and of low to moderate severity. As a result, there would be fewer positive effects for whitebark pine habitat condition and population trend.

Plant Species of Conservation Concern

Due to less intensive vegetation management, alternative C would likely have the fewest short-term negative effects to plant species of conservation concern, particularly those dependent on mixed conifer and Jeffrey pine ecosystems. New invasive plant species infestations and spread would be least likely under this alternative, resulting in the fewest negative effects to species of conservation concern habitat quality. Recreation site improvements would also be slightly fewer under this alternative compared to alternatives B and D, resulting in fewer impacts from those localized projects to plant species of conservation concern. The greater area of recommended wilderness under this alternative would provide benefit to some plant species of conservation concern that occupy these areas, such as species on the Inyo National Forest that occupy xeric shrub and blackbrush habitats or the special carbonate habitat type as mentioned in alternative B. Additional recommended wilderness on the Inyo National Forest under this alternative would also benefit some species of conservation concern that occur in the Glass Mountains (such as Raven's milk-vetch), which are negatively affected by unauthorized off-highway vehicle use. This assumes that enforcement and signage aimed at preventing unauthorized motorized vehicle use would be effective. Additional examples of species of conservation concern that may benefit from recommended wilderness under alternative C are Yosemite onion and Congdon's lewisia in the Devil Gulch area on the Sierra National Forest and field *ivesia* and Kern Plateau *horkelia* on the South Sierra wilderness additions of the Sequoia National Forest.

Consequences Specific to Alternative D

Federally Listed Plant Species

Under alternative D, short-term negative effects to at-risk listed plants would be mitigated when the effects to habitat from potential activities are evaluated at the project scale. There would be some long-term positive effects resulting from restoration of ecosystem structure and function, such as through the reintroduction of fire, or from watershed restoration. However, the greater acreage for vegetation management could lead to an increase in habitat impacts such as reduction in habitat connectivity and introduction of invasive species. This would be due to the increase in soil disturbances from mechanical treatments. Increases in invasive species would be addressed at the project level, but the large amount of acres being treated may lead to a long-term effect to at-risk species. Overall there would also be long-term positive effects resulting from moving ecological conditions toward the natural range of variation.

Candidate Plant Species

Effects to at-risk candidate plant species would be very similar between alternatives B and D, with slightly greater potential for whitebark pine restoration projects that require mechanical pre-treatment under alternative D. Under this alternative, there would be slightly greater opportunity for proactive restoration in whitebark, at least in the 12 percent of that ecosystem type that occurs outside wilderness. However, those same areas outside wilderness tend to be in or very near developed recreation sites, such as campgrounds, trailheads, boating, fishing, ski areas. Therefore, positive effects under this alternative would be at least partially counteracted by negative impacts,

such as associated soil compaction and greater potential for insect and disease vectors, especially on the eastside.

Plant Species of Conservation Concern

Alternative D proposes more intensive vegetation management, especially within the mixed conifer and Jeffrey pine ecosystems. These activities result in a higher risk for new invasive plant species infestations, through the disturbance of soils and removal of vegetation cover. Restoration as defined under the 2012 Planning Rule includes the maintenance of native species composition, and by inference, the exclusion or control of non-native species. However, though project design features minimize such introductions, they cannot eliminate the risk of introductions altogether.

Project design features would minimize invasive plant species introduction and spread, but the risk of invasions as the result of soil disturbance and loss of vegetation cover would be greater than under other alternatives B and C. The section above on "Consequences Common to Alternatives B, C, and D" provides an overview of potential negative and positive effects of both vegetation management to species of conservation concern. The 11 species identified in Table 97 as potentially threatened by fuels treatment and the 51 species potentially affected by recreational activities may have a greater number of short-term negative effects to habitat extent and condition under this alternative.

However, the greater acreage of restoration proposed under this alternative would benefit some species, especially those that are threatened by altered fire regimes, such as short-leaved *hulsea* (see Botany supplemental report).

Cumulative Effects

At-risk plant species are affected by management activities that occur both within the plan area and on adjacent land under Federal, State, local agency, or private management. The consequences of these actions are cumulative across boundaries. These cumulative actions could produce positive results, such as increased at-risk plant habitat extent or improved condition as restoration measures are taken. Similarly, there may be negative impacts, such as habitat loss, or degradation, such as by the introduction or spread of invasive plant species.

Reasonably foreseeable management activities on private, State, or other Federal land would be similar to vegetation management performed on the national forest—prescribed burning to restore fire disturbance regimes or the thinning or removal trees to reduce the risk of high-severity wildfire, with short-term impacts and long-term benefits similar to those described above.

Many restoration activities and project design features aimed at protecting at-risk species are shared by adjacent landowners, in particular the National Park Service and Bureau of Land Management. For example, efforts to use weed and seed-free plant material for animal feed or bedding, soil stabilization and land rehabilitation complements similar efforts in the adjacent Sequoia-Kings Canyon National Park. Combined and coordinated efforts in these areas would improve ecological conditions that provide for at-risk species viability.

Analytical Conclusions

Determinations and Plan Evaluation Outcomes

Federally Listed Endangered and Threatened Plant Species Determination

All alternatives would provide ecological conditions necessary to provide for the viability of at-risk listed plant species, therefore, all alternatives *may affect but are not likely to adversely affect* the Mariposa pussy-paws and Bakersfield cactus. This is primarily because none of the alternatives authorize specific activities, and because the listed species occupy such limited habitat that is most appropriately addressed at the project level. For alternatives B, C, and D, this determination is also based on the coarse-scale ecosystem benefits provided by the alternatives. These plan components are collectively listed in the Botany supplemental report and summarized in Table 98 on page 451.

Some key considerations in making this determination for Bakersfield cactus are: (1) plan components aimed at controlling non-native invasive plant species will help reduce threats, (2) new developments and trails should be located outside of rare plant habitat, and (3) numerous plan components aimed at restoring riparian areas are included.

Some key considerations for making this determination for Mariposa pussy-paws are: (1) plan components aimed at controlling non-native invasive plant species will help reduce threats, (2) emphasis on management that considers the effects of climate change will benefit this species, and (3) some fuel reduction projects may benefit individuals.

Candidate Plant Species Determination

All alternatives would provide ecological conditions necessary for the viability of whitebark pine, therefore, all alternatives *may affect individuals, but is not likely to contribute to the need for Federal listing or result in a loss of viability in the forest plan area*.

Under all alternatives, restoration activities aimed at maintaining a viable population of whitebark pine would provide for the persistence of that species, as would species monitoring, to assist with developing management strategies to protect whitebark pine. In addition, the management approach under alternatives B, C, and D that outlines the potential development of a whitebark pine conservation and restoration strategy could identify more specific actions to be taken to protect this species. Alternative B would have the most beneficial short- and long-term effects for whitebark pine, resulting from an emphasis on forest restoration. Alternative C would have beneficial effects, but the restoration extent would be somewhat limited. Alternative D would have some beneficial effects, but those would be counter-acted to some extent as a result of greater effects from invasive species. In alternative A, the current forest plan for the Inyo National Forest does not emphasize development of the whitebark pine conservation and restoration strategy, which does not preclude its development, but adds uncertainty about when and if it may be developed.

Plant Species of Conservation Concern Outcomes

The emerging plan components under alternatives B, C, and D when carried out *would provide the necessary ecological conditions to maintain viable populations of plant species of conservation concern*. These alternatives include coarse filter plan components aimed at protecting the broad habitats upon which these species depend. Fine filter (species-specific and special ecosystem type-specific) plan components are also included in all alternatives to ensure species persistence. Alternative A would provide the necessary ecological conditions to maintain

viable populations of plant species of conservation concern by relying primarily on project-level surveys and mitigations of adverse effects. Alternative B would provide the most long-term benefits to species of conservation concern habitat extent and quality, resulting from ecological and hydrologic restoration, invasive species control, recommendation of wilderness that would protect some species of conservation concern plants, and from the emphasis on ecosystem resilience to climate change. Alternative C would also provide many long-term benefits, but some limits to landscape scale restoration may also limit potential long-term benefits to species of conservation concern, primarily in mixed conifer ecosystems. Alternative D would result in some long-term benefits to species of conservation concern, but effects from potential greater acreages of activities such as mechanical thinning would have negative effects for habitat extent and condition of some species of conservation concern.

Revision Topic 3: Sustainable Recreation and Designated Areas

The following section provides the analysis for recreation and scenery, heritage, wilderness, wild and scenic rivers, and the Pacific Crest National Scenic Trail. Wilderness and the Pacific Crest National Scenic Trail are discussed with the recreation and scenery resource because of their key roles within the larger context of sustainable recreation. Maps showing the recreation opportunity spectrum, recreation places and scenic integrity objectives are located in appendix A of the draft forest plans.

Sustainable Recreation and Scenery

The need to provide sustainable recreation was a key topic of interest at public meetings and during public engagement. Sustainable recreation is the set of recreation settings and opportunities on National Forest System lands that are ecologically, economically, and socially sustainable for present and future generations.

Analysis and Methods

Indicators and Measures

- Percentage of recreation opportunity spectrum class by alternative.
- Change in partnerships due to areas being recommended for wilderness.
- Change in miles of system trails that allow mechanized transport within areas recommended for wilderness.
- Acres and kind of fuel treatment to reach the desired vegetation condition that reflects the natural range of variation which leads to scenic stability and relative protection of scenic character.
- Percentage of scenic integrity objectives on each forest by scenic integrity objectives.

Methods

For comparison purposes, we mapped the desired recreational opportunity spectrum across the national forests for each alternative. Then each alternative was analyzed for the total number of acres and percentage of the desired recreation opportunity spectrum settings on each national forest. We used geographic information systems data to calculate the number of acres in each setting.

We completed a review of existing partnerships in areas recommended for wilderness on the three national forests to see if specific partnerships that focused on recreation uses not suitable for recommended wilderness would be incompatible and would need to shift to other areas of the national forests.

For comparative purposes, we analyzed each alternative for the total number of miles where mechanized transport would not be suitable in areas recommended for wilderness. We used geographic information systems data to calculate the number of miles for each alternative.

For comparative purposes, we mapped the desired scenic integrity objectives for alternatives B, C, and D. The geographic information system was used to calculate the number of acres in each scenic integrity objective class. For scenic stability, we compared the amount and kind of fuel treatment needed to reach the desired vegetation condition that reflects the natural range of variation (which leads to scenic stability).

Assumptions

In the analysis for this resource, we made the following assumptions:

- Partnerships and volunteer opportunities are viable options to maintain, and in places, increase forest capacity. However, attempts to increase partnerships beyond certain levels may be constrained by agency capacity.
- Conservation education and interpretative services can play a key role in fostering a greater connection between people and nature and helping to create an understanding of sense of place.
- Recreation demand is increasing across the forests.
- Deferred maintenance on developed recreation sites and infrastructure is continuing to outpace budgets.
- Funding and agency recreation staffing are anticipated to decline throughout the planning cycle.
- Effective interpretive techniques and public information services can help to inform and motivate the public into becoming stewards of the forest (California State Parks 2002, NARRP 2009).
- Scenic integrity is maintained in places people visit and view.
- Restoration treatment of fuels (prescribed fire, mechanical treatment) that moves vegetative condition toward the natural range of variation faster has a positive effect to scenic stability ultimately sustaining scenic character; mechanical treatment of fuels moves vegetative condition toward the natural range of variation faster than prescribed fire.
- Climate change is predicted to produce warmer temperatures and drier conditions influencing snowpack, drought, and hydrologic flow. Activities dependent on snow and snow melt would be affected. Warmer temperatures could cause recreationists to shift their activities to higher elevations during the summer months (Morris and Walls 2009).
- Climate change may increase the frequency of large high-intensity wildfires or areas with high levels of insect or disease tree mortality that most likely would impact recreational settings, use, and scenic character.

Affected Environment

Background

Outdoor recreation contributes to human health and well-being by offering a variety of physical and mental health benefits. Eighty-four percent of the Californians polled in the most recent Comprehensive Outdoor Recreation Plan statewide survey said outdoor recreation was an “important” or “very important” contributor to their quality of life (Roberts et al. 2009).

Areas adjacent and within the national forests boundaries are projected to continue to increase in population. This growth is expected to increase recreation demand in these national forests, and increase the numbers of visitors in the future (English 2014). With projected growth, increase in use levels can potentially increase conflicts, such as crowding, which can lead to unmet visitor expectations for recreation experiences and can influence public satisfaction at recreation sites.

In addition to growth, increases in culturally diverse populations will likely be reflected in outdoor recreation (Winter et al. 2014). Two groups whose growth is expected to have the most influence on outdoor recreational styles and participation patterns in the future are Latinos and Asian Americans (Roberts et al. 2009). Current recreation infrastructure may not meet the needs of these two groups which include larger developed group sites with picnic tables, grills, trash cans and flush toilets picnicking that support day-long activities, hiking and walking, and opportunity to be with family (Roberts et al. 2009).

Increase in recreational use, particularly unmanaged recreation, impacts ecosystems by causing changes in habitat through vegetation trampling as well as the spread of noxious or invasive plant species to new locations. Unmanaged recreation can include areas that are difficult to manage, areas where inappropriate dispersed recreation is occurring or areas that have unmonitored nontraditional recreation activities (Pond 2007). Impacts from unmanaged recreation are often found in riparian areas, areas adjacent to the urban interface, areas of intense recreation use, and outside of developed recreation sites on the national forests. Examples of unmanaged recreation include development of rock climbing routes at newly discovered crags, user-created mountain bike trails, dispersed camping in sensitive ecosystems such as riparian areas, and motorized vehicle use outside of designated travel routes. Unmanaged recreation can also adversely affect visitor experience as a result of conflicting or competing uses and overcrowding. Ecosystem impacts may ultimately have a reciprocal effect on recreation if impacts on the land create conditions where recreation use can no longer be supported.

To ensure sustainable recreation on the three national forests, adaptive management will be necessary. This is particularly true for unmanaged recreation, where timely response to new uses that have potential ecological effects will be necessary. Given the expected increase in population and recreation demand, tradeoffs will need to be made to ensure that resources are managed sustainably.

National forest scenery contributes to the identity and sense of place for local communities by serving as the backdrop and backyard to residents. The scenery of each national forest is a significant attraction to visitors and creates a sense of place and connection to the land. The magnificent vistas, meandering rivers, and forested settings are featured by State and local tourism and marketing efforts, and contribute to the economic sustainability of communities. The scenic character of a national forest is a combination of physical, biological, and cultural images that gives an area its visual and cultural identity and helps to define a “sense of place.” Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity.

Sustainable Recreation

Recreation Facility Analysis and National Forest Niche Statements

In 2007 and 2008, recreation facility analyses were conducted to address growing concern about the Forest Service’s ability to maintain recreation sites to meet the needs of the public (USDA FS 2007a, 2007b, 2008). The goal was to align management of recreation sites and facilities with

each national forest's recreation program niche and economic capability. The recreation programs on the three national forests have been guided by recreation program niche statements and complementary niche settings developed through the recreation facility analysis process. Niche statements broadly define the scope of a national forest's recreation program and highlight those aspects that are distinctive.

Recreation Settings and Opportunities

People choose a specific setting for recreation activities to achieve a desired set of experiences. For example, camping in a large undeveloped area with few facilities offers a sense of solitude, challenge, and self-reliance. In contrast, camping in a setting having easy access and developed facilities such as restrooms and tables offers more comfort, convenience, security, and opportunities for social interaction. The national forests provide opportunities for recreationists to obtain satisfying recreation experiences through choices in both the types of settings and use (levels and types of use), and conditions provided by management (developments, roads, regulations).

Recreation settings allow a range of experiences to be achieved, from remote and challenging to easily navigated and supported by tourism services in surrounding communities. The "recreation opportunity spectrum" offers a framework for understanding these settings and experiences. It is aligned with scenic character and scenery settings that support the value of recreation opportunities and the ability to connect people with nature. The recreation opportunity spectrum has six distinct classes in a continuum to describe settings that range from highly modified and developed to primitive and undeveloped (Clark and Stankey 1979). The six classes are described below and illustrated in Figure 41.

- **Primitive** (P) – An unmodified natural environment with very high probability of experiencing solitude. Motorized use within the area is generally not permitted.
- **Semi-primitive nonmotorized** (SPNM) – A predominantly natural or natural-appearing environment with high probability of experiencing solitude. Motorized use is generally not permitted.
- **Semi-primitive motorized** (SPM) – A predominantly natural or natural-appearing environment with moderate probability of experiencing solitude. Motorized use is generally permitted.
- **Roaded natural** (RN) – A predominantly natural-appearing environment with moderate evidence of the sights and sounds of other humans. Motorized use is provided for in construction standards and design of facilities.
    - **Roaded modified** (subclass of roaded natural) – A substantially modified natural environment except for campsites. Motorized use is provided for in construction standards and design of facilities.
- **Rural (R)** – A substantially modified natural environment. Sights and sounds of people are readily evident, and the interaction between users is often moderate to high.
- **Urban (U)** – A substantially urbanized environment, although the background may have natural-appearing elements. Sights and sounds of people onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas.

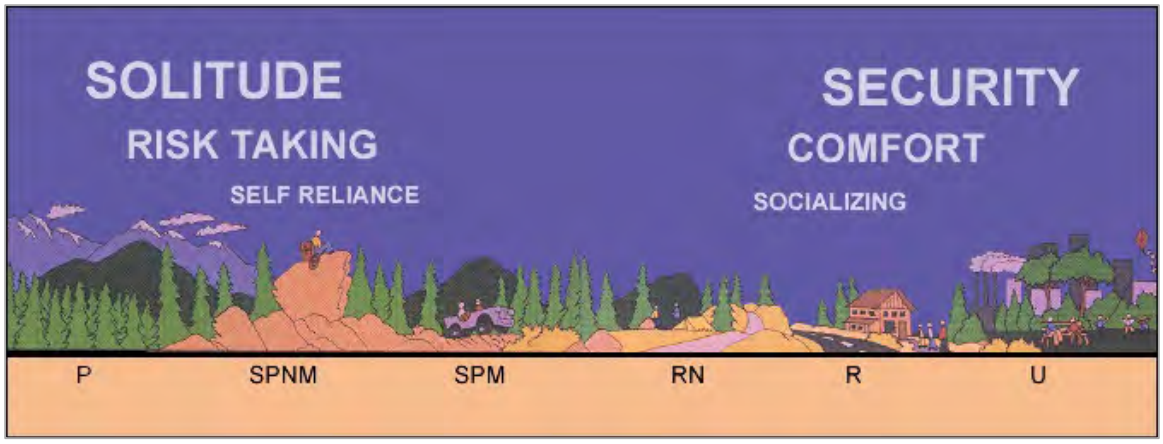

Figure 41. Graphic showing how the spectrum of recreation opportunity shifts from primitive to urban

The recreation opportunity spectrum is a key component of sustainable recreation. It incorporates not only access and visitor experience but integrates other resource values such as areas with wildlife concerns, or areas that are at risk of high-severity fire. The physical, social and managerial components within the recreation opportunity spectrum framework combine to define the types of outdoor experience the public desires and to identify the desired class of the spectrum each area of the national forests would be managed towards.

The existing recreation opportunity spectrum map (volume 3) was updated to correct for unintended data errors from data migration and technology improvements over time, and to reflect changes adopted by forest plan amendments that had not yet been updated in the recreation opportunity spectrum data system.

Use and Activities

Despite differences in recreation preferences across demographic groups and changes that have occurred over time, the core set of activities preferred by the majority of people have generally been nonmotorized activities like walking, picnicking, swimming, riding bicycles, and viewing and learning about nature. These activities are some of the easiest and least expensive to provide and address the needs of a broad group of people (Watts and Fisher 2010). Nonmotorized activities are popular on the three national forests and have maintained some of the highest participation rates according to national visitor use monitoring data. Motorized activities and use of motor vehicles to travel to and engage in nonmotorized activities are also important and are discussed in the context of access below.

Access

Recreation access consists of trails, roads, and other transportation that connect people to recreation settings and opportunities. Recreation access to and within the national forests is provided by state highways, county roads, and a designated system of National Forest System roads and trails. Roads and trails not only provide access to recreation opportunities, but are themselves a recreation experience as driving for pleasure increases in popularity. Forest roads offer scenic views and provide direct access to trailheads, vistas, staging areas, campgrounds, and picnic facilities. Roads referred to as “maintenance level 1” are closed to motorized use and are maintained in storage and for future access needs. Maintenance level 2 roads are managed to accommodate travel by off-highway and high-clearance vehicles. Maintenance level 3, 4 and 5

roads are managed to accommodate passenger cars and other licensed vehicles (these are closed to unlicensed off-highway vehicles, unless specifically designated).

In this analysis, the term "mechanized transport" is defined as transport powered by a living or non-living power source and includes such things as bicycles and game carts. The term bicycle is used to represent mechanized transport in the discussion below. Bicycle use is allowed on designated motorized trails in addition to designated nonmotorized trails except within wilderness areas as described above.

Nonmotorized trails are open to nonmotorized uses including mechanized transport outside of wilderness unless otherwise closed by a Forest Service closure order. The Pacific Crest National Scenic Trail is closed by a regional closure order to mechanized transport. Electric bicycles are considered motorized vehicles and are allowed on designated motorized routes.

The three national forests are open to motorized and nonmotorized winter recreation activities. Over-snow vehicles are allowed on routes and open areas outside of designated wilderness. Existing over-snow-vehicle use is not suitable in recommended wilderness areas. After site-specific analysis through subpart C of the Travel Management Rule is completed, over-snow motorized use would be prohibited by future Forest Service orders inside recommended wilderness areas. These open areas and routes are or will be shown on over-snow vehicle use maps as winter travel management analyses are completed in the future. Designated winter routes can be groomed, and open areas, which are not groomed, consist of natural snowpack that ranges from powder to spring freeze conditions.

Partnerships

Partnerships and volunteerism are key components of sustainable recreation and allow the Forest Service to forge valuable relationships that help to provide a means of leveraging the agency's financial investment in recreation, while connecting people to the natural environment. It is generally through outdoor recreation activities, partnerships, and volunteerism that visitors interact with nature and experience the intrinsic values of the national forest.

Scenery Resources

To evaluate scenery resources, the current forest plans used the Visual Management System, which was a systematic approach to inventory, analyze, and monitor scenic resources, but did not recognize or incorporate natural disturbance processes such as fire, insects, and disease. The Forest Service has been transitioning from the Visual Management System to the newer Scenery Management System, which uses different scenery evaluation terminology. A cross-walk between the two systems terminology is shown in Table 100.

Table 100. Cross-walk between Visual Management System and Scenery Management System terminology

Visual Management System Terminology (Visual Quality Objectives)	Scenery Management System Terminology (Scenic Integrity Objectives)
Preservation	Very High
Retention	High
Partial retention	Moderate
Modification	Low
Maximum modification	Very Low

Scenic Character

Scenic character is defined as the combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity. All landscapes have definable scenic character attributes. In most national forest settings, scenic character attributes are positive natural elements such as landform, vegetative patterns, and water characteristics. In pastoral or rural settings, positive cultural elements may include historic elements such as split rail fences, stone walls, barns, orchards, hedgerows, and cabins. In urban settings, scenic character attributes may include a fabric of architectural styles. A combination of these attributes define scenic character. The concept of scenic character is embodied in the "image of an area."

Descriptions of different types of scenic character include:

- **Naturally Evolving** – Scenic character expressing the natural evolution of biophysical features and processes, with very limited human intervention. These landscapes are largely associated with wilderness areas."
- **Natural Appearing** – Scenic character that expresses predominantly natural evolution, but also human intervention including cultural features and processes.
- **Cultural** – Scenic character expressing built structures and landscape features that display the dominant attitudes and beliefs of specific human cultures. These landscapes are largely associated with areas containing recreation site development, administrative sites, or public uses under special use permits.
- **Pastoral** – Scenic character expressing dominant human-created pastures, meadows and associated structures, reflecting valued historic land uses and lifestyles. Pastoral lands also occur on private lands outside of the national forest administrative boundary, where they may be viewed while traveling on forest roads or trails.
- **Agricultural** – Scenic character expressing dominant human agricultural lands uses producing food crops and domestic products. These landscapes generally occur on private lands that are outside of the National Forest System administrative boundary, but may be visible while traveling on national forest roads or trails.
- **Historic** – Scenic character expressing valued historic features that represent events and period of human activity in the landscape.
- **Urban** – Scenic character expressing concentrations of human activity, primarily of commercial, cultural, education, residential, transportation structures, and supporting infrastructure. These landscapes generally occur on private lands, but may be visible while visiting a national forest.

Scenic Integrity

Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variation. Scenic integrity measures these disturbance effects in degrees of consistency, harmony, dominance and contrast with the valued scenic character.

Scenic integrity uses a graduated scale of five levels ranging from very high integrity to low integrity. It is emphasized within view of travelways, use areas, and special places. These levels include:

- **Very High Integrity** – The valued scenery appears natural or unaltered. Only minute visual disturbances to the valued scenery, if any, are present.
- **High Integrity** – The valued scenery appears natural or unaltered, yet visual disturbances are present; however, they remain unnoticed because they repeat the form, line, color, texture, pattern and scale of the valued scenery
- **Moderate Integrity** – The valued scenery appears slightly altered. Noticeable disturbances are minor and visually subordinate to the valued scenery because they repeat its form, line, color, texture, pattern and scale.
- **Low Integrity** – The valued scenery appears moderately altered. Visual disturbances are co-dominant with the valued scenery, and may create a focal point of moderate contrast. Disturbances may reflect, introduce or "borrow" valued scenery attributes from outside the landscape being viewed.
- **Very Low Integrity** – The valued scenery appears heavily altered. Disturbances dominate the valued scenery being viewed; and they may only slightly borrow from, or reflect, valued scenery attributes within or beyond the viewed landscape.

Many of the landscapes that include wilderness areas and areas within the primitive nonmotorized and semi-primitive nonmotorized recreation opportunity spectrum classes have high to very high scenic integrity. Common developments that alter scenic integrity include but are not limited to powerlines, communication sites, substations, propane tanks, geothermal developments, ski areas, hydropower facilities, reservoirs, recreation facilities, resorts, and temporary conditions like dust and smoke.

Scenic integrity objectives are developed in coordination with recreational settings, management direction and scenic classes. Scenic classes represent the relative landscape value by combining visibility mapping inventories and scenic attractiveness inventories. Generally, scenic classes 1 and 2 have high public value; classes 3, 4, and 5 have moderate value; and classes 6 and 7 have low value.

Scenic Stability

Scenic stability measures the degree to which the scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes. Scenic stability recognizes major changes to the landscape that are outside of the natural range of variation, such as large wildfires and land clearing for developments, but it also includes subtle, incremental changes that can severely diminish or eliminate scenic character.

The natural range of variation can be used to assess the scenic stability of forest landscapes. This can be measured in terms of the landscape's departure from the natural range of variation. Insufficient fire or too much fire on the landscape can determine the level of departure from the natural range of variation. Departures in fire regime, insect outbreaks, and other disturbances from the natural range of variation help assess scenic stability.

Inyo National Forest

Sustainable Recreation

Niche Statement for the Inyo National Forest

The Inyo National Forest is characterized by large magnificent mountains that attract and inspire visitors locally, regionally, nationally, and internationally. The word Inyo is Paiute for "dwelling place of a great spirit." This stunning landscape is home to well-known attractions such as Mount Whitney, Mono Lake, the Ancient Bristlecone Pine Forest, and Mammoth Mountain. These icons, along with the Inyo's proximity to other recreation attractions, make the national forest a destination place for visitors who typically drive at least 4 hours to experience this amazing place. Travelers on routes and trails pass through contrasting landscapes that intrigue them to learn more. Year-round trail use provides the means to high-quality recreation; from hiking, mountain biking, and equestrian use, to skiing, snowmobiling, and other motorized uses (such as 4-wheel-drive vehicles and motorcycles). Conservation education and interpretation focus on developing a land ethic as part of the recreation experience. Staffed visitor centers and Forest Service employees at renowned attractions help people learn about and connect with this special place.

Recreation Settings and Opportunities

Table 101 shows the allocation of the existing recreation opportunity spectrum classes on the Inyo National Forest. The largest four recreation opportunity spectrum classes are primitive (53 percent), roaded natural (15 percent), semi-primitive motorized (14 percent), and semi-primitive nonmotorized (12 percent). The nonmotorized setting accounts for 65 percent of the national forest; this is primarily due to designated wilderness areas (46 percent of the forest) and large amounts of inventoried roadless areas (836,583 acres). The motorized setting occurs on 31 percent of the national forest.

Table 101. Existing recreation opportunity spectrum classes, Inyo National Forest

Recreation Opportunity Spectrum Class	Acres	Percent Total Acres
Primitive	790,306	53
Semi-primitive nonmotorized	471,686	12
Semi-primitive motorized	331,964	14
Roaded natural	335,756	15
Roaded modified	62,507	2
Rural	15,545	1
Urban	0	0
No assigned class	93,483	4

Some lands were transferred to the Inyo National Forest after the release of the forest plan in 1988 as a result of the National Forest and Public Lands of Nevada Enhancement Act, and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping. Those areas are shown as "not assigned."

The primitive recreation opportunity spectrum setting on the Inyo National Forest provides large, remote, and predominately unmodified landscapes where there is no motorized activity while providing for solitude with few facilities or developments. Most of these primitive settings are in

wilderness areas. Semi-primitive nonmotorized recreation opportunity spectrum settings include areas of the Inyo managed for nonmotorized use although mountain bikes and other mechanized equipment can be present. Rustic facilities (like wooden bridges over wet areas) are present for the primary purpose of protecting the natural resources of the area. Semi-primitive nonmotorized settings offer opportunities for exploration, challenge, and self-reliance.

Sixteen percent of the Inyo National Forest consists of semi-primitive motorized recreation opportunity spectrum settings, which are managed for backcountry motorized use on designated routes. Routes are designed for off-highway vehicles and other high-clearance vehicles. This setting offers visitors motorized opportunities for exploration, challenge, and self-reliance. Mountain bikes and other mechanized equipment are also sometimes present. Rustic facilities are present for the primary purpose of protecting the natural resources of the area or providing portals to adjacent areas of primitive, or semi-primitive, nonmotorized areas.

The roaded natural setting, on 16 percent of the Inyo National Forest, is managed as natural appearing with corridors and destinations that support developments and concentrated use, user comfort, and social interaction. Corridors include roads such as the Ancient Bristlecone Scenic Byway, Horseshoe Meadow road, and Eureka Valley road. Destinations can include trailheads such as Bloody Canyon, Pine Creek, or Baxter Pass or campgrounds such as Hartley Springs or Inyo Craters. The road system is generally well defined in this setting and can typically accommodate sedan travel. National Forest System roads also provide access to other recreation opportunity spectrum settings of semi-primitive motorized, semi-primitive nonmotorized and primitive areas.

The smallest recreation opportunity spectrum setting on the Inyo is rural (1 percent). The rural setting represents the most developed recreation sites and modified natural settings. Facilities like picnic areas and campgrounds are designed primarily for user comfort and convenience. The rural setting is characterized by a substantially developed environment although the background may have natural appearing elements. There is no urban recreation opportunity setting on the Inyo National Forest.

Use and Activities

The top 10 most popular activities in terms of visitor participation on the Inyo National Forest stayed relatively constant between 2006 and 2011, though rankings have changed over time. They include:

- viewing natural features
- relaxing
- downhill skiing
- hiking/walking
- viewing wildlife
- driving for pleasure
- nature center activities
- developed camping
- picnicking (in 2011)
- resort use (in 2011)
- fishing (in 2006)
- visiting historic sites (in 2006)

Nonmotorized activities such as downhill skiing, hiking, and walking are popular on the Inyo and have maintained some of the highest participation rates according to national visitor use monitoring data (USDA FS 2011a). The majority of areas on the Inyo National Forest provide for nonmotorized activities. These areas largely coincide with the designated wilderness which is 46 percent of the national forest.

The Inyo National Forest has a total of 455 developed recreation sites, the majority of which are found in the roaded modified and rural recreation opportunity spectrum classes. They include 70 campgrounds, 16 group camping areas, 2 horse camps, 28 picnic or day use areas, 5 boating sites, and 1 swimming site. Many of the campgrounds are operated under special use permit by concessionaires.

Dispersed recreation activities occur throughout the forest in undeveloped or general forest areas where there are few or no facilities. Dispersed recreation includes a wide range of outdoor motorized and nonmotorized recreation opportunities that are available throughout the year. Activities may include camping, hiking, off-highway-vehicle driving or riding, rock climbing, mountain biking, wildlife viewing, fishing, hunting, cross-country skiing, snowmobiling, visiting historic sites and scenic areas, and exploring the forest. Dispersed recreation opportunities are found in all recreation opportunity spectrum classes.

The Inyo National Forest currently manages 504 active special use authorizations; of those, 69 percent are recreation residence authorizations, 10 percent are outfitter and guide permits, and 8 percent are boat docks and wharf permits.

Key recreation sites or areas on the Inyo National Forest include Mount Whitney, Mammoth Mountain and June Mountain Ski Areas, Mammoth Lakes Basin, Mono Lake, June Lake, Coyote Flat, Bishop Creek, Whitney Portal, Papoose Flat, the Ancient Bristlecone Pine Forest, Reds Meadow, Buttermilk climbing area, the Kern Plateau, Ansel Adams and John Muir Wilderness Areas, and Rock Creek. Many of these key recreation sites or areas receive high amounts of concentrated recreation use.

Access

The Inyo National Forest offers a lot of nonmotorized access. Out of the 1,612 miles of designated trails on the Inyo, 999 miles are standard nonmotorized trails, and 48 miles are over-snow nonmotorized trails. Bicycle use is allowed on 475 miles of trails. There are 340 miles of motorized trails, and 86 miles of snow motorized trails.

Seventy-five percent of the national forest trails are located in designated wilderness, where only primitive means of travel is permitted, such as hiking, horseback, ski mountaineering or snowshoeing; motorized use and mechanized transport such as mountain bikes, are not allowed. The remaining 25 percent of the trails offer a wider variety of nonmotorized travel options, such as mountain biking, and bicycling or roller blading on paved paths. Approximately 33 percent of the snow trails are groomed by permit holders as an authorized special use. All of the nonmotorized system snow trails are located outside of wilderness, and have a variety of nonmotorized activities, including Nordic skiing, snowshoeing, or walking. Nonmotorized use such as Nordic skiing or backcountry skiing is acceptable in designated wilderness.

The Inyo National Forest provides motorized access through conventional two-wheel-drive roads, four-wheel-drive roads, motorized trails, and motorized snow trails. Access to the Inyo National Forest is also provided by partners, agencies that manage adjoining public lands, and private land owners. Forest roads offer scenic views and provide direct access to trailheads, staging areas, campgrounds, and picnic facilities. The Inyo National Forest has approximately 1,945 miles of national forest transportation system roads; 126 miles of which are designated at a maintenance level for all passenger cars that are street legal (maintenance level 3, 4, and 5). The remaining 1,819 miles are designated at a maintenance level recommended for high clearance, four-wheel drive vehicles (maintenance level 2).

The current transportation system of National Forest System motorized roads and trails open to public access are guided by the Travel Management Rule[32] and implemented through the use of Forest Service orders. This would not change in any of the alternatives.

Partnerships

Partnerships, volunteerism, and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails, and restoring and rehabilitating landscapes on the Inyo National Forest. These efforts are critical to meeting recreation demand in the future. Partners and volunteers willing to help meet and manage recreation demand will help mitigate or off-set the negative impacts of unmanaged recreation.

Concessionaires, or private businesses that operate and maintain government recreation facilities under a special use permit, operate approximately 101 developed family campgrounds, as well as group campgrounds, day use facilities, and cabin rentals on the Inyo National Forest. The Federal Lands Recreation Enhancement Act has increased the funds available for some recreation facilities and opportunities that the Forest Service manages. Under this Act, the Forest Service collects use fees at 10 campgrounds and 3 day-use sites on the Inyo National Forest. The fees collected at these sites help provide services and make improvements that benefit the visitors who pay these fees. Outfitter guides, organizational camps, and special recreation events operate under special use permits to provide recreation opportunities to the public. The level of facilities and programs currently available to the public are dependent on these partnerships with commercial and private operators. Under the Recreation Enhancement Act, 90 percent of the fees collected from outfitter-guides and for special recreation events are returned to the Inyo National Forest to provide and improve the recreation experience of visitors.

Partnerships and volunteerism play an important role in maintaining trails and restoring and rehabilitating landscapes and watersheds on the Inyo National Forest. Between 2010 and 2015, Inyo National Forest partners and volunteers contributed 203,787 hours; of those, 94,119 were wilderness and nonwilderness trail maintenance, and 4,479 hours were restoration and rehabilitation. Partners and volunteers play an important role in maintaining trails as well; approximately 579 miles of trails were maintained on the Inyo National Forest in 2015.

Scenery Resources on the Inyo National Forest

The scenic character of the Inyo National Forest is diverse and is representative of the three major biological provinces within this area: the Sierra Nevada, the Great Basin, and the Mojave Desert. With elevations ranging from 3,800 to 14,495 feet, this shapes the scenic character of this area. The topographic relief is extreme, and 10,000 foot vertical gradients are found in the Sierra Nevada, White and Inyo Mountains. Opportunities for scenic overlooks are found throughout the area and allow visitors to experience the large expanses of undeveloped land; rare geologic formations like the Mono Craters and Obsidian Dome; wilderness areas such as the Ansel Adams and John Muir Wildernesses; and diverse ecosystems from alpine, mixed-conifer, Jeffrey pine, sagebrush steppe, to desert. Some of the most outstanding visual attractions include Mono Lake with geologic formations like tufa, and Mount Whitney, the highest peak in the continental United States at 14,494 feet in elevation. These are areas where visitors are expected to have a high concern for scenic values and changes to scenery.

[32] 36 CFR Parts 212, 251, 261, and 295 (Travel Management; Designated Routes and Areas for Motor Vehicle Use; Final Rule)

The most common developments on the Inyo National Forest that alter scenic integrity include powerlines, communication sites, substations, propane tanks, geothermal development, ski areas, hydropower facilities, reservoirs, recreation facilities, resorts, and temporary conditions like dust and smoke.

On the Inyo National Forest, many of the valued vegetation scenery attributes are at high risk of being impaired or seriously threatened due to dense vegetation conditions, ecosystem stressors such as insect and disease outbreaks, and fire return interval conditions that render landscapes susceptible to severe wildfire (see "Terrestrial Vegetation Ecology" and "Fire Trends" sections). Forest landscapes characterized by these conditions are considered to have low scenic stability. Many of the landscapes include wilderness areas and areas have high to very high scenic integrity.

Sequoia National Forest

Sustainable Recreation

Niche Statement for the Sequoia National Forest

The Sequoia National Forest, named for the world's largest trees, celebrates the greatest concentration of giant sequoia groves in the world. The Sequoia's landscape is as spectacular as its trees. Soaring granite monoliths, glacier-carved canyons, caves, roaring world-class whitewater, and scenic lakes and reservoirs characterize the Sierra Nevada's southern reach. Elevations range from 1,000 feet in the lower canyons to peaks over 12,000 feet on the crest of the Sierra, providing visitors with spectacular views in a dramatic range of settings. These mountains stand in contrast to California's San Joaquin Valley, providing cool relief for families from the scorching heat of summer and welcome blue skies and sun during the cold fog of winter. These spectacular features provide an attractive overnight destination for visitors from far and near.

Recreation Settings and Opportunities

Table 102 shows the allocation of the existing recreation opportunity spectrum classes on the Sequoia National Forest. The largest four recreation opportunity spectrum classes are roaded natural (48 percent), semi-primitive motorized (22 percent), semi-primitive nonmotorized (19 percent) and primitive (10 percent). Approximately 345,583 acres are inventoried roadless areas on the Sequoia. The nonmotorized setting accounts for 29 percent of the Sequoia National Forest and the motorized setting is found on 71 percent of the national forest.

Table 102. Existing recreation opportunity spectrum classes, Sequoia National Forest

Recreation Opportunity Spectrum Class	Acres	Percent Total Acres
Primitive	106,931	10
Semi-primitive nonmotorized	202,863	19
Semi-primitive motorized	244,090	22
Roaded Natural	527,340	48
Rural	10,916	1
Urban	0	0
No assigned class	3,916	<1

Some lands were transferred to the Sequoia National Forest after the release of the forest plan in 1988 in the area around Lake Isabella, and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping. Those areas are shown as "not assigned."

Use and Activities

The top 10 most popular activities in terms of visitor participation on the Sequoia National Forest stayed relatively constant between 2004 and 2011, though rankings have changed over time. According to national visitor use monitoring data from fiscal year 2011 (USDA FS 2011b), which was the latest round of surveys, the total estimate of national forest visits on the Sequoia National Forest was estimated at 626,000. The 10 most popular activities that visitors participated in were:

- fishing
- relaxing
- hiking/walking
- viewing wildlife
- driving for pleasure
- viewing natural features
- developed camping
- picnicking
- nature center activities (in 2011)
- other nonmotorized
- nonmotorized water (in 2006)

Relaxing, viewing wildlife, hiking and walking, and driving for pleasure have consistently remained the top five most popular activities. Fishing had the highest percentage of participation (48 percent) in 2011. Nationally, increases in site-based activities, such as camping in developed sites and family gatherings, and in viewing and photographing nature occur (Watts and Fisher 2010).

The Sequoia National Forest is an overnight destination, rather than a day use destination. Overnight visitors typically choose to camp in developed sites rather than primitive sites. Because overnight visitors spend more time using recreation resources and require more support services such as restrooms, drinking water, and trash service, they require more Forest Service resources than day use visitors (Doucette and Cole 1993). According to national visitor use monitoring data, most of the recreation on the Sequoia happens in the summer, and is especially heavy on holidays and weekends. Many visitors looking for relief from the summer heat are attracted to waterbodies and cooler temperatures at higher elevations. During winter months, most of the higher elevation areas become inaccessible due to snow covered roads.

The majority of visitors to the Sequoia National Forest prefer developed recreation sites. There are 115 developed recreation sites on the Sequoia National Forest, and 52 developed recreation sites within the Giant Sequoia National Monument.

The Sequoia National Forest currently manages 259 active special use authorizations. There are: 10 organization camps (9 in the Monument), 206 recreation residences (148 in the Monument), 5 resorts (3 in the Monument), 1 airport, 4 marinas, 2 permits for concession campgrounds, 22 outfitting and guiding services, 1 winter recreation resort, 1 target range, 1 golf course, 1 cavern, 5 recreation events, and 1 noncommercial group use.

Access

The Sequoia National Forest offers a variety of nonmotorized access: Out of the 1,056 miles of designated trails on the Sequoia, 687 miles are nonmotorized trails, and 5 miles are nonmotorized snow trails. Bicycle use is allowed on 300 miles of nonmotorized trails on the national forest.

There are 370 miles of trails for motorized use. Motor vehicle use is restricted to designated routes that can include paved highways and roads, gravel or dirt National Forest System roads, and trails designated for motor vehicle travel.

According to the national visitor use monitoring data, driving for pleasure is the most popular motorized activity on the Sequoia National Forest, with about one-third or more visitors participating in this activity in 2006 and 2011. Off-highway-vehicle use occurs in areas such as the Greenhorn Mountains, Piutes, and Kern Plateau. Off-highway-vehicle use is often associated with four-wheel-drive and all-terrain vehicles, dirt bikes, and other high-clearance vehicles.

The Sequoia National Forest provides motorized access on the national forest through conventional two-wheel-drive roads, four-wheel-drive roads, motorized trails, and motorized snow trails. Forest roads offer scenic views and provide direct access to trailheads, staging areas, campgrounds, and picnic facilities. The Sequoia National Forest has approximately 1,382 miles of National Forest System roads; 440 miles of which are designated at a maintenance level for all passenger cars that are street legal (maintenance level 3, 4, and 5). The remaining 942 miles are designated at a maintenance level recommended for high clearance, four-wheel drive vehicles (maintenance level 2).

Partnerships

Partnerships, volunteerism, and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails on the Sequoia National Forest. Concessionaires, or private businesses operate approximately 30 developed family campgrounds, as well as group campgrounds, day use facilities, and cabin rentals. The Federal Lands Recreation Enhancement Act allows the Forest Service to collect use fees at nine campgrounds and four day-use sites on the Sequoia National Forest. The fees collected at these sites help the Sequoia National Forest provide services and make improvements that benefit the visitors that pay these fees. Outfitter guides, organizational camps, and special recreation events operate under special use permits to provide recreation opportunities to the public. The level of facilities and programs currently available to the public are dependent on these partnerships with commercial and private operators.

Between 2010 and 2015, partners and volunteers for the Sequoia National Forest contributed 134,782 hours; 41,354 hours were for system trails and 959 hours were for restoration and rehabilitation of landscapes and watersheds. Partners and volunteers helped to maintain approximately 249 miles of trail on the Sequoia National Forest in 2015.

Scenery Resources on the Sequoia National Forest

Scenic character on the Sequoia National Forest is diverse. The Sequoia occupies the most southern reaches of the Sierra Nevada Bio-region and is split into two sections north and south of Sequoia and Kings Canyon National Parks. The Sequoia is a unique place, highly valued by its neighbors, visitors, and distant admirers. Giant sequoias are a symbolic vestige of the wild Sierra, evoking a deep emotional response, even from people who have never experienced their grandeur firsthand. The Sequoia National Forest offers a wide range of scenic features that include desert-like, foothill and mid- to high-elevation landscapes. Elevations vary from 1,000 feet to over 12,400 feet above sea level, an indication of the diversity of the area's visual resource. Some of the most outstanding visual attractions include the Kings River Canyon with high, steep walls and massive rocky ridges; the Little Kern River drainage characterized by many streams, small lakes, and alpine meadows surrounded by majestic mountain peaks; and the North Fork Kern River with

steep canyon walls and clear water flowing in cascades over bedrock and into deep pools. Numerous geologic features that are aesthetically significant combined with diverse vegetation types form the valued images of the Sequoia National Forest. These are areas where visitors are expected to have a high concern for scenic values and any changes to scenery.

The most common developments on the Sequoia National Forest that alter scenic integrity include powerlines, communication sites, substations, propane tank storage, geothermal development, ski areas, hydropower facilities, reservoirs, recreation facilities, resorts, and temporary conditions like dust and smoke.

On the Sequoia National Forest, many of the valued vegetation scenery attributes are at high risk of being impaired or seriously threatened due to dense vegetation conditions and encroachment, ecosystem stressors such as insect and disease outbreaks, and fire return interval conditions that render landscapes susceptible to severe wildfire, to name a few (see "Terrestrial Vegetation Ecology" and "Fire Trends" sections). Forest landscapes characterized by these conditions are considered to have low scenic stability. Many of the landscapes include wilderness areas and areas that have high to very high scenic integrity.

Sierra National Forest

Sustainable Recreation

Niche Statement for the Sierra National Forest

From lakeside camping and picnicking to wilderness solitude, the Sierra National Forest is destination recreation. With intensely used and highly developed lakes and the world famous Ansel Adams and John Muir Wildernesses, the Sierra provides the extreme ends of recreation settings. These sharp contrasts provide destinations for visitors to escape from the heat and routine urban life, connect with nature, family and friends. Given the proximity to large, diverse and growing urban areas, the Forest Service has a responsibility to provide heritage and conservation education to sustain this incredible landscape for future generations.

Recreation Settings and Opportunities

Table 103 below shows the allocation of the existing recreation opportunity spectrum classes on the Sierra National Forest. The largest two recreation opportunity spectrum classes are primitive (45 percent) and roaded natural (43 percent). Approximately 171,395 acres are inventoried roadless areas on the national forest. The nonmotorized setting accounts for 48 percent of the Sierra National Forest and the motorized setting is found on 52 percent of the national forest.

Table 103. Existing recreation opportunity spectrum classes, Sierra National Forest

Recreation Opportunity Spectrum Class	Acres	Percent Total Acres
Primitive	515,780	45
Semi-primitive nonmotorized	132,080	3
Semi-primitive motorized	45,769	3
Roaded Natural	606,386	43
Rural	133,002	6
Urban	0	0

Use and Activities

Recreation opportunities are affected by recreational trends and the mix of outdoor activities chosen by the public, which continuously evolve (USDA FS 2012). Visitor use and visitor satisfaction can help us understand what types of activities people are interested in and the quality of their experiences. According to national visitor use monitoring data from fiscal year 2012 (USDA FS 2012) which was the latest round of surveys, the total estimate of national forest visits on the Sierra National Forest was estimated at 726,000 thousand. The 10 most popular activities that visitors participated in were:

- relaxing (60 percent)
- viewing natural features (53 percent)
- hiking/walking (39 percent)
- viewing wildlife (37 percent)
- driving for pleasure (30 percent)
- picnicking (22 percent)
- other nonmotorized activities (17 percent)
- developed camping (17 percent)
- fishing (12 percent)

Overall visitor satisfaction was high on the Sierra National Forest: 76 percent of visitors were very satisfied with their visit and 19 percent were somewhat satisfied.

The Sierra National Forest offers a range of developed recreation across 14 areas of the forest. Some facilities are open year round and others are open from Memorial Day through Labor Day weekend. About 62 percent of facilities have site modification levels that provide visitor convenience and comfort. The other 38 percent have site modification levels where rustic or rudimentary modifications may be provided for resource protection.

The Sierra National Forest currently manages 647 active special use authorizations that cover 12 different types of specials uses. By far, recreation residences account for the greatest number of special use authorizations (75 percent) that occur on the national forest.

Access

The Sierra National Forest offers nonmotorized access: Out of the 1,241 miles of designated trails on the Sierra, 830 miles are nonmotorized trails, and 13 miles of nonmotorized snow trails. Bicycle use is allowed on 454 miles of nonmotorized trails on the national forest.

The forest provides 388 miles of trails for motorized use. Motor vehicle use is restricted to designated routes that can include paved highways and roads, gravel or dirt Forest Service roads, and trails designated for motor vehicle travel.

The Pacific Crest National Scenic Trail is the only congressionally designated trail on the Sierra National Forest. There are five national recreation trails, including Black Rock, Kings River, Lewis Creek, Rancheria Falls, and Shadow of the Giants that have been designated by the Forest Service.

According to the national visitor use monitoring data, driving for pleasure is one of the most popular motorized activity on the Sierra National Forest, with about a third of visitors participating in this activity in 2012. State Highways 41, 140, and 168 provide views of mountains, rock formations, and forests. County roads such as Dinkey Creek, Huntington Lake, Miami Mountain, and Chowchilla Mountain provide access from the state highway to forest opportunities.

The Sierra National Forest provides motorized access to areas of the national forest through conventional two-wheel drive roads, four-wheel drive roads, motorized trails, and motorized snow trails. Access to the Sierra National Forest is also provided by partners, agencies that manage adjoining public lands, and private land owners. Forest roads offer scenic views and provide direct access to trailheads, staging areas, campgrounds, and picnic facilities. The Sierra National Forest has approximately 2,313 miles of national forest transportation system roads; 364 miles of which are designated at a maintenance level for all passenger cars that are street legal (maintenance level 3, 4, and 5). The remaining 1,949 miles are designated at a maintenance level recommended for high clearance, four-wheel drive vehicles (maintenance level 2).

Partnerships

Partnerships, volunteerism and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails and restoring landscapes and watersheds on the Sierra National Forest. These efforts will be critical to meeting recreation demand in the future. Concessionaires, or private businesses that operate and maintain government recreation facilities under a special use permit, operate approximately 61 developed campgrounds, as well as group campgrounds, day use facilities, and cabin rentals. The Federal Land Recreation Enhancement Act has increased the funds available for some recreation facilities and opportunities that the Forest Service manages. Under this Act, the Forest Service collects use fees at 53 campgrounds and 9 day-use sites on the Sierra National Forest. The fees collected at these sites help provide services and make improvements that benefit the visitors that pay these fees. Outfitter guides, organizational camps, and special recreation events operate under special use permits to provide recreation opportunities to the public. The level of facilities and programs currently available to the public are dependent on these partnerships with commercial and private operators. Under the Federal Lands Recreation Enhancement Act, 90 percent of the fees collected from outfitter guides and for special recreation events are returned to the forest to provide and improve the recreation experience of visitors.

Partnerships and volunteerism play an important role in maintaining trails and landscapes and watersheds on the Sierra National Forest. Between 2010 and 2015 Sierra National Forest partners and volunteers contributed 258,704 hours, 91,364 were for trail maintenance and 496 hours were for landscape and watershed restoration. Partners and volunteers play an important role in maintaining trails; approximately 687 miles of trails were maintained on the Sierra National Forest in 2015.

Scenery Resources on the Sierra National Forest

The scenic character of the Sierra National Forest is one of its greatest assets. The Sierra National Forest is the gateway to the Sierra Nevada, including the heavily visited Yosemite and Kings Canyon National Parks. The national forest exhibits diverse and distinctive landscape qualities highly suited to scenic appreciation. The forest landscape ranges from steeply rolling chaparral and grass-woodland foothills, to barren windswept crags on the Sierra Crest. Dominant scenery attributes on the national forest and essential to its valued image are the lakes and reservoirs that define the lakes recreation niche setting. This setting is also noted for its open, park-like conifer and mixed-conifer forests, dominated by large trees, which people tend to have a preference for (Ryan 2005). Other dominant scenery attributes are rivers and streams, wilderness areas, sharp granite peaks, rock outcroppings, and visual access through the forest understory.

Scenic integrity uses a graduated scale of six levels ranging from very high integrity to no integrity. Nearly 50 percent of the Sierra National Forest contains naturally evolving landscapes with limited human intervention (preservation and retention). These landscapes are largely

wilderness and within the semi-primitive nonmotorized recreation opportunity spectrum class and have very high to high scenic integrity. For the landscapes outside the wilderness, the Sierra National Forest has natural appearing landscapes. Although it is on these landscapes that development occurs, they are expected to have a high scenic integrity. There are a few areas where developments such as powerlines, hydroelectric facilities, transportation systems, and ski runs are visual disturbances because they are noticeable and slightly detract from the form, line, color, texture, pattern, and scale of the surrounding landscape. However, other developments contribute to the enhancement of the scenery experience. For example, the hydroelectric facilities have led to the construction of reservoirs. These reservoirs have contributed to the lakes recreation setting.

Many of the valued vegetation scenery attributes on the Sierra National Forest are at high risk of being impaired or seriously threatened due to dense vegetation conditions and encroachment, ecosystem stressors such as insect and disease outbreaks, and fire return interval conditions that render landscapes susceptible to severe wildfire, to name a few (see "Terrestrial Vegetation Ecology" and "Fire Trends" sections). Forest landscapes characterized by these conditions are considered to have low scenic stability. Many of the landscapes include wilderness areas and areas that have high to very high scenic integrity. Departures in fire regime, insect outbreaks, and other disturbances from the natural range of variation help assess scenic stability. Insufficient fire or too much fire on the landscape can determine the level of departure from the natural range of variation.

Environmental Consequences to Sustainable Recreation and Scenery Resources

Inyo National Forest

Sustainable Recreation

Alternatives B, C, and D contain the following plan components to help achieve sustainable recreation:

- REC-FW-DC-02: The condition and function of recreation facilities reflect the diversity of cultures and activities in our community.
- REC-FW-DC-04: Visitors can connect with nature, culture and history through a full range of inclusive and sustainable outdoor recreation opportunities.
- REC-FW-DC-08: Developed recreation sites and infrastructure provide for the planned use, are managed for public safety, and are maintained for ecological, social and economic sustainability.
- REC-FW-OBJ-02 states, within 10 years of plan approval, convert 10 percent of existing recreation sites to group sites.

The plan objective helps the Inyo to meet the needs of Latinos and Asian Americans whose recreational styles and participation patterns tend to use larger developed group sites with picnic tables, grills, trash cans, and flush toilets that support day-long activities, hiking and walking, and opportunities to be with family.

Recreation Settings and Opportunities

Alternatives B, C, and D contain the following plan components to help address recreation settings:

- REC-FW-DC-01: The diverse landscapes of the forest offer a variety of year-round recreation settings for a broad range of nature-based recreation opportunities, derived from assigned recreation opportunity spectrum classes and recreation places management areas. Management focuses on settings that enhance the forest recreation program niche.
- REC-FW-DC-14: Recreation settings provide a range of opportunities as described by the recreation opportunity spectrum. The desired distribution of recreation opportunity spectrum settings are shown in Table 104, and displayed in maps in volume 3.

In addition to the recreation opportunity spectrum classes that were changed as described for alternative A, additional changes were made to assign a class to areas where lands were acquired but a class was not formally assigned. In this last situation, recreation opportunity spectrum classes were assigned to be generally consistent with how the areas have been currently managed.

Table 104 below shows the recreation opportunity spectrum classes for the existing forest plan (alternative A) and for alternatives B, C, and D, which present variations of the desired recreation opportunity spectrum. In alternative A, lands were transferred to the Inyo National Forest after the release of the forest plan in 1988 as a result of the National Forest and Public Lands of Nevada Enhancement Act and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping. Those areas are shown as not assigned. Since these areas are not assigned a recreation opportunity spectrum class, caution should be used when comparing alternative A to the other alternatives. Maps of the recreation opportunity spectrum classes for the Inyo National Forest can be found in volume 3.

Table 104. Existing (alternative A) and desired (alternatives B, C, D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Inyo National Forest

Class	Alternative A	Alternative B	Alternative C	Alternative D
Primitive	790,306 53%	1,089,745 55%	1,320,540 67%	1,081092 55%
Semi-primitive nonmotorized	471,686 12%	218,817 11%	97,503 5%	226,727 11%
Semi-primitive motorized	331,964 14%	364,328 18%	270,546 14%	364,924 18%
Roaded Natural	335,756 15%	239.287 12%	224,504 11%	239,432 12%
Roaded Modified	62,507 2%	47,645 2%	47,016 2%	47,645 2%
Rural	15,545 <1%	19,300 1%	19,012 1%	19,300 1%
Urban	0	0	0	0
Not assigned	93,483 4%	0	0	0

Consequences Specific to Alternative A

In the current plan, the largest recreation opportunity spectrum class on the Inyo National Forest is primitive at 53 percent followed by roaded natural (15 percent), and then by semi-primitive

motorized (14 percent) and roaded natural (16 percent). When the two nonmotorized settings are combined (primitive and semi-primitive nonmotorized), this alternative provides 65 percent of the national forest in a nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural), this alternatives provides 31 percent of the national forest in a motorized setting. The amount of nonmotorized setting in this alternative is higher than alternative B and less than alternatives C and D. The amount of motorized setting in this alternative is also higher than alternative B and lower than alternatives C and D.

Consequences Specific to Alternative B

In alternative B, the largest recreation opportunity spectrum class on the Inyo National Forest would be primitive at 55 percent of the forest followed by semi-primitive motorized (18 percent), and then by roaded natural (12 percent). When the two nonmotorized settings are combined, this alternative would result in 66 percent of the Inyo in a nonmotorized setting. Combining the motorized settings, this alternative would provide a motorized setting on 33 percent of the national forest. The amount of nonmotorized setting in this alternative would be the same as alternative D, and less than alternative C. The amount of motorized setting in this alternative would be the same as alternative D but higher than alternative C.

Consequences Specific to Alternative C

In alternative C, the largest recreation opportunity spectrum class on the Inyo National Forest would be primitive at 67 percent, followed by semi-primitive motorized (14 percent), and then by roaded natural (11 percent). When the two nonmotorized settings are combined, this alternative would result in 72 percent of the Inyo in a nonmotorized setting. Combining the motorized setting, this alternative would provide a motorized setting on 28 percent of the national forest. The amount of nonmotorized setting in this alternative would be the highest of all alternatives. Conversely, the amount of motorized setting in this alternative would be the lowest of all alternatives.

The change in settings in alternative C is due largely to the increase in recommended wilderness in this alternative; the nonmotorized setting would increase from 65 percent to 72 percent, which offers more opportunity for nonmotorized settings that provide quiet solitude, and reduce probabilities of seeing or hearing other people in remote and predominately unmodified landscapes. Motorized settings would decrease from 31 percent to 28 percent of the national forest, which would provide less opportunity in settings that are more developed and in roaded areas of the Inyo that allow motorized activities.

Consequences Specific to Alternative D

In alternative D, the largest recreation opportunity spectrum class would be primitive at 55 percent of the Inyo National Forest, followed by semi-primitive motorized (18 percent), and then by roaded natural (12 percent). When the two nonmotorized settings are combined, this alternative would result in 66 percent of the Inyo in a nonmotorized setting. Combining the motorized settings, this alternative would provide a motorized setting on 33 percent of the national forest. The amount of nonmotorized setting in this alternative would be higher than alternative B and less than alternative C. Conversely, the amount of motorized setting in this alternative would be the same as alternative B and higher than alternative C.

Partnerships

Consequences Common to Alternatives B, C, and D

The following plan components provide an emphasis on partnerships and volunteers and are common to alternatives B, C, D:

- VIPS-FW-DC-01: The Inyo National Forest has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.
- VIPS-FW-DC-01: The Inyo National Forest uses partnerships to build local capacity for providing information and content using the best available methods, including, but not limited to, advances in technology.
- VIPS-FW-GOAL-03: Maintain and expand contracting and partnering opportunities with local governments, businesses, and organizations. Develop partnerships that leverage different sources of funding to support opportunities to contribute to the economic and social sustainability of local communities.
- VIPS-FW-GOAL-04: Work with partners and volunteers to provide recreation opportunities, maintain and enhance recreation settings, collect and manage data on recreation use and demand, and contribute to socioeconomic benefits associated with recreation and tourism.

Consequences Specific to Alternative A

Under the current forest plan, partnerships, volunteers, grants, and agreements help maintain and improve developed recreation facilities and trails on the Inyo National Forest. Most developed campgrounds and fee day-use sites are managed under a concessionaire contract. Some sites and facilities not under concessionaire management have partnership agreements with local non-profit organizations and user groups. These partnerships, volunteers, and agreements assist with maintenance on motorized and nonmotorized trails, wilderness patrols, and facilities operation and maintenance. Non-profit organizations help remove graffiti and trash, and provide visitor information and interpretive programs along river corridors, popular dispersed recreation sites, and developed recreation sites. These partnerships and agreements are often made possible with funding (such as green sticker funds, resource advisory council grants, the Federal Lands Recreation Enhancement Act, stewardship council, and other sources) that supplements appropriated dollars.

Consequences Specific to Alternative B

There would be four new recommended wilderness areas in this alternative. The wilderness polygons do not include any existing motorized uses and roadways; therefore, existing partnerships centered on motorized use would not be affected. There would be an opportunity for partnerships and volunteerism focused on wilderness stewardship and trails in the new recommended wilderness areas. Partnerships, volunteerism grants and agreements that help maintain or improve developed recreation facilities could increase. The pace and scale of ecologic restoration may increase or decrease partnerships and volunteerism in the short term depending on location and type of treatment.

Consequences Specific to Alternative C

There would be six new recommended wildernesses areas in this alternative. The wilderness polygons do not include any existing motorized uses and roadways, similar to alternative B.

However, mechanized transport such as bicycle use would not be suitable on 43 miles of trails that currently allow bicycles, which could affect existing and future partnerships and volunteerism by groups focused on mechanized use. The bicycle partnerships and volunteerism could shift to other locations on the Inyo National Forest. There is a potential for types and locations of partnerships and volunteerism to change due to the addition of recommended wilderness. There is an opportunity for partnerships and volunteerism focused on wilderness stewardship and trails in the new recommended wilderness areas. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Consequences Specific to Alternative D

There would not be any recommended wilderness areas in this alternative. The pace and scale of ecologic restoration may have a greater increase or decrease on partnerships and volunteerism in the short term depending on location and type of treatment than what is proposed in alternative B. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Access

Consequences Specific to Alternative A

There is no recommended wilderness in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use. Existing recreation opportunity spectrum settings would not limit future motorized or mechanized transport recreation opportunities from the existing condition.

Consequences Specific to Alternative B

There would be four recommended wilderness areas in this alternative and none contain any system trail that allows bicycle use; therefore, there would be no change in miles of system trails that allow mechanized transport. Within the four recommended wilderness areas there would be no designated motor vehicle routes or open areas; therefore there would be no changes in miles of system trails, roads, or open areas allowing motorized use.

Consequences Specific to Alternative C

There would be six recommended wilderness areas in this alternative that contain 43 miles of system trails that currently allow bicycle use. A plan component (MA-WILD-SUIT-04) makes mechanized transport unsuitable in recommended wilderness areas; therefore, bicycle use would be decreased by 43 miles on system trails, which is a 9 percent reduction in nonmotorized trails open to bicycles compared to alternatives A and D. A site-specific decision to close trails within recommended wilderness areas would need to be completed before an enforceable closure could be made to prohibit bicycle use. Hence, system roads, trails, and areas that allow for motorized and mechanized use would remain open until a project-level decision was completed. If site-specific decisions were made, bicycle use on system trails could decrease by 43 miles within recommended wilderness areas and mechanized transport would be allowed on 432 miles of nonmotorized system trails across the entire Inyo National Forest.

Consequences Specific to Alternative D

There would not be any recommended wilderness in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use. Recreation opportunity spectrum settings for motorized and mechanized transport would be the same as alternative B.

Scenery Resources on the Inyo National Forest

Alternatives B, C, and D would add the following specific plan components relevant to scenery:

- SCEN-FW-DC-01: The forest provides a variety of ecologically sound, resilient and visually appealing forest landscapes that sustain scenic character, supporting the forest recreation program niche in ways that contribute to visitors' sense of place and connection with nature.
- SCEN-FW-DC-02: Scenic character is maintained and/or adapted to changing conditions to support ecological, social and economic sustainability on the national forest and in surrounding communities.
- SCEN-FW-DC-04: The Forest's scenery provides a range of scenic quality as described by the scenic integrity objectives. The desired distribution of scenic integrity objectives is displayed in figure 15, appendix a.
- SCEN-FW-OBJ-01: Within 10 years of plan approval, improve scenic stability by treating 500 acres of vegetation in areas with a high likelihood of large, high-intensity wildfire, that depart from the natural range of variation.
- REC-FW-DC-12: Developed recreation facilities sites are situated in areas resilient to large, high-intensity wildfires.
- REC-FW-OBJ-01: Within 10 years of plan approval, complete fuel treatment restoration activities on 200 acres at recreation sites that are in areas with a high risk of large, high-intensity wildfire.

All alternatives would help move vegetation conditions toward the natural range of variation but the amount and scheduling of restoration to move toward the natural range of variation would vary between alternatives. Mechanical treatments for restoration may have short-term impacts to scenic integrity compared to hand treatments or prescribed fire, but over the long term, scenic character would benefit through increased scenic stability. There would be short-term scenic integrity losses with fire, but long-term potential increases in scenic integrity, especially with the reestablishment of the role of fire on the landscape.

Scenic Stability and Character

Embedded within the restoration treatment discussed for each alternative is the objective SCEN-FW-OBJ-01, which focuses some fuel treatment restoration activities on recreation sites that are in areas with a high risk of large, high-intensity wildfire. This plan component helps focus restoration treatment at high-risk recreation sites to become more resilient to large, high-intensity fires, thus increasing scenic stability.

Consequences Specific to Alternative A

Under the existing plan, this alternative would increase scenic stability across the Inyo National Forest, which in turn improves scenic character; however it would be less than alternatives B and D, but more than the lower range of alternative C. Mechanical treatment achieves the natural range of variation quicker and with more precision, lessening the short-term visual impacts of treatment compared to prescribed fire or wildfire managed to meet resource objectives. This alternative has slightly less mechanical treatment than alternatives B and D but slightly more than alternative C. This alternative would trend vegetation toward achieving the natural range of variation but at a substantially slower rate than alternatives B and D and slightly less than alternative C, thus providing the lowest protection for scenic character.

Consequences Specific to Alternative B

This alternative would increase scenic stability across the landscape, which in turn would improve scenic character more than alternatives A and C, and less than alternative D. This alternative would have about the same amount to slightly more mechanical treatment than alternative A and up to two and a half times as much mechanical treatment as alternative C. In contrast to the Sequoia and Sierra National Forests, there are fewer opportunities to substantially increase the amount of mechanical thinning to restore vegetation and reduce fuels because of the costs associated with treatment and lack of wood products infrastructure serving the Inyo National Forest. Much of the restoration would be to restore sagebrush and Jeffrey pine ecosystems, or reduce fuels around communities and other infrastructure. This alternative would manage about five time more wildfire area to meet resource objectives, which would increase scenic stability by lessening the consequences of large high-intensity wildfire. This alternative would help trend vegetation toward achieving the natural range of variation at about twice the rate of alternative A but at about two-thirds the rate of alternative D, providing the second highest protection for scenic character.

Consequences Specific to Alternative C

This alternative would increase scenic stability across the landscape, which in turn would improve scenic character less than alternatives B and D, and similar to alternative A. Although this alternative would manage wildfires to meet resource objectives on about twice as many acres as compared to alternative A, it would treat about one-half to three-quarters as many areas with mechanical treatments and up to twice as much areas with prescribed fire than alternative A. As with alternative B, mechanical treatment opportunities are more limited on the Inyo National Forest than the other two national forests, but where used, it can reduce the short-term visual impacts to scenery compared to the multiple treatments with fire to achieve the same level of fuel reduction. This alternative would have similar amounts of mechanical treatment as other alternatives and would still help trend vegetation toward achieving the natural range of variation, but at a slightly greater rate of achieving the natural range of variation as alternative A, thus providing the second to lowest protection for scenic character.

Consequences Specific to Alternative D

This alternative would increase scenic stability across the landscape across the largest area and faster, which in turn would improve scenic character more than alternatives A, B and C. This alternative would have the most amount of mechanical treatment of all the alternatives, which would increase the rate of achieving the natural range of variation more quickly and with more precision. Alternative D would increase the amount of area restored with mechanical treatments about three times more than alternative A and about twice as much as alternative B. However, the greatest increase in area restored would be from increasing the amount of prescribed burning about two to three times and increasing the amount of area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about 10 times more than alternatives A and C and about twice as much as alternative B.

Scenic Integrity Objectives

Future developments that have the potential to affect scenic integrity on the Inyo National Forest include powerline development and replacement, geothermal and alternative energy development, and periodic smoke and dust events. In addition, there may be potential negative short-term impacts to scenic integrity from fuel reduction restoration projects, especially those that are accomplished by mechanical means. This is primarily due to the more open vegetation on much of the Inyo National Forest and the greater visibility from high points. Short-term negative

impacts would be off-set by long-term benefits where vegetation conditions are moving toward the natural range of variation to reduce impacts to scenic character from high-intensity fires and increased vegetation density caused by fire suppression.

Table 105 shows the acres and percent of the Inyo National Forest for each scenic integrity objective by alternative. The visual quality objectives for alternative A were converted to scenic integrity objectives as shown in the cross-walk in Table 100. Because alternative A does not include approximately 44,600 acres of lands that were added to the Inyo National Forest from the National Forest and Public Lands of Nevada Enhancement Act of 1988, caution should be used when comparing alternative A to the other alternatives.

The table shows that alternative C would have the highest percentage of very high scenic integrity objective compared to all alternatives, mainly due to the higher acreage of recommended wilderness and increase in the Pacific Crest Trail width in this alternative. Alternative B would have a slightly higher percentage of very high scenic integrity objective compared to alternative D, mainly due to the acreage of recommended wilderness. In alternative D, those areas would be managed to meet mostly high and very high desired scenic integrity objectives. Alternative A would have the highest amount of low scenic integrity objective of all alternatives, primarily because of the difference in approaches to mapping the older visual quality objectives.

Table 105. Desired scenic integrity objectives by acres and percent of forest and alternative, Inyo National Forest

Scenic Integrity Objective	Alternative A	Alternative B	Alternative C	Alternative D
Very high	751,860 37%	1,001,596 50%	1,276,987 64%	964,564 49%
High	537,540 26%	669,545 34%	459,070 23%	701,768 35%
Moderate	716,375 35%	301,095 16%	237,812 12%	305,903 15%
Low	35,470 2%	11,661 1%	10,028 1%	11,661 1%
Very Low*	5 <1%	0	0	0

* Although the maximum modification objective was used in the visual management system, the current scenery management system tends to not have desired objectives for very low scenic integrity. Thus, the maximum modification/very low objective will not be compared to alternatives B, C, and D.

Cumulative Effects for the Inyo National Forest

Areas modified by vegetation treatments, powerlines and other infrastructure would continue to appear highly managed over the next 10 to 15 years and scenic integrity would remain moderate to very low in those areas. Vegetation treatments and infrastructure development on adjacent private, State and Federal lands may influence overall scenic integrity. Restoration treatments across the landscape would trend vegetation toward the natural range of variation and protection of the scenic character. Driving for pleasure and other scenery dependent activities on the Inyo National Forest could be affected slightly by human disturbance to areas under other administrations. Wildfire and other disturbance processes, if large in scale and intensity, may result in lowered scenic character in those areas affected by the disturbance.

Sequoia National Forest

Sustainable Recreation

Alternatives B, C, and D contain the following plan components to help achieve sustainable recreation:

- REC-FW-DC-02: The condition and function of recreation facilities reflect the diversity of cultures and activities in our community.
- REC-FW-DC-04: Visitors can connect with nature, culture and history through a full range of inclusive and sustainable outdoor recreation opportunities.
- REC-FW-DC-08: Developed recreation sites and infrastructure provide for the planned use, are managed for public safety, and are maintained for ecological, social and economic sustainability.
- REC-FW-OBJ-02 states, within 10 years of plan approval, convert 10 percent of existing recreation sites to group sites.

The plan objective helps the Sequoia National Forest to meet the needs of Latinos and Asian Americans whose recreational styles and participation patterns tend to use larger developed group sites with picnic tables, grills, trash cans, and flush toilets that support day-long activities, hiking and walking, and opportunities to be with family.

Recreation Settings and Opportunities

Alternatives B, C, and D contain the following plan components to help address recreation settings:

- REC-FW-DC-01: The diverse landscapes of the forest offer a variety of year-round recreation settings for a broad range of nature-based recreation opportunities, derived from assigned recreation opportunity spectrum classes and recreation places management areas. Management focuses on settings that enhance the forest recreation program niche.
- REC-FW-DC-14: Recreation settings provide a range of opportunities as described by the recreation opportunity spectrum. The desired distribution of recreation opportunity spectrum settings are shown in Table 106 and displayed on maps in volume 3.

In addition to the recreation opportunity spectrum classes that were changed as described for alternative A, additional changes were made to assign a class to areas where lands were acquired but a class was not formally assigned. In this last situation, recreation opportunity spectrum classes were assigned to be generally consistent with how the areas have been currently managed.

Table 106 shows the recreation opportunity spectrum classes for the existing forest plan (alternative A) and for alternatives B, C, and D, which present variations of the desired recreation opportunity spectrum. In alternative A, lands were transferred to the Sequoia National Forest after the release of the forest plan in 1988 and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping. Since these areas are not assigned a recreation opportunity spectrum class and are not shown in the table, caution should be used when comparing alternative A to the other alternatives. Maps of the recreation opportunity spectrum classes for the Sequoia National Forest can be found in volume 3.

Table 106. Existing (alternative A) and desired (alternatives B, C, and D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Sequoia National Forest

Class	Alternative A	Alternative B	Alternative C	Alternative D
Primitive	329,034 30%	329,034 30%	535,899 48%	329,034 30%
Semi-primitive nonmotorized	57,085 5%	57,085 5%	57,614 5%	57,085 5%
Semi-primitive motorized	174,455 16%	250,541 22%	133,631 12%	250,541 23%
Roaded Natural	529,338 48%	453,379 41%	363,983 33%	453,379 41%
Rural	10,643 1%	24,711 2%	23,624 2%	24,711 2%
Urban	0	0	0	0
No assigned class	3,916 <1	0	0	0

The acreage difference on the Sequoia National Forest in alternatives B, C, and D is because of additional land (around Lake Isabella) that was acquired after the release of the forest plan and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping.

Consequences Specific to Alternative A

In the current plan, the largest recreation opportunity spectrum class on the Sequoia National Forest is roaded natural at 48 percent followed by primitive (30 percent), and then by semi-primitive motorized (16 percent). When the two nonmotorized settings are combined (primitive and semi-primitive nonmotorized), this alternative provides 35 percent of the national forest in a nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural), this alternatives provides a motorized setting on 65 percent of the national forest. The amount of nonmotorized setting in this alternative is the same as alternatives B and D, and less than alternative C. The amount of motorized setting in this alternative is the same as alternatives B and D, and higher than alternative C.

Consequences Specific to Alternative B

In alternative B, the largest recreation opportunity spectrum class on the Sequoia National Forest is roaded natural at 41 percent followed by primitive (30 percent), and then by semi-primitive motorized (22 percent). When the two nonmotorized settings are combined, this alternative would result in 35 percent of the Sequoia in a nonmotorized setting. Combining the motorized settings, this alternative would provide a motorized setting on 65 percent of the national forest. The nonmotorized setting in this alternative would be the same as alternatives A and D, and less than alternative C. The motorized setting in this alternative would be the same as alternatives A and D, and higher than alternative C.

Consequences Specific to Alternative C

In alternative C, the largest recreation opportunity spectrum class on the Sequoia National Forest would be primitive at 48 percent followed by roaded natural (33 percent), and then by semi-primitive motorized (12 percent). When the two nonmotorized settings are combined, this alternative would result in 53 percent of the Sequoia in a nonmotorized setting. Combining the motorized settings, this alternative would provide a motorized setting on 47 percent of the national forest. The nonmotorized setting in this alternative would be the highest of all alternatives. Conversely, the motorized setting in this alternative would be the lowest in all alternatives.

The change in settings in alternative C is due largely to the addition of recommended wilderness acreage in this alternative; the nonmotorized setting would increase from 35 percent to 53 percent, which offers more opportunity in settings that provide quiet solitude and reduce probabilities of seeing other people in remote and predominately unmodified landscapes. Motorized settings would decrease from 65 percent to 47 percent of the forest, which would provide less opportunity in settings in more developed and roaded areas of the forest that allow motorized activities.

Consequences Specific to Alternative D

In alternative D, the largest recreation opportunity spectrum class would be roaded natural at 41 percent of the forest followed by primitive (30 percent), and then by semi-primitive motorized (23 percent). When the two nonmotorized settings are combined, this alternative would result in 35 percent of the national forest in a nonmotorized setting. Combining the motorized settings, this alternative would result in a motorized setting on 65 percent of the national forest. The nonmotorized setting in this alternative is the essentially the same as alternatives A and B (semi-primitive motorized is 23 percent in this alternative as opposed to 22 percent in alternatives A and B) and less than alternative C. Conversely, the motorized setting in this alternative is the same as alternatives A and B, and higher than alternative C.

Partnerships

The following plan components provide an emphasis on partnerships and volunteers and are common to alternatives B, C, D:

- VIPS-FW-DC-01: The Sequoia has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.
- VIPS-FW-DC-02: The Sequoia uses partnerships to build local capacity for providing information and content using the best available methods, including advances in technology.
- VIPS-FW-GOALS-01: Maintain and expand contracting and partnering opportunities with local governments, businesses, and organizations. Develop partnerships that leverage different sources of funding to support opportunities to contribute to the economic and social sustainability of local communities.
- VIPS-FW-GOALS-02: Work with partners and volunteers to provide recreation opportunities, maintain and enhance recreation settings, collect and manage data on recreation use and demand, and contribute to socioeconomic benefits associated with recreation and tourism.

Consequences Specific to Alternative A

Under the current forest plan, partnerships, grants, and agreements help maintain trails and recreation sites on the Sequoia National Forest. Most developed campgrounds and fee day-use sites are managed under a concessionaire contract. Many sites and facilities not under concessionaire management have partnership agreements with local non-profit organizations and user-groups. These partnerships, volunteers, and agreements assist with maintenance on motorized and nonmotorized trails, wilderness patrols, and facilities operation and maintenance. Non-profit organizations help remove graffiti and trash, and provide visitor information and interpretive programs along river corridors, popular dispersed recreation sites, and developed recreation sites. Some of these partnerships and agreements are often made possible with funding

(such as green sticker funds, resource advisory council grants, the Federal Lands Recreation Enhancement Act, stewardship council, and other sources) that supplements appropriated dollars.

Consequences Specific to Alternative B
There would not be any new recommended wilderness areas in this alternative. The pace and scale of ecologic restoration may increase or decrease partnerships and volunteerism in the short term depending on location and type of treatment. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Consequences Specific to Alternative C
There would be nine new recommended wildernesses areas in this alternative. The wilderness polygons do not include any existing motorized uses and roadways. However, mechanized transport such as bicycle use would not be suitable on 125 miles of trails that currently allow bicycles, which could affect existing and future partnerships and volunteerism from groups focused on mechanized use. Bicycle use partnerships and volunteerism could shift to other locations on the national forest. There is a potential for types and locations of partnerships and volunteerism to change due to the addition of recommended wilderness. There is an opportunity for partnerships and volunteerism focused on wilderness stewardship and trails in the new recommended wilderness areas to occur. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Consequences Specific to Alternative D
There would not be any new recommended wilderness areas in this alternative. The pace and scale of ecologic restoration may have a greater increase or decrease on partnerships and volunteerism in the short term depending on location and type of treatment than found in alternative B. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Access

Consequences Specific to Alternative A
There is no recommended wilderness in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use. Existing recreation opportunity spectrum settings would not limit future motorized recreation opportunities from what currently exists.

Consequences Specific to Alternative B
There would be no recommended wilderness areas in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use.

Consequences Specific to Alternative C
There would be nine recommended wilderness areas in this alternative that contain 125 miles of system trails that currently allow for bicycle use. The plan component MA-WILD-SUIT-04 makes mechanized transport unsuitable in recommended wilderness areas, therefore bicycle use would be decreased by 125 miles on system trails, which is a 42 percent reduction in nonmotorized trails open to bicycles compared to alternatives A, B, and D. A site-specific decision to close trails within recommended wilderness areas would need to be completed before an enforceable closure could be made to prohibit bicycle use. Hence, system roads, trails, and areas that allow for motorized and mechanized use would remain open until a project-level decision was completed. If site-specific decisions were made, bicycle use on system trails could

decrease by 125 miles within recommended wilderness areas and mechanized transport would be allowed on 175 miles of nonmotorized system trails across the entire Sequoia National Forest.

Recreation opportunity spectrum settings for motorized use would be reduced from 65 percent to 47 percent of the Sequoia National Forest. Existing designated motor vehicle routes and areas have been accommodated by adjusting recommended wilderness boundaries and including the Sirretta Trail as a corridor.

Consequences Specific to Alternative D

There would not be any recommended wilderness in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use.

Scenery Resources on the Sequoia National Forest

Alternatives B, C, and D would add the following specific plan components relevant to scenery:

- SCEN-FW-DC-01: The forest provides a variety of ecologically sound, resilient and visually appealing forest landscapes that sustain scenic character, supporting the forest recreation program niche in ways that contribute to visitors' sense of place and connection with nature.
- SCEN-FW-DC-02: Scenic character is maintained and/or adapted to changing conditions to support ecological, social and economic sustainability on the national forest and in surrounding communities.
- SCEN-FW-DC-04: The Forest's scenery provides a range of scenic quality as described by the scenic integrity objectives. The desired distribution of scenic integrity objectives is displayed in figure 20, appendix a.
- SCEN-FW-OBJ-01: Within 10 years of plan improve scenic stability by treating 2,000 acres of vegetation in areas with a high likelihood of large, high-intensity wildfire, that greatly depart from vegetation desired conditions, and that conform most closely to the forest recreation program niche.
- REC-FW-DC-12: Developed recreation facilities sites are situated in areas resilient to large, high-intensity wildfires.
- REC-FW-OBJ -01: Within 10 years of plan approval, complete fuel treatment restoration activities on 200 acres at recreation sites that are in areas with a high risk of large, high-intensity wildfire.

All alternatives would help move vegetation conditions toward the natural range of variation but the amount and scheduling of restoration to move toward the natural range of variation would vary between alternatives. Mechanical treatments for restoration may have a short-term impacts to scenic integrity compared to hand treatments or prescribed fire but over the long term, scenic character benefits through increased scenic stability. There would be short-term scenic integrity losses with fire, but long-term potential increases in scenic integrity, especially with the reestablishment of the role of fire on the landscape.

Scenic Stability

Embedded within the restoration treatment discussed for each alternative is SCEN-FW-OBJ-01, which focuses some fuel treatment restoration activities on recreation sites that are in areas with a high risk of large, high-intensity wildfire. This plan component helps focus restoration treatment at high-risk recreation sites to become more resilient to large, high-intensity fires, thus increasing scenic stability.

Consequences Specific to Alternative A
Under the existing plan, this alternative would increase scenic stability across the Sequoia National Forest, which in turn improves scenic character; however, it would be less than alternatives B and D, but more than the lower range of alternative C. Mechanical treatment achieves the natural range of variation quicker and with more precision. This alternative would have less mechanical treatment than alternatives B and D but more than C. This alternative would help trend vegetation toward achieving the natural range of variation but at a slower rate than alternatives B and D thus, providing the third highest protection for scenic character.

Consequences Specific to Alternative B
This alternative would increase scenic stability across the landscape which, in turn would improve scenic character more than alternatives A and C, and less than alternative D. This alternative would have about the same amount to about one and a half times more mechanical treatment as alternative A, and two to three times as much mechanical treatment as alternative C. This alternative would allow two to two and a half times more area of wildfire managed to meet resource objectives, which would increase scenic stability by lessening the consequences of large high-intensity wildfire. This alternative would help trend vegetation toward achieving the natural range of variation at about half the rate of alternative D, thus providing the second highest protection for scenic character.

Consequences Specific to Alternative C
This alternative would increase scenic stability across the landscape, which in turn would improve scenic character less than alternatives B and D, but similar to alternative A. Although this alternative would have slightly more acres for managing wildfires to meet resource objectives compared to alternative A, it would treat about one-quarter to one-half as many areas with mechanical treatments and about one-quarter to one-half as much areas with prescribed fire than alternative A. This substantial reduction in treatment is due to the more limited treatment opportunities and steeper terrain coupled with direction for Pacific fisher and California spotted owls, limiting both mechanical treatment and prescribed burning opportunities. Mechanical treatment achieves the natural range of variation quicker and with more precision, reducing the short-term visual impacts to scenery that would be needed with multiple treatments with fire to achieve the same level of fuel reduction. This alternative would have the least amount of mechanical treatment of all the alternatives. Although it would still help trend vegetation toward achieving the natural range of variation, it would have the slowest rate of achieving the natural range of variation, thus providing the lowest protection for scenic character.

Consequences Specific to Alternative D
This alternative would increase scenic stability across the landscape across the largest area and faster, which in turn would improve scenic character more than alternatives A, B and C. This alternative would have the most amount of mechanical treatment of all the alternatives, which would increase the rate of achieving the natural range of variation more quickly and with more precision. Alternative D would increase the amount of area restored with mechanical treatments about two to three times more than alternative A and about twice as much as alternative B. However, the greatest increase in area restored would be from increasing the amount of prescribed burning about two times and increasing the amount of area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about four times more than alternatives A and C and about one and one-half as much as alternative B, thus providing the highest protection for scenic character.

Scenic Integrity Objectives

Table 107 shows the acres and percent of the Sequoia National Forest for each scenic integrity objective by alternative. The visual quality objectives for alternative A were converted to scenic integrity objectives as shown in the cross-walk in Table 100. Because alternative A does not include approximately 254,000 acres of lands that were added to the Sequoia National Forest in the Lake Isabella area, caution should be used in comparing alternative A to the other alternatives.

Table 107. Desired scenic integrity objectives by acres and percent of forest and alternative, Sequoia National Forest

Scenic Integrity Objective	Alternative A	Alternative B	Alternative C	Alternative D
Very high	255,574 24%	300,627 37%	425,341 52%	300,627 37%
High	159,734 15%	345,247 43%	238,699 29%	345,247 43%
Moderate	394,009 37%	163,182 20%	145,019 18%	163,182 20%
Low	191,680 18%	1,487 <1%	1,485 <1%	1,487 <1%
Very Low*	63,893 6%	0	0	0

* Although the maximum modification objective was used in the visual management system, the current scenery management system tends to not have objectives for very low scenic integrity. Thus, the maximum modification/very low objective will not be compared to alternatives B, C, and D.

Cumulative Effects for the Sequoia National Forest

Areas modified by vegetation treatments, powerlines and other infrastructure will continue to appear highly managed over the next 10 to 15 years and scenic integrity will remain moderate to very low in those areas. Vegetation treatments and infrastructure development on adjacent private, state and federal lands may influence overall scenic integrity. Restoration treatments across the landscape will trends toward the natural range of variation and protection of the scenic character. Driving for pleasure and other scenery dependent activities on the Sequoia National Forest could be affected slightly by human disturbance to areas under other administrations. Wildfire and other disturbance processes, if large in scale and intensity, may result in lowered scenic character in those areas affected by the disturbance.

Sierra National Forest

Sustainable Recreation

Alternatives B, C, and D contain the following plan components to help achieve sustainable recreation:

- REC-FW-DC-02: The condition and function of recreation facilities reflect the diversity of cultures and activities in our community.
- REC-FW-DC-04: Visitors can connect with nature, culture and history through a full range of inclusive and sustainable outdoor recreation opportunities.
- REC-FW-DC-08: Developed recreation sites and infrastructure provide for the planned use, are managed for public safety, and are maintained for ecological, social and economic sustainability.

- REC-FW-OBJ-02 states, within 10 years of plan approval, convert 10 percent of existing recreation sites to group sites.

The plan objective helps the Sierra National Forest to meet the need of Latinos and Asian Americans whose recreational styles and participation patterns tend to use larger developed group sites with picnic tables, grills, trash cans, and flush toilets that support day-long activities, hiking and walking, and opportunities to be with family.

Recreation Settings and Opportunities

Alternatives B, C, and D contain the following plan components to help address recreation settings:

- REC-FW-DC-01: The diverse landscapes of the forest offer a variety of year-round recreation settings for a broad range of nature-based recreation opportunities, derived from assigned recreation opportunity spectrum classes and recreation places management areas. Management focuses on settings that enhance the forest recreation program niche.
- REC-FW-DC-14: Recreation settings provide a range of opportunities as described by the recreation opportunity spectrum. The desired distribution of recreation opportunity spectrum settings are shown in Table 108 and displayed on maps in volume 3.

Table 108 shows the recreation opportunity spectrum classes for the existing forest plan (alternative A) and for alternatives B, C, and D, which present variations of the desired recreation opportunity spectrum. Maps of the recreation opportunity spectrum classes for the Sierra National Forest can be found in volume 3.

Table 108. Existing (alternative A) and desired (alternatives B, C, and D) recreation opportunity spectrum classes in acres and percent of national forest by alternative, Sierra National Forest

Class	Alternative A	Alternative B	Alternative C	Alternative D
Primitive	587,287 45%	567,482 43%	773,519 59%	567,482 43%
Semi-primitive nonmotorized	36,077 3%	44,760 3%	9,531 1%	44,760 3%
Semi-primitive motorized	44,724 3%	57,999 4%	17,493 1%	57,999 4%
Roaded Natural	564,980 43%	524,049 40%	402,744 31%	524,049 40%
Rural	82,894 6%	121,671 9%	112,673 9%	121,671 9%
Urban	0	0	0	0

Consequences Specific to Alternative A

In the current plan, the largest recreation opportunity spectrum class on the Sierra National Forest is primitive at 45 percent followed by roaded natural (43 percent), and then by rural (6 percent). When the two nonmotorized settings are combined (primitive and semi-primitive nonmotorized), this alternative provides 48 percent of the national forest in a nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural) this alternatives provides a motorized setting on 52 percent of the national forest. The amount of nonmotorized setting in this alternative is higher than alternatives B and D and less than

alternative C. Conversely, the amount of motorized setting in this alternative is higher than alternative C and lower than alternatives B and D.

Consequences Specific to Alternative B
In alternative B, the largest recreation opportunity spectrum class on the Sierra National Forest would be primitive at 43 percent followed by roaded natural (40 percent), and then by rural (9 percent). When the two nonmotorized settings are combined, this alternative would have 46 percent of the national forest in a nonmotorized setting. Combining the motorized settings, this alternatives would provide a motorized setting on 53 percent of the national forest. The amount of nonmotorized setting in this alternative would be the same as alternative D, and less than alternatives A and C. Conversely, the amount of motorized setting in this alternative is the same as alternative D, and higher than alternatives A and C.

Consequences Specific to Alternative C
In alternative C, the largest recreation opportunity spectrum class on the Sierra National Forest would be primitive at 59 percent followed by roaded natural (31 percent), and then by rural (9 percent). When the two nonmotorized settings are combined, this alternative would result in 60 percent of the national forest in a nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural) this alternatives provides a motorized setting on 41 percent. The nonmotorized setting in this alternative is the highest of all alternatives. Conversely, the motorized setting in this alternative is the lowest of all alternatives.

The change in settings is due largely to the increase in recommended wilderness acreage and a larger corridor for the Pacific Crest Trail with this alternative; the nonmotorized setting increased from 48 percent to 60 percent which offers more opportunity in settings that provide quiet solitude and reduce probabilities of seeing other people in remote and predominately unmodified landscapes. Conversely, motorized settings are decreased from 52 percent to 41 percent of the forest which provide less opportunity in settings in more developed and roaded areas of the forest that allow motorized activities.

Consequences Specific to Alternative D
The largest recreation opportunity spectrum class is primitive at 43 percent of the forest followed by roaded natural at 40 percent, and then by rural (9 percent). When the two nonmotorized settings are combined (primitive and semi-primitive nonmotorized), this alternative has 46 percent in nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural) this alternatives provides a motorized setting on 53 percent. The nonmotorized setting in this alternative is the same as alternative B and less than alternatives A and C. Conversely, the motorized setting in this alternative is the same as alternative B, and higher than alternatives A and C.

Partnerships
The following plan components provide an emphasis on partnerships and volunteers and are common to alternatives B, C, D:

- VIPS-FW-DC-01: The Sierra National Forest has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.
- VIPS-FW-DC-02: The Sierra National Forest uses partnerships to build local capacity for providing information and content using the best available methods, including advances in technology.

- VIPS-FW-GOAL-03: Maintain and expand contracting and partnering opportunities with local governments, businesses, and organizations. Develop partnerships that leverage different sources of funding to support opportunities to contribute to the economic and social sustainability of local communities.
- VIPS-FW-GOAL-04: Work with partners and volunteers to provide recreation opportunities, maintain and enhance recreation settings, collect and manage data on recreation use and demand, and contribute to socioeconomic benefits associated with recreation and tourism.

Consequences Specific to Alternative A
Under the current forest plan, partnerships, volunteerism, grants, and agreements help maintain trails and recreation sites on the Sierra National Forest. Most developed campgrounds and fee day-use sites are managed under a concessionaire contract. Many sites and facilities not under concessionaire management have partnership agreements with local non-profit organizations and user-groups. These partnerships, volunteers, and agreements assist with maintenance on motorized and nonmotorized trails, wilderness patrols, and facilities operation and maintenance. Non-profit organizations help remove graffiti and trash, and provide visitor information and interpretive programs along river corridors, popular dispersed recreation sites, and developed recreation sites. Some of these partnerships are often made possible with funding (such as green sticker funds, resource advisory council grants, the Federal Lands Recreation Enhancement Act, stewardship council, and other sources) that supplements appropriated dollars.

Consequences Specific to Alternative B
There would not be any new recommended wilderness areas in this alternative. The pace and scale of ecologic restoration may increase or decrease partnerships and volunteerism short-term depending on location and type of treatment. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Consequences Specific to Alternative C
There would be 12 new recommended wildernesses areas in this alternative. The wilderness polygons do not include any existing motorized uses and roadways. However, mechanized transport such as bicycle use would not be suitable on 119 miles of mechanized trails that currently allow bicycles, which could affect existing and future partnerships and volunteerism by groups focused on mechanized use. Some bicycle use partnerships and volunteerism could shift to other locations on the national forest. There is a potential for types and locations of partnerships and volunteerism to change due to the addition of recommended wilderness. There is an opportunity for partnerships and volunteerism focused on wilderness stewardship and trails in the new recommended wilderness areas to occur. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Consequences Specific to Alternative D
There would not be any new recommended wilderness areas in this alternative. The pace and scale of ecologic restoration may have a greater increase or decrease on partnerships and volunteerism in the short term depending on location and type of treatment than found in alternative B. Partnerships, volunteerism, grants and agreements that help maintain or improve developed reaction facilities could increase.

Access

Consequences Specific to Alternative A
There is no recommended wilderness in this alternative; therefore, there would be no change in miles of system trails that allow bicycle use.

Consequences Specific to Alternative B
Because there would not be any recommended wilderness areas in this alternative, there would be no change in miles of system trails that allow bicycle use. The recreation opportunity spectrum motorized settings would slightly increase to 53 percent of the forest.

Consequences Specific to Alternative C
There are 12 recommended wilderness areas in this alternative that contain 119 miles of system trails that allow for bicycle use. The plan component MA-WILD-SUIT-04 makes mechanized transport unsuitable in recommended wilderness areas, therefore bicycle use would be decreased by 119 miles on system trails, which is a 26 percent reduction in nonmotorized trails open to bicycles compared to alternatives A, B, and D. A site-specific decision to close trails within recommended wilderness areas would need to be completed before an enforceable closure could be made to prohibit bicycle use. Hence, system roads, trails and areas that allow for motorized and mechanized use would remain open until a project-level decision was completed. If site-specific decisions were made, bicycle use on system trails could decrease by 119 miles within recommended wilderness areas and mechanized transport would be allowed on 335 miles of nonmotorized system trails across the entire Sierra National Forest.

Consequences Specific to Alternative D
Because there would not be any recommended wilderness in this alternative, there would be no change in miles of system trails that allow bicycle use. The recreation opportunity spectrum motorized settings would slightly increase to 53 percent of the forest.

Scenery Resources on the Sierra National Forest

Alternatives B, C, and D add the following specific plan components relevant to scenery:

- SCEN-FW-DC-01: The forest provides a variety of ecologically sound, resilient and visually appealing forest landscapes that sustain scenic character, supporting the forest recreation program niche in ways that contribute to visitors' sense of place and connection with nature.
- SCEN-FW-DC-02: Scenic character is maintained and/or adapted to changing conditions to support ecological, social and economic sustainability on the national forest and in surrounding communities.
- SCEN-FW-DC-04: The Forest's scenery provides a range of scenic quality as described by the scenic integrity objectives. The desired distribution of scenic integrity objectives is displayed in figure 20, appendix A.
- SCEN-FW-OBJ 01: Within 10 years of plan improve scenic stability by treating 2,000 acres of vegetation in areas with a high likelihood of large, high-intensity wildfire, that greatly depart from vegetation desired conditions, and that conform most closely to the forest recreation program niche.
- REC-FW-DC-12: Developed recreation facilities sites are situated in areas resilient to large, high-intensity wildfires.

All alternatives would help move vegetation conditions toward the natural range of variation but the amount and scheduling of restoration to move toward the natural range of variation would vary between alternatives. Mechanical treatments for restoration may have short-term impacts to scenic integrity compared to hand treatments or prescribed fire, but over the long term, scenic character would benefit through increased scenic stability. There would be short-term scenic integrity losses with fire, but long-term potential increases in scenic integrity, especially with the reestablishment of the role of fire on the landscape.

Scenic Stability

Embedded within the restoration treatment discussed for each alternative is SCEN-FW-OBJ-01, which focuses some fuel treatment restoration activities on recreation sites that are in areas with a high risk of large, high-intensity wildfire. This plan component helps focus restoration treatment at high risk recreation sites to become more resilient to large, high-intensity fires, thus increasing scenic stability.

Consequences Specific to Alternative A

Under the existing plan, this alternative would increase scenic stability across the Sierra National Forest, which in turn would improve scenic character less than alternatives B and D, but more than the lower range of alternative C. Mechanical treatment achieves the natural range of variation quicker and with more precision. This alternative would have less mechanical treatment than alternatives B and D but more than C. This alternative would help trend vegetation toward achieving the natural range of variation but at a slower rate than alternatives B and D thus, providing the third highest protection for scenic character.

Consequences Specific to Alternative B

This alternative would increase scenic stability across the landscape which, in turn would improve scenic character more than alternatives A and C, and less than alternative D. This alternative would have about the same amount to twice as much mechanical treatment than alternative A, and two to seven times as much mechanical treatment as alternative C. This alternative would allow substantially more area of wildfire managed to meet resource objectives, which would increase scenic stability by lessening the consequences of large high-intensity wildfire. This alternative would help trend vegetation toward achieving the natural range of variation about five times the rate of alternative A, but at about half the rate of alternative D, thus providing the second highest protection for scenic character.

Consequences Specific to Alternative C

This alternative would increase scenic stability across the landscape which, in turn would improve scenic character less than alternatives B and D, but similar to alternative A. Although this alternative would have about 3 times as many acres for managing wildfires to meet resource objectives as compared to alternative A, it treats about one-third to one-half as many areas with mechanical treatments and up to twice as much areas with prescribed fire than alternative A. Mechanical treatment achieves the natural range of variation quicker and with more precision, reducing the short-term visual impacts to scenery that would be needed with multiple treatments with fire to achieve the same level of fuel reduction. This alternative would have the least amount of mechanical treatment of all the alternatives. Although it still would help trend vegetation toward achieving the natural range of variation, it would have the slowest rate of achieving the natural range of variation, thus providing the lowest protection for scenic character.

Consequences Specific to Alternative D

This alternative would increase scenic stability across the landscape across the largest area and faster, which in turn would improve scenic character more than alternatives A, B and C. This alternative would have the most amount of mechanical treatment of all the alternatives, which would increase the rate of achieving the natural range of variation more quickly and with more precision. Alternative D would increase the amount of area restored with mechanical treatments about three times more than alternative A and about twice as much area as alternative B. However the greatest increase in area restored is from increasing the amount of prescribed burning about two to three times and a substantial increase in the area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about 10 times more than alternatives A and C and about twice as much as alternative B, thus providing the highest protection for scenic character.

Scenic Integrity Objectives

Table 109 shows the acres and percent of the Sierra National Forest for each scenic integrity objective by alternative. The visual quality objectives for alternative A were converted to scenic integrity objectives as shown in the cross-walk in Table 100. Alternative C would have the highest percentage of very high scenic integrity objective compared to all alternatives, mainly due to the higher acreage of recommended wilderness and increase in the Pacific Crest Trail width in this alternative. Alternatives B and D would have the same scenic integrity objectives. Alternative A has the highest amount of low scenic integrity objective of all alternatives, primarily to the difference in approaches to mapping the older visual quality objectives.

Table 109. Desired scenic integrity objectives by acres and percent of forest and alternative, Sierra National Forest

Scenic Integrity Objective	Alternative A	Alternative B	Alternative C	Alternative D
Very high	579,066 41%	552,902 43%	760,325 59%	552,902 43%
High	106,791 7%	539,741 42%	366,371 28%	539,741 42%
Moderate	264,255 19%	193,845 15%	159,809 12%	193,845 15%
Low	397,091 28%	5,223 <1%	5,195 <1%	5,223 <1%
Very Low*	70,905 5%	0	0	0

* Although the maximum modification objective was used in the visual management system, the current scenery management system tends to not have objectives for very low scenic integrity. Thus, the maximum modification/very low objective will not be compared to alternatives B, C, and D.

Cumulative Effects for Sierra National Forest

Areas modified by vegetation treatments, powerlines and other infrastructure will continue to appear highly managed over the next 10 to 15 years and scenic integrity will remain moderate to very low in those areas. Vegetation treatments, utilities and infrastructure development on adjacent private, state and federal lands may influence overall scenic integrity. Restoration treatments across the landscape will trends toward the natural range of variation and protection of the scenic character. Driving for pleasure and other scenery dependent activities on the Sierra National Forest could be affected slightly by human disturbance to areas under other

administrations. Wildfire and other disturbance processes, if large in scale and intensity, may result in lowered scenic character in those areas affected by the disturbance.

Analytical Conclusions

Analytical Conclusions for the Inyo National Forest

Table 110 provides a relative comparison of how the alternatives respond to several indicators for the Inyo National Forest.

Table 110. Comparison of indicators by alternatives for the Inyo National Forest

Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Comparison of amount of nonmotorized recreation opportunity spectrum setting	Lowest amount	Moderate amount	Highest amount	Moderate amount
Comparison of motorized recreation opportunity spectrum setting	Second highest amount	Highest amount along with alternative D	Lowest amount	Highest amount along with alternative B
Change in partnerships and volunteerism opportunities due to additional recommended wilderness	No change	No change in motorized partnerships; Increase in partnerships relating to wilderness stewardship on Inyo National Forest	Decrease in mountain bike and motorized partnerships; Increase in partnerships relating to wilderness stewardship	No change
Change in partnerships due to increase in stewardship funding for recreation, based on pace and scale of restoration	Third highest increase	Second highest increase	Lowest increase	Highest increase
Change in miles of mechanized transport (bicycle use)	No change	No change	Decrease of 43 miles	No change
Protection of scenic character based on pace and scale of restoration	Third highest	Second highest	Lowest	Highest

Comparison of recreation opportunity spectrum for the nonmotorized setting. Alternative A has the lowest amount of nonmotorized setting and the lowest amount of motorized setting but this is partly due to the recreation opportunity spectrum not being formally assigned to acquired lands. Alternatives B and D would have the highest amounts of motorized setting with alternative D having slightly more due to not having any recommended wilderness areas. Alternative C would have the highest amount of nonmotorized setting and the lowest amount of motorized setting due to the recommended wilderness areas.

Change in partnerships due to recommended wilderness. Alternative A would have no change in partnerships or volunteerism. Existing partnerships would likely continue and new partnerships would be considered as staffing and resources allow. In alternative B, there would be no change in motorized partnerships or volunteerism. There could be an increase in partnerships and volunteerism relating to wilderness stewardship and trails, and there could be increased partnerships and volunteerism due to the pace and scale of ecological restoration that could help address recreation impacts and improve recreation settings, access, or scenery. Alternative C has the potential to change mechanized partnerships and volunteerism by reducing some opportunity and focusing on improving other opportunities. With the increase in recommended wilderness areas, there could be a potential increase in partnerships and volunteerism relating to wilderness stewardship and trails. Alternative D would have no change for motorized partnerships and existing partnerships would likely continue. Since there is a substantial increase in the pace and scale of ecological restoration, there could be a potential increase in partnerships and volunteerism to better provide for sustainable recreation.

Change in protection of scenic character based on pace and scale of restoration. Alternative D would have the highest protection of scenic character because the pace and scale of mechanical treatment is the highest of all alternatives, which would increase the rate of achieving the natural range of variation, thus providing the highest protection for scenic character. Alternative D would increase the amount of area restored with mechanical treatments about three times more than alternative A and about twice as much area as alternative B. However, the greatest increase in area restored would be from increasing the amount of prescribed burning about two to three times and increasing the area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about 10 times more than alternatives A and C and about twice as much as alternative B. Alternative C would have the lowest amount of protection of scenic character as it would have the lowest amount of mechanical treatment.

Analytical Conclusions for the Sequoia National Forest

Table 111 provides a relative comparison of how the alternatives respond to several indicators for the Sequoia National Forest.

Table 111. Comparison of indicators by alternatives for the Sequoia National Forest

Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Comparison of amount of nonmotorized recreation opportunity spectrum setting	Lowest amount	Moderate amount	Highest amount	Moderate amount
Comparison of motorized recreation opportunity spectrum setting	Second highest amount	This alternative and alternative D have the highest amounts	Lowest amount	This alternative and alternative B have the highest amounts
Change in partnerships and volunteerism opportunities due to additional recommended wilderness	No change	No change in motorized partnerships; Increase in partnerships relating to wilderness stewardship	Decrease in mountain bike partnerships; Increase in partnerships relating to wilderness stewardship	No change
Change in partnerships due to increase in stewardship funding for recreation, based on pace and scale of restoration	Third highest increase	Second highest increase	Lowest increase	Highest increase
Change in miles of mechanized transport (bicycle use)	No change	No change	Decrease of 125 miles	No change
Protection of scenic character based on pace and scale of restoration	Third highest	Second highest	Lowest	Highest

Comparison of recreation opportunity spectrum nonmotorized setting. Alternative A has the lowest amount of nonmotorized setting and the lowest amount of motorized setting but this is partly due to recreation opportunity spectrum not being formally assigned to acquired lands. Alternatives B and D would have the highest amounts of motorized setting with alternative D having slightly more due to not having any recommended wilderness areas. Alternative C would have the highest amount of nonmotorized setting and the lowest amount of motorized setting due to the recommended wilderness areas.

Change in partnerships due to recommended wilderness. Alternative A would have no change in partnerships or volunteerism. Existing partnerships would likely continue and new partnerships would be considered as staffing and resources allow. In alternative B, there would be no change in motorized partnerships or volunteerism; potential increase in partnerships and volunteerism relating to wilderness stewardship and trails but there would be the potential for increased partnerships and volunteerism due to pace and scale of ecological restoration that could help to address recreation impacts and improve recreation settings, access, or scenery. Alternative C has the potential to change mechanized partnerships and volunteerism by reducing some opportunity and focusing on improving other opportunities. With the increase in recommended wilderness

areas, there could be a potential increase in partnerships and volunteerism relating to wilderness stewardship and trails. Alternative D would have no change for motorized partnerships and existing partnerships would likely continue. Since there is a substantial increase in the pace and scale of ecological restoration, there could be a potential increase in partnerships and volunteerism to better provide for sustainable recreation.

Change in protection of scenic character based on pace and scale of restoration. Alternative D would have the highest protection of scenic character because the pace and scale of mechanical treatment is the highest of all alternatives. Mechanical treatment would increase the rate of achieving the natural range of variation, thus providing the highest protection for scenic character. Alternative D would increase the amount of area restored with mechanical treatments about two to three times more than alternative A and about twice as much area as alternative B. However, the greatest increase in area restored would be from increasing the amount of prescribed burning about two times and a substantial increase in the area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about four times more than alternatives A and C and about one and a half times as much as alternative B.

Analytical Conclusions for Sierra National Forest

Table 112 provides a relative comparison of how the alternatives respond to several indicators for the Sierra National Forest.

Table 112. Comparison of indicators by alternatives for the Sierra National Forest

Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Comparison of amount of nonmotorized recreation opportunity spectrum setting	Lowest amount	Moderate amount	Highest amount	Moderate amount
Comparison of motorized recreation opportunity spectrum setting	Second highest amount	This alternative and alternative D have the highest amounts	Lowest amount	This alternative and alternative B have the highest amounts
Change in partnerships and volunteerism opportunities due to additional recommended wilderness	No change	No change in motorized partnerships; Increase in partnerships relating to wilderness stewardship	Decrease in mountain bike and motorized partnerships; Increase in partnerships relating to wilderness stewardship	No change
Change in partnerships due to increase in stewardship funding for recreation, based on pace and scale of restoration	Third highest increase	Second highest increase	Lowest increase	Highest increase
Change in miles of mechanized transport (bicycle use)	No change	No change	Decrease of 119 miles	No change
Protection of scenic character based on pace and scale of restoration	Third highest	Second highest	Lowest	Highest

Comparison of recreation opportunity spectrum nonmotorized setting. Alternative A has the lowest amount of nonmotorized setting and the lowest amount of motorized setting. Alternatives B and D would have the highest amounts of motorized setting with alternative D having slightly more due to not having any recommended wilderness areas. Alternative C would have the highest amount of nonmotorized setting and the lowest amount of motorized setting due to the recommended wilderness areas.

Change in partnerships due to recommended wilderness. Alternative A would have no change in partnerships or volunteerism. Existing partnerships would likely continue and new partnerships would be considered as staffing and resources allow. In alternative B, there would be no change in motorized partnerships or volunteerism; potential increase in partnerships and volunteerism relating to wilderness stewardship and trails but there would be the potential for increased partnerships and volunteerism due to pace and scale of ecological restoration that could help to address recreation impacts and improve recreation settings, access, or scenery. Alternative C has the potential to change mechanized partnerships and volunteerism by reducing some opportunity and focusing on improving other opportunities. With the increase in recommended wilderness areas, there could be a potential increase in partnerships and volunteerism relating to wilderness stewardship and trails. Alternative D would have no change for motorized partnerships and existing partnerships would likely continue. Since there is a substantial increase in the pace and scale of ecological restoration, there could be a potential increase in partnerships and volunteerism to better provide for sustainable recreation.

Change in protection of scenic character based on pace and scale of restoration. Alternative D would have the highest protection of scenic character because the pace and scale of mechanical treatment is the highest of all alternatives. Mechanical treatment would increase the rate of achieving the natural range of variation, thus providing the highest protection for scenic character. Alternative D would increase the amount of area restored with mechanical treatments about three times more than alternative A and about twice as much area as alternative B. However, the greatest increase in area restored would be from increasing the amount of prescribed burning about two to three times and a substantial increase in the area where wildfire is managed to meet resource objectives. With all restoration combined, the area restored would be about 10 times more than alternatives A and C and about twice as much as alternative B.

Heritage Resources

Background

This section summarizes the current heritage resources environment on the Inyo, Sequoia, and Sierra National Forests and the potential consequences to heritage resources from the draft forest plans and their alternatives.

Heritage resources (also sometimes referred to as “cultural resources”) are an object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Heritage resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties. Heritage resources include the entire spectrum of resources for which the Forest Service is responsible, from artifacts to cultural landscapes without regard to eligibility for listing on the National Register of Historic Places. These resources represent past human activities or uses and, by their nature, are considered an irreplaceable and nonrenewable resource if not managed for preservation over the long term.

Because heritage resources represent important cultural values, they are of special concern to the public. Interest in our heritage and concern over the destruction of archaeological sites has prompted the passage of national, state, and local levels of legislation that are designed to promote and protect these examples of our nation's historical and traditional legacy. As a result, a variety of laws, regulations, and policies provide direction for managing and protecting heritage resources on National Forest System lands. This guidance is independent from forest plan direction and does not change across alternatives.

Every endeavor that results in ground disturbance or brings an increase of public or agency use has the potential to affect heritage resources. Activities that disturb the ground include such things as digging postholes for sign placement, timber harvest, constructing a new bathroom, enhancing a campground, laying fiber optic cable, large scale vegetation management, or fire prevention and suppression activities. In addition, projects may have indirect effects on areas of the landscape that are important for cultural and tribal values. The consequences to tribes and tribal resources are discussed separately in the "Tribal Relations and Uses" section.

Although the Forest Service Heritage program has operated under the premise of "flag and avoid" heritage resources during project implementation for years. A flag-and-avoid strategy works for protection of heritage resources on "small foot-print" types of projects because scheduling and heritage staff can be made available to accomplish compliance with section 106 of the National Historic Preservation Act. It is difficult and costly to implement for large landscape scale projects and has led to the conundrum the three national forests now face regarding heritage resources and project implementation. Sites that have been "flagged and avoided" usually have not been evaluated; thus until evaluated, they must be treated as if they are historic properties eligible for listing on the National Register of Historic Places. This presents a major management challenge given the number of sites already known and the increased numbers that will be discovered during surveys as larger landscape areas are being evaluated for restoration projects. Having to manage resources that may not be eligible for listing on the National Register of Historic Places, takes away valuable staff time which could be better spent on managing and monitoring those resources that are listed or eligible for listing, inventorying areas that have not been previously surveyed for heritage resources and providing recordation and evaluation for newly identified heritage assets.

Analysis and Methods

It is not possible to evaluate the impacts of the alternatives on specific heritage sites because a high percentage of known sites have not been evaluated and because the draft forest plans are programmatic in nature. Instead, the analysis is based on considering the amount of potential ground disturbance as a proxy for the potential for impacts to heritage resources.

Indicators and Measures

The amount of ground disturbance that might occur under each alternative is used as an indicator because of the potential for ground disturbance to adversely affect heritage resources. This is complicated by the fact that the total occurrences of cultural sites are unknown due to the lack of complete survey and inventory in the three national forests.

Affected Environment

Heritage resources on the three national forests represent a diversity of cultures and their uses of the landscapes, including native people, colonial California, late 19th and 20th century state history

(such as the Gold Rush) and American history, Civilian Conservation Corps history, and Forest Service history.

The area encompassed by the three draft forest plans has at least a span of 9,000 years of human occupation and use. People arrived in California more than 13,000 years ago (Johnson et al. 2002). The exact date of Native American arrival is unknown. Occupation of the lower southern Sierra Nevada foothills began prior to 9,000 years ago and would have been limited in many locations due to high-elevation glaciation. As the climate and resource availability changed so did the people as they adapted to changing environmental conditions and the distribution of plants and animals used for sustenance and shelter. Archaeological research within the three national forests is limited but a chronological sequence of cultural transitions in adjacent areas is applicable as described below from McGuire and Garfinkle (1980).

Paleoindian Period (9,000 to 6,000 years ago)

Most prehistoric sites on the national forests from this time period would have been associated with trans-Sierran travel and trade or seasonal big game hunting. Most prehistoric use of the land within the planning area during this period appears to have been pass-through travel or seasonal resource extraction. Generally, the forests were only used sporadically by nomadic groups during the Paleoindian period.

Lamont Phase or Little Lake Period (6,000 to 3,200 years ago)

This was a dry time with sites located on ridges, saddles, and along meadow margins. Visits to the planning area were sporadic and associated with plant collecting and big game hunting. During the warm dry time, it is postulated that the stands of pinyon pine shifted and expanded providing additional plant foods for foraging peoples. Obsidian and other stone tool materials are common to this period.

Canebrake Phase or Newberry Period (3,200 to 1,400 years ago)

This time period saw a tremendous increase in Native American use of the pinyon pine stands and other plant foods. Milling equipment increased in both quantity and variety. Obsidian quarrying in the eastern Sierras intensified. Stone tool point styles were more varied and diverse. The spear and atlatl were the primary hunting weapons, as they were during the Paleoindian period. While populations remained highly mobile, a pattern of returning use began to emerge with suggestions of a more permanent settlement pattern becoming established throughout the lower western Sierra foothills. The first signs of intensive occupation are found in ecological boundary areas rich in plant and animal resources, such as the Kern River Valley.

Sawtooth Phase or Haiwee Period (1,400 to 700 years ago)

During this time there was a tremendous increase in the number and diversity of archaeological sites over the entire landscape. The number of people living and traveling through the forests increased exponentially as the bow and arrow, a much superior weapon, replaced the spear as the hunting tool of choice. Large mammals such as mule deer, pronghorn and bighorn sheep were hunted, as were smaller mammals such as rabbits, hares and rodents. The development of the ubiquitous bedrock mortar and pestle, and milling and grinding slabs across the landscape indicate the importance of plant foods such as acorns, seeds, pine nuts, grasses and forbs. Wetlands and waterfowl were also important. Populations appeared less mobile, with favored food processing locations revisited again and again over many millennia, resulting in the development of deeply stratified archaeological sites. The appearance of Olivella beads at sites east of the Sierra suggest the beginning of trade networks stretching to the California coast, and

there is some discussion of a possible major of emigration of people into the Great Basin from southeastern California.

Chimney Phase or Marana Period (700 years ago; the historic period)

Subsistence strategies during this period were diverse and intensive, with resources from a large number of ecological zones used, including wetlands, desert sage communities, upland and montane environments, tablelands, and pinyon groves. Pottery use began and an increase in shell and steatite beads at sites in the eastern Sierra foothills suggest there were robust trade networks. Clearly defined house pits point to increased levels of permanent settlement.

At the time of European incursion, the foothills and river valleys on the west side of the Sierra Nevada range were some of the most densely populated areas in North America. Sites recorded today document large semi-permanent villages, house pits, formal cemeteries, pottery, soapstone bowls and decorative objects, rock art. Villages were being reused, populations were increasing in size, ceremonial areas developed, and long distance trade networks existed that imported trade goods from over long distances.

Historic Period (400 years ago; the present period)

The introduction of European diseases decimated more than 95 percent of the indigenous peoples and they were later displaced by miners, ranches, and other early pioneers. Mines, ranches, built towns, and engineered roads were built over many of the old traditional Native settlements. Tribal people adapted and changed and accepted paid employment in the mines and on the ranches as the landscape evolved with new settlers. Many traditional peoples were displaced as large segments of land were allocated to Government ownership and active stewardship by Government managers. Administrative Government facilities were built along the trails and adjacent to key mining and grazing areas. The rivers were dammed to provide hydroelectric power to the growing urban areas in California. Dams, flumes, tunnels, company towns, construction camps, railroads and all manner of facilities associated with hydroelectric power generation began to be built within the planning area in the early teens of the 20th century. Timber harvest increased, especially on the Sequoia and Sierra National Forests, in the early 1900s. The intensity and extent changed as new methods and machinery were developed, starting with logging by horses and mules. The development of steam equipment led to more road building and eventually to railroads to meet the demands of growing populations in towns and cities. Modern log trucks and heavy equipment allowed access to more areas and replaced railroads and created the foundation for the current road system on the Sequoia and Sierra National Forests. Recreational interest and use of the forests became important as motor vehicles developed and flourished. Campgrounds, recreation residences, resorts, and organizational camps expanded throughout the forests.

Cultural Resources Surveys

The prehistoric Native American past is embodied in the rock art and prehistoric archaeological sites that range in size from small stone tool scatters to large villages occupied for hundreds of years that dot the contemporary landscape. These sites are highly valued by local tribes as the very embodiment of their past and the places where their ancestors lived, worshiped, and died. It is a tangible link to a very long history but despite their persistence through time, sites are extremely vulnerable to damage by ground-disturbing activities and even from high-intensity fire. Prehistoric Native American sites are also vulnerable to illegal looting and illicit excavation.

Historic period sites are also extremely vulnerable to destruction by disturbing activities including wildfire; especially wooden cabins, flumes, lookouts and old mine buildings. Looting of historic artifacts at historic sites is as much of a problem as that on deeply buried Native American sites.

The presence of prehistoric and historic sites reflects the human use of the area encompassing the three national forests. Table 113 shows the approximate number of acres surveyed on the Inyo, Sequoia, and Sierra National Forests. The total extent of the heritage resource database for the three national forests has not been determined. However, from an evaluation of survey data, it is estimated that approximately 11 percent of the Inyo National Forest, 13 percent of the Sequoia National Forest, and 29 percent of the Sierra National Forest have been inventoried for heritage resources; equating to approximately 17 percent of the entire acreage comprising the three Sierran Forests (the Giant Sequoia National Monument is not included in these calculations). Most of these surveys have been project-specific rather than large-scale or systematic surveys. Almost 728,700 acres of land of the total 4.2 million acres comprising the area of the three national forests (excluding the Giant Sequoia National Monument) have been inventoried for heritage resources and 12,727 heritage resource sites have been recorded within that area.

Table 113. Heritage survey for Inyo, Sequoia, and Sierra National Forests

Heritage Survey Attributes	Inyo	Sequoia[1]	Sierra	Total
Total Acres	2.03 million	865,000	1.4 million	4.3 million
Approximate Acres Surveyed	216,400	112,300	400,000	728,700
Percent Surveyed	11%	13%	29%	17%

[1] Does not include Giant Sequoia National Monument.

Those heritage surveys have identified a total of 5,405 sites on the Inyo National Forest, 2,836 sites on the Sequoia National Forest, and 4,486 sites on the Sierra National Forest as shown in Table 114. Of those totals, 83 percent of the sites on the Inyo National Forest remain unevaluated; 94 percent of the sites on the Sequoia National Forest are unevaluated, and 92 percent of the sites on the Sierra National Forest are unevaluated for the National Register of Historic Places. This means that all unevaluated sites (88 percent of all of the known sites on the three national forests) are considered to be eligible properties for listing on the National Register of Historic Places and must be managed as such until an eligibility determination is submitted to the Office of Historic Preservation for the State Historic Preservation Officer's concurrence; or it must be submitted directly to the Keeper of the National Register for a determination.

Table 114. Number of heritage sites for Inyo, Sequoia, Sierra National Forests by type

Type of Site	Inyo	Sequoia	Sierra	Total
Prehistoric	2,386	1,581	3,401	7,368
Historic	762	518	799	2,079
Multi-Component	160	87	176	423
Unidentified	2,097	650	106	2,853
Contemporary	0	0	2	2
Protohistoric	0	0	2	2
Total Sites	5,405	2,836	4,486	12,727

Table 115 summarizes the numbers of site evaluations and designations on each national forest for sites that have undergone evaluation. Of those evaluated, 73 percent of the evaluated sites on the Inyo National Forest were found to be not eligible for listing on the National Register of Historic Places, 53 percent of the sites on the Sequoia National Forest were found not eligible, and 56 percent of the sites on the Sierra National Forest were not eligible. Given that only a small portion of the known heritage sites have been evaluated, the three national forests are currently managing potentially non-eligible heritage resources, all of which need to be considered as eligible during the planning process and avoided.

Table 115. Number of heritage site determinations and number of historic landmarks under the National Register of Historic Places (NRHP) for the Inyo, Sequoia, and Sierra National Forests

Heritage Site Determinations	Inyo	Sequoia[1]	Sierra	Total
NRHP Listed	0	1	1	2
National Historic Landmark	0	0	1	1
State Historic Landmark	0	1	0	1
NRHP Eligible	249	77	173	499
Not Eligible	688	87	221	996
Total Determinations	937	165	395	1,497
No Determination	4,468	2,671	4,091	11,230

[1] Does not include Giant Sequoia National Monument.

Environmental Consequences to Heritage Resources

Nearly every action undertaken by the Forest Service has the potential to affect heritage resources either directly or indirectly. Not all effects are necessarily adverse and some effects may be avoided either through project design or the implementation of standard protection measures as outlined in appendix E of the Programmatic Agreement with the California and Nevada State Historic Preservation Officers and the Advisory Council on Historic Preservation (USDA FS 2013).

Heritage resources are nonrenewable and any effect can result in the unacceptable destruction or damage to examples of the area's heritage. Heritage resources also need to be reviewed not only as individual resources, but holistically at larger landscape levels. What may appear to be individual sites, or dots on a map may very well be historic districts (for example, mining complexes, ranching complexes; or cultural landscapes) that include village sites with surrounding special use areas containing trails, plant gathering areas, lithic quarries, and other essential resources.

Consequences Common to all Alternatives

Regardless of the alternatives, all site-specific projects would consider effects to heritage resources at the outset of every project planning process. Compliance with section 106[33] of the National Historic Preservation Act of 1966 as amended would be completed prior to making a decision to implement a project, approve a permit, or undertake an activity. The section 106 process may be completed by consultation with the State Historic Preservation Officer, tribes, the

[33] Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.

public, and other stakeholders, and at times with the Advisory Council on Historic Preservation using the regulatory process codified at 36 CFR Part 800 as amended or through implementation of the stipulations of the Region 5 Programmatic Agreement (USDA FS and CA SHPO 2013).

All alternatives include direction to reduce fuels and restore fire to the landscape, but using different approaches and with a different pace and scale of restoration. The extent that each alternative reduces the extent and severity of wildfires would reduce the risk of inadvertent impacts to heritage sites from fire suppression activities and from damage from high soil heating.

Consequences Common to Alternatives B, C, and D

The emphasis on variable treatment intensities and on restoring and managing for vegetation heterogeneity in alternatives B, C, and D should provide opportunities to design projects around small sites to minimize or avoid disturbances to heritage resources. Avoidance would follow the standard practice of using the "flag and avoid" strategy, but would also encourage designing projects to reduce threats to heritage resources from large high-intensity wildfires by allowing low-intensity treatments around small sites to promote an increase in resilience and sustainability of forests. A plan objective (CULT-FW-OBJ-01) focuses on increasing the number of sites managed and monitored that are listed or eligible for listing, increasing the areas inventoried that have not been previously surveyed for heritage resources and increasing recordation and evaluation for newly identified heritage assets.

Management activities (such as mechanical thinning, prescribed burning, and managing wildfires to meet resource objectives), appropriately implemented so as to avoid direct and indirect effects to heritage resources and tribal values, may afford greater protection compared to consequences from continued forest growth and density increases that lead to larger and higher intensity wildfires. Activities associated with wildfire suppression under emergency conditions often have adverse impacts to heritage resources, such as running a dozer line through sites and areas sensitive to tribes.

Alternatives B, C, and D encourage managing wildfires to meet resource objectives, especially in the wildfire maintenance zone. Some wildfires are also managed to meet resource objectives in alternative A in wilderness and remote areas. Decisions to manage wildfires and on-the-ground activities while managing wildfires would consider the location of known sites and where possible, resource advisors would be consulted to develop strategies to minimize or to mitigate impacts. The desired outcome is to restore fire to the landscape similar to conditions that have occurred historically such that the impacts to sites would not be substantially different than they have been exposed to for centuries. There is some additional opportunity in alternatives B and D which are discussed separately for those alternatives.

Consequences Specific to Alternative A

Alternative A represents the existing plans (as amended) and would have no measurable direct effects on any known heritage resources from continuing activities currently allowed under the existing plan. This is because planned projects involving ground-disturbing activity would either avoid direct and indirect effects to heritage resources or would include project-specific mitigation measures to address any adverse effects to specific heritage resources by reducing them to acceptable levels or following existing processes when effects cannot be adequately mitigated.

During wildfires, there are risks to sites and resources from fires that burn at high intensity with heat pulses into the soil that can damage individual resources and threaten sites where high-intensity fires result in surface erosion and the movement of soils and the rearrangement of sites.

In some cases, high-intensity fire can ruin the ability to date some artifacts, especially obsidian, by changing the hydration bands. Fire can also burn wood or natural fiber artifacts.

Consequences Specific to Alternative B

Alternative B emphasizes ecological fire resilience and restoration of fire as an ecosystem process with a greater focus on large-scale landscape level projects. There would be more mechanical thinning treatments and more prescribed burning than alternative A. As only 11 percent of the Inyo National Forest, 13 percent of the Sequoia National Forest and 29 percent of the Sierra National Forest have been inventoried for heritage resources, a large-scale on the ground effort would be needed to identify heritage resources in previously unsurveyed areas. Known sites that are unevaluated are managed as if they were eligible for listing on the National Register of Historic Places resulting in the need to include additional mitigation measures when designing projects. Vegetation treatment measures that emphasize low-intensity fire, and increased use of hand treatment in and around known sites would lower the potential for adverse impacts to heritage resources. Prescribed burning can be compatible with heritage sites and heritage resources if the fire can burn at low intensity or with mitigations to protect them such as constructing fire lines to exclude fire or covering or protecting features to reduce the risk of ignition.

Alternative B has additional areas recommended as wilderness on the Inyo National Forest, which could reduce the risk of direct human impacts to more known and unknown sites. Sites located within designated wilderness and areas recommended as wilderness would benefit from the restrictions on motorized use and restrictions on mechanical vegetation treatments but may be negatively impacted by continuing fuel accumulations and the risks associated with fires that burn at high intensity.

Alternative B emphasizes restoring fire to the landscape, which would include a consideration of heritage resources in determining where and how it can be used to meet resource objectives. This would benefit heritage resources by reducing fuels while reducing impacts by managing the intensity of fire. Projects would be designed to avoid and minimize impacts and effects to heritage sites and to indirectly improve the resilience of sites by reducing threats from fire and other uses. Treatment of focus landscapes and treatments along strategic roads and ridgetops, especially in the wildfire restoration zone are expected to increase the potential to manage wildfires in this zone over time, further reducing the risk of high-intensity fire impacts to heritage sites.

Consequences Specific to Alternative C

Alternative C places an emphasis on providing more short-term protections for wildlife habitat. This alternative proposes to add the most areas recommended for wilderness designation of all the alternatives. Additionally, this alternative has more areas with restrictions or limitations on the intensity and extent of treatment using mechanical vegetation management methods, which would afford greater short-term protection by resulting in less impacts to known and unknown heritage resources. Conversely, those restrictions and protection measures could have more indirect effects by leaving more areas with levels of surface fuels outside the natural range of variation which could damage sensitive sites and resources if they burn at high intensity in wildfires. Alternative C emphasizes more use of prescribed burning in lieu of mechanical treatments where possible. As described for alternative B, prescribed burning can be compatible with heritage sites and heritage resources, but careful planning is needed, especially where fuels are heavy and there is no mechanical pre-treatment to reduce them prior to burning. Some work by hand or to remove

small-diameter trees and other vegetation may occur, but the extent would be limited by funding. Most prescribed burning would need to be designed in existing heavy fuel conditions which may mean some burns would become backlogged if suitable conditions for a favorable burn outcome do not occur as frequently due to climate change with drier spring conditions and longer fire seasons into the fall.

Consequences Specific to Alternative D

Alternative D has the greatest increase in the pace and scale of ecological restoration that could involve ground-disturbing activities. Given the increase in development, such as the increase in recreation opportunities and the increase in the scale of treatments, the need for project-level survey and design mitigations would be the greatest in this alternative compared to the other alternatives. There is some uncertainty in how project planning may need to change to ensure surveys do not become obstacles to achieving the increased amount of restoration in this alternative.

Alternative D would have similar effects and benefits as described for alternative B. The increase in area of mechanical treatments with greater fuel reductions would require more coordination and consultation to design projects to avoid and minimize impacts and effects, but would result in a greater reduction in the potential for large high-intensity fires. Alternative D would have the most ability, primarily through increased stewardship funding opportunities, to do additional preparatory work, including evaluation of sites, to mitigate impacts and to avoid and minimize the potential for impacts to heritage sites and heritage resources during mechanical treatments and prescribed burning.

Cumulative Effects

Direct and indirect effects are considered to be adverse when the project or action may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register of Historic Places in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects to a historic property may also include reasonably foreseeable effects caused by the project or action that may occur later in time, be farther removed in distance or be cumulative. Examples of adverse effects are effects that change the character of the property's use or of physical features within the property's setting that contribute to its historic significance; removal of the property from its historic location; or, the introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features. Because all Federal agencies must comply with section 106 of the National Historic Preservation Act, similar management approaches are used on lands managed by the National Park Service and Bureau of Land Management.

Cumulative effects are difficult to evaluate because of the large proportion of known sites that have not been evaluated. Each of the three national forests manages for "no effect" or "no adverse effect" to heritage resources for all planned management activities, which lessens the risk of cumulative effects by presuming known sites are eligible for inclusion in the National Register of Historic Places and protecting them. Some project activities may result in unplanned or inadvertent adverse impacts to heritage resources. Such unplanned or inadvertent adverse impacts are addressed and mitigated on a case-by-case basis through consultation with the State Historic Preservation Officer, tribal partners, other interested parties, the public, and at times the Advisory Council on Historic Preservation. Heritage resources are non-renewable resources and the destruction or damage to them cannot be reversed. The alternatives all have a restoration

component, but care must be taken to protect significant heritage resources, such as prehistoric and historic sites, traditional cultural properties, traditional gathering and use areas, sacred sites and landscapes, archaeological and historic districts.

Analytical Conclusions

At the project level, all of the alternatives have the potential to impact heritage resources given that less than 18 percent of the plan area has been systematically inventoried for heritage resources and that 88 percent of all known recorded sites remain unevaluated for the National Register of Historic Places. A "flag and avoid" strategy works for protection of heritage resources on "small foot-print" types of projects because scheduling and heritage staff can be made available to accomplish compliance with section 106 of the National Historic Preservation Act. It becomes more problematic with larger landscape scale projects encompassing thousands of acres because of the unknowns relating to heritage resources. Large-scale projects generally have to be phased in terms of section 106 compliance, or the use of predictive modeling could be employed to assist with informing on the "likely" location of heritage resources, with an outcome for an increase in unplanned or inadvertent effects to known or unknown heritage resources.

Alternative A would continue a slow rate of restoration that is suitable for continuing a "flag and avoid" strategy but leaves much of the forest and heritage resources at risk of damage from high-intensity fires. Alternative C would reduce the amount of restoration accomplished using mechanical methods which would reduce the potential for direct impacts to heritage resources. Alternative C would use more prescribed fire but less mechanical pre-treatment of fuels, which would require careful planning to avoid burning at high intensity where fuels are heavy. Alternatives B and D strive to balance the greater risks of impacts to heritage sites by increasing the amount of mechanical thinning treatments and the amount of prescribed burning that would restore vegetation conditions and lower the risk of large, high-intensity wildfires over time. This would benefit heritage resources that would be damaged by fires that burn at high intensity.

Wilderness

Background

The Forest Supervisors for the Inyo, Sequoia, and Sierra National Forests are required by the Planning Rule[34] to "identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System, and determine whether to recommend any such lands for wilderness designation." Any lands the Forest Supervisors recommend for wilderness designation through forest plan revision would be a preliminary administrative recommendation, and are referred to as "recommended wilderness" below.

The process to identify and evaluate lands on the three national forests that may be suitable for inclusion in the National Wilderness Preservation System is documented in appendix B: Wilderness Evaluation for the Inyo, Sequoia and Sierra National Forests (volume 2). Appendix B also documents the process used for identifying which evaluated areas to analyze in one or more alternatives in the draft environmental impact statement. Detailed information and maps for each area included as recommended wilderness in the analysis, and the rationale for areas or portions of areas that are not included in the analysis, can also be found in appendix B.

[34] 36 CFR 219.7 (v)

Alternatives A and D do not include any new recommended wilderness on any of the three national forests. Alternative B includes four new recommended wilderness areas totaling 37,029 acres on the Inyo National Forest and no new recommended wilderness on the Sequoia and Sierra National Forests. Alternative C includes new recommended wilderness on all three national forests: 24 areas totaling 315,531 acres on the Inyo National Forest, 18 areas totaling 206,904 acres on the Sequoia National Forest, and 17 areas totaling 220,641 acres on the Sierra National Forest.

Analysis and Methods

The analysis area for direct and indirect effects includes the existing designated wildernesses and the additional recommended wilderness on the Inyo, Sequoia, and Sierra National Forests in alternative B and alternative C. The analysis area excludes the designated wilderness in the Giant Sequoia National Monument on the Sequoia National Forest. The timeframe for the environmental consequences is dependent upon whether the preliminary administrative recommendations are addressed by the U.S. Congress. The timeframe for the environmental consequences related to any recommended wilderness would be the expected life of the forest plans, or 10 to 15 years, unless the recommended wilderness is designated by Congress, in which case the timeframe for environmental consequences would be the long term, or more than 20 years. The timeframe for the environmental consequences related to potential areas that are not recommended as wilderness in the record of decision is the expected life of the forest plans, or 10 to 15 years.

Wilderness Character

This analysis includes a qualitative discussion of the effects of proposed management direction on wilderness character of the recommended areas and the existing designated wilderness areas. The Wilderness Act, section 4(b) indicates each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area. The Forest Service has identified five “qualities” that are used to assess wilderness character from the statutory language of the Wilderness Act (Landres et al. 2011): natural quality; undeveloped quality; untrammeled quality; opportunities for solitude or primitive and unconfined recreation; and other features of value described as follows (see appendix B in volume 2 for the evaluation of the wilderness characteristics of each recommended area).

Natural Quality: This quality pertains to terrestrial, aquatic, and atmospheric resources, and ecological processes. The natural qualities of wilderness for this analysis are based on the concepts of naturalness discussed in Cole and Yung (2010), and the discussion on ecosystem connectivity and diversity contained in “Chapter 1: Terrestrial, Aquatic, and Riparian Ecosystems” of the Inyo, Sequoia, and Sierra National Forest Assessments, (USDA FS 2013a, 2013b, 2013c). The natural quality of wilderness is protected to the extent biological diversity and ecological resilience is sustained, ecosystem structure and function is maintained, and natural disturbance processes are sustained.

Undeveloped quality: This quality pertains to whether wilderness is essentially without permanent improvement or modern human occupation. This quality is influenced by what are commonly called the “section 4c prohibited uses;” that is, the presence of modern structures, installations, habitations, and use of motor vehicles, motorized equipment, or mechanical transport.

Untrammeled quality: This quality pertains to whether wilderness is essentially unhindered and free from the actions of modern human control or manipulation. This quality is influenced by any activity or action that controls or manipulates the components or processes of ecological systems inside the wilderness.

Opportunities for solitude or a primitive and unconfined type of recreation: This quality pertains to whether visitors can find opportunities for solitude in wilderness, or to engage in primitive-type or unconfined recreation activities.

Other Features of Value: A wilderness may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value" that occur only in specific locations and are unique to an individual wilderness. Features of value may be identified in the law that designates a wilderness or through the Congressional legislative history, and are not present in every wilderness.

Affected Environment

There are currently three groups of contiguous wilderness. The first group in the central and southern Sierra Nevada Mountains includes 11 wilderness areas with a combined size of approximately 2,475,000 acres. This group of wilderness areas is notable for being the second largest contiguous block of wilderness in the continental United States. The second group is in the Basin and Range Province. This group includes two contiguous wilderness areas and the Ancient Bristlecone Pine Forest, with a combined size of approximately 260,500 acres. The Ancient Bristlecone Pine Forest is included with the wilderness areas in this group because it is a congressionally designated area where all natural features are protected. The third group is also in the Basin and Range Province and includes one wilderness contiguous with a large portion of the Death Valley Wilderness.

Existing Designated Wilderness Areas

The following lists existing wilderness areas on the Inyo, Sequoia, and Sierra National Forests, their size, whether they are jointly administered by other agencies, and prominent areas that lie along their boundaries. Maps of each wilderness area are located in volume 3 in each national forest map section.

Ansel Adams Wilderness: The Ansel Adams Wilderness is 231,279 acres and is jointly administered by the Inyo National Forest (78,428 acres), the Sierra National Forest (152,104 acres), and Devil's Postpile National Monument (747 acres). It is contiguous with Yosemite National Park along its northern boundary, the John Muir Wilderness along its southern boundary, and the Owens River Headwaters Wilderness along its eastern boundary.

Dinkey Lakes Wilderness: The Dinkey Lakes Wilderness is 30,000 acres and is administered by the Sierra National Forest. It is contiguous with the John Muir Wilderness along its eastern boundary.

Domeland Wilderness: The Domeland Wilderness is 133,160 acres and is jointly administered by the Sequoia National Forest (93,781 acres) and the Bureau of Land Management (39,379 acres).

Golden Trout Wilderness: The Golden Trout Wilderness is 303,511 acres and is jointly administered by the Inyo National Forest (192,765 acres) and the Sequoia National Forest (110,746 acres). It is contiguous with the John Muir, Sequoia-Kings Canyon, and John Kreb

Wilderness Areas along its northern boundary, and the South Sierra Wilderness along its southern boundary.

Inyo Mountain Wilderness: The Inyo Mountain Wilderness is 198,874 acres and is jointly administered by the Inyo National Forest (73,799 acres) and the Bureau of Land Management (125,075 acres). It is contiguous with the Death Valley Wilderness along portions of its eastern boundary.

Jennie Lakes Wilderness: The Jennie Lakes Wilderness is 10,509 acres and is administered by the Sequoia National Forest. It is contiguous with the Sequoia-Kings Canyon Wilderness along its eastern and southern boundary.

John Muir Wilderness: The John Muir Wilderness is 651,992 acres and is jointly administered by the Inyo National Forest (299,235 acres) and the Sierra National Forest (352,757 acres). It is contiguous with the Ansel Adams Wilderness along its northern boundary, the Dinkey Lakes, and Sequoia-Kings Canyon Wildernesses along its western boundary, and the Golden Trout and Monarch Wildernesses along its southern boundary.

Monarch Wilderness: The Monarch Wilderness is 44,896 acres and is jointly administered by the Sequoia National Forest (24,152 acres) and the Sierra National Forest (20,744 acres). It is contiguous with the John Muir Wilderness along its northern boundary, and the Sequoia-Kings Canyon Wilderness along its eastern boundary.

Piper Mountain Wilderness: The Piper Mountain Wilderness is 72,192 acres and is administered by the Bureau of Land Management (BLM). None of the alternatives would directly or indirectly affect the BLM's administration of the Piper Mountain Wilderness.

Sacatar Trail Wilderness: The Sacatar Trail Wilderness is 50,451 acres and is administered by the Bureau of Land Management. None of the alternatives would directly or indirectly affect the BLM's administration of the Sacatar Trail Wilderness. It is not contiguous with other wilderness areas, but is only separated by a narrow road corridor from the Chimney Peak, Domeland and Owens Peak Wilderness Areas.

South Sierra Wilderness: The South Sierra Wilderness is 60,084 acres and is jointly administered by the Inyo National Forest (31,865 acres) and the Sequoia National Forest (28,219 acres). It is contiguous with the Golden Trout Wilderness along its northern boundary and is separated only by a narrow road corridor from the Domeland Wilderness.

White Mountains Wilderness: The White Mountains Wilderness is 230,958 acres in size, and is jointly administered by the Inyo National Forest (206,796 acres) and the Bureau of Land Management (24,162 acres). It is contiguous with the Boundary Peak Wilderness along its northeast boundary.

Environmental Consequences to Wilderness

Overview of Recommended Wilderness Proposed in Alternatives B and C

Alternative B

In alternative B, four areas totaling 37,029 acres are recommended as wilderness additions on the Inyo National Forest, all of which adjoin existing designated wilderness as shown in Table 116.

There are no areas recommended for wilderness for the Sequoia or Sierra National Forests in alternative B.

Table 116. Recommended wilderness additions adjacent to existing designated wilderness, Inyo National Forest

Recommended Wilderness Addition	Size (acres)
Piper Mountain Wilderness Addition	11,840
South Sierra Wilderness Addition	17,622
White Mountains Wilderness Addition – East	2,505
White Mountains Wilderness Addition – West	5,062

Alternative C

Alternative C would increase the range of elevations and increase the biodiversity of areas recommended for inclusion in the National Wilderness Preservation System along the west slope of the Sierra Nevada. The recommended additions to the Monarch Wilderness contain several ecosystem types of the foothill ecological zone that are not currently within Forest Service wilderness areas: Annual-Grass, Blue-Oak and Valley Oak Woodland. The recommended additions to the Ansel Adams Wilderness contain the Aspen ecosystem type, which supports very diverse understory plant and bird communities.

Inyo National Forest

In alternative C there are 24 areas totaling 315,531 acres of new recommended wilderness on the Inyo National Forest, of which 9 areas (70,278 acres) are adjacent to existing designated wilderness and 15 areas (245,253 acres) are not. Approximately 22.3 percent of the new recommended wilderness areas on the Inyo National Forest in alternative C is adjacent to existing designated wilderness as shown in Table 117.

Table 117. Recommended wilderness additions adjacent to existing designated wilderness, Inyo National Forest

Recommended Wilderness Addition	Size (acres)
Ansel Adams Wilderness Addition – Northeast	7,212
Golden Trout Wilderness Addition – East	5,954
Inyo Mountain Wilderness Addition	6,775
Piper Mountain Wilderness Additions (1)	10,657
Piper Mountain Wilderness Additions (2)	2,678
South Sierra Wilderness Additions – East (1)	25,249
South Sierra Wilderness Additions – East (2)	1,424
White Mountains Wilderness Additions – East	3,187
White Mountains Wilderness Additions – West	7,142

Approximately 77.7 percent of new recommended wilderness areas on the Inyo National Forest are not adjacent to existing designated wilderness as shown in Table 118.

Table 118. Recommended wilderness not adjacent to existing designated wilderness, Inyo National Forest

Recommended Wilderness	Size (acres)
Adobe Hills	10,297
Deadman Canyon	15,445
Deep Springs North	34,164
Dexter Canyon	8,674
Glass Mountains	34,591
Huntoon Creek	8,855
Marble Canyon	15,392
Marble Creek	13,886
Mazourka Peak	41,524
McBride Flat	10,461
Pizona-Truman Meadows	19,762
Redding Canyon	8,284
Silver Creek	8,076

Sequoia National Forest

In alternative C there are 18 areas totaling 206,904 acres of new recommended wilderness on the Sequoia National Forest, of which 11 areas (86,105 acres) are adjacent to existing designated wilderness and 7 areas (120,799 acres) are not. Approximately 41.6 percent of the new recommended wilderness areas on the Sequoia National Forest in alternative C is adjacent to existing designated wilderness as shown in Table 119.

Table 119. Recommended wilderness additions adjacent to existing designated wilderness, Sequoia National Forest

Recommended Wilderness Addition	Size (acres)
Domeland Wilderness Addition – South	14,666
Domeland Wilderness Addition – West	18,817
Domeland Wilderness Fish Creek Addition	3,932
Golden Trout Wilderness Addition – Southwest	27,973
Golden Trout Wilderness Additions (1)	3,488
Golden Trout Wilderness Additions (2)	967
Golden Trout Wilderness Additions (3)	492
Jennie Lakes Wilderness Addition	5,263
Monarch Wilderness Addition – South	5,472
South Sierra Wilderness Additions – West (1)	2,155
South Sierra Wilderness Additions – West (2)	2,880

Approximately 58.4 percent of new recommended wilderness areas on the Sequoia National Forest is not adjacent to existing designated wilderness as shown in Table 120.

Table 120. Recommended wilderness not adjacent to existing designated wilderness, Sequoia National Forest

Recommended Wilderness	Size (acres)
Cannell Peak	27,208
Dennison Peak	7,100
Hatchet Peak	6,060
Long Canyon	15,794
Saturday Peak	8,176
Slate Mountain	16,004
Stormy Canyon	40,457

Sierra National Forest

In alternative C there are 17 areas totaling 220,641 acres of new recommended wilderness on the Sierra National Forest, of which 12 areas (133,943 acres) are adjacent to existing designated wilderness and 5 areas (86,698 acres) are not. Approximately 60.7 percent of the new recommended wilderness areas on the Sierra National Forest in alternative C is adjacent to existing designated wilderness as shown in Table 121.

Table 121. Recommended wilderness additions adjacent to existing designated wilderness, Sierra National Forest

Recommended Wilderness Addition	Size (acres)
Ansel Adams Wilderness Addition	37,062
Ansel Adams Wilderness Granite Creek Additions (1)	6,964
Ansel Adams Wilderness Granite Creek Additions (2)	2,949
Ansel Adams Wilderness Mount Raymond Additions (1)	9,117
Ansel Adams Wilderness Mount Raymond Additions (2)	661
Dinkey Lakes Wilderness Additions (1)	8,317
Dinkey Lakes Wilderness Additions (2)	4,178
Dinkey Lakes Wilderness Additions (3)	16,318
John Muir Wilderness Additions – Southwest	3,359
John Muir Wilderness Additions – West (2)	1,206
John Muir Wilderness Additions – West (1)	1,299
Monarch Wilderness Addition – West*	42,513

*This recommended wilderness area includes land on both the Sierra and Sequoia National Forests and the acreage given here includes only the Sierra portion of the total acres.

Approximately 39.3 percent of new recommended wilderness areas on the Sierra National Forest are not adjacent to existing designated wilderness as shown in Table 122.

Table 122. Recommended wilderness not adjacent to existing designated wilderness, Sequoia National Forest

Recommended Wilderness	Size (acres)
Bear Mountain	9,247
Devil Gulch	37,325
Ferguson Ridge	7,800
Shuteye	14,418
Sycamore Springs	17,908

Consequences Common to All Alternatives

In all alternatives, the existing designated wilderness acres remain the same. Because direction for wilderness management is detailed in law, regulation, and agency policy, management would be the same for existing wilderness in all alternatives. There would be no effect to undeveloped or special features and other features of value in any alternative.

Significant effects to wilderness areas are not expected under any alternative nor are effects expected to differ by alternative.

Making the preliminary wilderness recommendation for a forest plan revision does not create a wilderness. Congress must pass legislation designating wilderness. The draft plan direction for recommended wilderness would protect the values that make the area suitable for wilderness designation. Management strategies for recommended wilderness may affect recreation opportunities and experiences within these areas.

Recommending areas adjacent to existing designated wilderness would have the potential effect of protecting wilderness resources. Alternative C would add the most to the size of the protected areas followed by alternative B. Alternative D would not recommend any additional wilderness and would potentially have the most effect by management of adjacent lands.

Consequences from Forest Plan Management Direction

Consequences Specific to Alternative A

Under alternative A, the existing forest plans would continue to guide management of existing wilderness areas on the Inyo National Forest (1988), the Sequoia National Forest (1988), and the Sierra National Forest (1992). Current plan direction for wilderness varies by national forest. General management direction exists but many designated wilderness areas have wilderness management plans that provide more specific management guidance.

The existing forest plan direction on the three national forests would continue to protect and maintain the five qualities of wilderness character in designated wilderness. The opportunity for solitude and primitive, unconfined recreation would be maintained and no new permanent developments or human occupancy would be authorized. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure and patterns of vegetation.

The Ansel Adams, John Muir, and Dinkey Lakes Wildernesses would continue to be managed for low density, low disturbance, and widely distributed visitor use. In popular destination areas, impacts associated with visitor use would continue to be concentrated by limiting visitor freedom to established overnight camping sites and areas. Group size limits, wilderness permits, and other restrictions on overnight occupancy would continue to be implemented to effectively manage visitor use levels and maintain or improve opportunities for solitude. Biophysical impacts associated with recreation would be reduced by prohibiting camping in areas that have experienced high levels of impact and are in need of restoration. There would be no new recommended wilderness areas on any of the national forests in this alternative.

Consequences Specific to Alternative B

Alternative B includes desired conditions and guidelines to enhance protection of certain aspects of wilderness character that are not addressed in existing wilderness plan direction. Specific direction is added for the use of herbicide or biocide to consider the risks and benefits of controlling non-native invasive species in wilderness (MA-WILD-GDL-01) and the requirement to maintain naturalness in wilderness areas. New plan direction also promotes passive restoration to natural conditions when campsites adversely affect water quality or exceed established density standards (MA-WILD-GDL-03).

In the Kaiser Wilderness, desired conditions would be established in three zones consistent with the management of the Ansel Adams, John Muir and Dinkey Lakes Wilderness Areas. Opportunities for solitude and primitive, unconfined recreation would be maintained as most areas in the Kaiser Wilderness would be managed for low density, low disturbance, and widely distributed visitor use. In popular destination areas, impacts associated with visitor use would continue to be concentrated by limiting visitor freedom to established sites.

Alternative B also identifies four areas on the Inyo National Forest as administrative recommendations for inclusion in the National Wilderness Preservation System (South Sierra Wilderness – East Addition; the White Mountains Wilderness Additions; and the Piper Mountain Wilderness Addition). The four areas are adjacent to existing designated wilderness area boundaries. These areas would be managed in the same manner as designated wilderness to maintain their wilderness characteristics, including their natural conditions, opportunities for solitude or primitive, unconfined recreation, scenic beauty, and identified special features (MA-WILD-DC-01 to 03, -06 to 07). This would result in continued and expanded wilderness recreation opportunities for hikers and equestrians and enhanced backcountry camping opportunities. The recreation opportunity spectrum map on the Inyo National Forest would reflect the recreation opportunities associated with the recommended wilderness areas (see maps in volume 3).

Connectivity would be enhanced between the large protected areas in Forest Service and National Park wilderness areas to the north and Bureau of Land Management wilderness areas to the south. Such connectivity is important to maintaining wildlife corridors and bird migration routes between the protected areas of the southern Sierra and relatively undeveloped areas to the east of the Sierra, as well as a major corridor along the Sierra Crest connecting the Tehachapi Mountains and the central Sierra Nevada (Wilderness Stewardship Plan and Final EIS for Sequoia and Kings Canyon National Parks, USDI NPS 2015). The increased connectivity would likely benefit species richness. The Wilderness Stewardship Plan also cited the combination of location, large size, and diversity of habitats as contributing to the great numbers of species in the parks. The Bio-Regional Assessment, citing Lindenmayer and Fisher (2006), indicated the connectedness of

open space, species habitat, and ecological processes are important to biodiversity and ecological integrity.

No additional recommended wilderness areas are proposed on the Sequoia or Sierra National Forests; therefore there would be no effect of this alternative on wilderness in those national forests.

Consequences Specific to Alternative C

Alternative C emphasizes the role of natural processes in forest restoration. This alternative includes the same desired conditions and guidelines in alternative B that were developed to enhance protection of aspects of wilderness character that are not addressed in existing wilderness plan direction, including plan components to provide for restoration in wilderness, address invasive species, and support social and natural qualities of wilderness character.

Alternative C includes additional areas recommended by the public to be considered for inclusion in the National Wilderness Preservation System. These recommended wilderness areas would be managed in the same manner as designated wilderness to maintain their wilderness characteristics, including their natural conditions, opportunities for solitude or primitive and unconfined recreation, scenic beauty, and identified special features. This alternative would serve future demands of wilderness opportunities; however, the restrictions associated with wilderness designation would limit future development of mountain bike and off-highway vehicle recreation opportunities by creating more non-motorized areas outside designated wilderness.

The Kaiser, Ansel Adams, John Muir and Dinkey Lakes Wilderness would have the same direction and effects as alternative B.

Consequences Specific to Alternative D

Alternative D includes the same desired conditions and guidelines in alternatives B and C that were developed to protect aspects of wilderness character that are not addressed in existing wilderness plan direction, including plan components to provide for restoration in wilderness, address invasive species, and support social and natural qualities of wilderness character.

No areas are recommended for inclusion in the National Wilderness Preservation System in alternative D because the restrictions imposed on wilderness prohibit the use of motorized and mechanized equipment and would limit the increased pace and scale of mechanical restoration treatments, prescribed burning, and managing wildfires to meet resource objectives proposed in this alternative.

The Kaiser, Ansel Adams, John Muir and Dinkey Lakes Wilderness would have the same management direction and effects as alternative B.

Consequences of Fire Management Direction

The fire management zones that are analyzed for each alternative are described in detail in the “Fire Management and Smoke” section.

Consequences Specific to Alternative A

In alternative A both the wildland-urban intermix defense and threat zones emphasize hazardous fuels reduction treatments and lack management direction to restore fire as an ecological process, which are likely to have adverse effects on existing wilderness characteristics. Some wildfires

may be managed to meet resource objectives when conditions allow and it can be done in a safe manner which could have beneficial effects on wilderness characteristics.

Table 123. Percent of area in fire management zones for areas in designated wilderness by national forest, alternative A

National Forest	Wildland-urban Intermix Defense Zone	Wildland-urban Intermix Threat Zone	Other
Inyo	<1	7	93
Sequoia*	<1	5	95
Sierra	<1	6	94

*Reported percentages only represent areas outside of the Giant Sequoia National Monument where fire management zones exist.

Consequences Specific to Alternatives B and D

In alternatives B and D there are four fire management zones. The community wildfire protection zone and general wildfire protection zone emphasize fuel treatments that would likely have an adverse effect on wilderness characteristics. The wildfire restoration zone prioritizes ecological restoration, which could have both adverse and beneficial effects to wilderness characteristics. In areas in the wildfire maintenance zone, fire management activities are most likely to retain and have beneficial effects to existing wilderness characteristics because this zone emphasizes management of wildfires to meet resource objectives.

Table 124. Percent of area in fire management zones for areas in designated wilderness by national forest, alternatives B and D

National Forest	Community Wildfire Protection Zone	General Wildfire Protection Zone	Wildfire Restoration Zone	Wildfire Maintenance Zone
Inyo	3	14	27	56
Sequoia*	<1	3	29	67
Sierra	<1	2	12	86

*Reported percentages only represent areas outside of the Giant Sequoia National Monument where fire management zones exist.

Table 125. Percent of area in fire management zones for areas in recommended wilderness by national forest, alternative B

National Forest	Wildfire Protection Zone	General Wildfire Protection Zone	Wildfire Restoration Zone	Wildfire Maintenance Zone
Inyo	1	17	6	76

Consequences Specific to Alternative C

In alternative C, there are three fire management zones: The wildland-urban intermix defense zone which is the same as in alternative A; the wildfire maintenance zone is the same as in alternatives B and D; and the general wildfire zone for the remaining area. The general wildfire zone would have an increased emphasis on managing wildfire to meet resource objectives and increased use of prescribed fire in fire adapted ecosystems. Of the three fire management zones in alternative C, the wildfire maintenance zone would be most likely to retain wilderness characteristics where wildfires can be safely managed to restore fire as an ecosystem process. The general wildfire zone may make it more difficult to evaluate wildfire risk resulting in slightly less

wildfires managed to meet resource objectives within existing and recommended wilderness areas. Fewer fuels reduction treatments outside of but adjacent to wilderness area would result in higher risks to managing wildfires.

Table 126. Percent of area in fire management zones for areas in designated wilderness by national forest, alternative C

National Forest	Wildland-urban Intermix Defense Zone	General Wildfire Zone	Wildfire Maintenance Zone
Inyo	<1	40	60
Sequoia*	<1	32	68
Sierra	<1	13	86

*Reported percentages only represent areas outside of the Giant Sequoia National Monument where fire management zones exist.

Table 127. Percent of area in fire management zones for areas in recommended wilderness by national forest, alternative C

National Forest	Wildland-urban Intermix Defense Zone	General Wildfire Zone	Wildfire Maintenance Zone
Inyo	<1	46	54
Sequoia*	1	58	41
Sierra*	1	76	23

*Reported percentages only represent areas outside of the Giant Sequoia National Monument where fire management zones exist.

Cumulative Effects

In general, cumulative effects are the past, present, and reasonably foreseeable effects from management activities on the national forest and adjacent lands. Reasonable and foreseeable actions on National Forest System lands include vegetation management, mining, recreation use, and reduction of fuels in the wildland-urban intermix. These actions could impact the wilderness characteristics of solitude, depending on how close and pervasive the actions are, although typically just sights and sounds within the recommended wilderness area are considered when determining effects to wilderness characteristics. For example, vegetation management activities such as harvesting adjacent to recommended wilderness area may increase the sights and sounds of logging equipment such as chainsaws and mechanized equipment within the recommended wilderness area, but because it is outside of the recommended wilderness area, it is not considered to degrade the wilderness characteristic of solitude. However, an expansion of a developed recreation site adjacent to recommended wilderness could increase use levels within the recommended wilderness, which may affect solitude as the number of encounters with others could increase within the recommended wilderness area.

Population growth in California and Nevada is likely to increase recreation use of the national forests including an increase in use within recommended wilderness. The effects of urbanization and population growth on recommended wilderness use and resource conditions are likely to be gradual and to extend well beyond the planning period. Increased recreation use may negatively impact wilderness characteristics, particularly the opportunity for solitude and natural quality. Examples of potential impacts include increased opportunity for crowding in certain locations, soil compaction or erosion, and threats to native plant species from the spread of noxious weeds from sources outside the wilderness.

Coordination with the Bureau of Land Management and the National Park Service to Manage Contiguous Wilderness Areas

The Inyo and Sequoia National Forests would need to increase their coordination with the Bureau of Land Management (BLM) to protect both the wilderness characteristics of recommended wilderness that is adjacent to BLM-managed wilderness, and the wilderness character of BLM-managed wilderness. The Sierra National Forest would need to increase its coordination with the National Park Service to protect both the wilderness characteristics of recommended wilderness that is adjacent to National Park wilderness, and the wilderness character of National Park wilderness. This would require some additional expenditure of resources by these other agencies in addition to the existing coordination that occurs for the existing designated wilderness areas.

Analytical Conclusions

The existing designated wilderness areas remain unchanged and their management direction would remain essentially the same because most direction is derived from law, regulation, and agency policy. Draft forest plan direction for all alternatives protects and maintains the five qualities of wilderness characteristics in designated wilderness areas.

Alternatives B and C recommend additional areas for inclusion in the National Wilderness Preservation System, with alternative B recommending additional areas on the Inyo National Forest only and alternative C recommending the additional areas on all three national forests. Alternatives B and C include plan direction that would protect the values that make the area suitable for wilderness designation. Areas managed as recommended wilderness would be unsuitable for motorized and mechanized transport (mountain bikes) and would limit future development of mountain bike and off-highway vehicle recreation opportunities. Some existing mountain bike use would be affected where recommended wilderness areas include existing trails open to mechanized transport.

A large portion of the existing designated wilderness areas are within the wildfire maintenance zone, where fire risk is lower and generally favors managing wildfires to meet resource objectives. Plan direction for alternatives B, C, and D would encourage restoring fire as an ecological process when it is safe to do so in the wildfire maintenance zone. Alternative B also includes 17 percent of the remaining portions of the recommended wilderness areas in the general wildfire protection zone where there is a moderate fire risk and some fuels reduction with mechanical treatments or prescribed burning may be needed before wildfires can be safely managed to meet resource objectives. The methods of treatment would be limited to prescribed burning and nonmechanized methods within recommended wilderness areas. Alternative C includes a substantial portion of the recommended wilderness in the general wildfire zone where there is a wide range of fire risk. Limitations on the use of mechanized equipment would make it difficult to manage some wildfires to meet resource objectives due to the existing levels of fuels within recommended wilderness areas coupled with fewer areas of fuel reduction between wilderness and communities. Alternative D, with no new recommended wilderness, would allow the greatest opportunity to manage wildfires to meet resource objectives because there would be no restrictions on the use of mechanized equipment (chainsaws, aircraft, and pumps) to manage wildfires safely while meeting resource objectives. Alternative A would have some of these benefits but does not emphasize restoring fire as an ecological process in these areas since it does not have an explicit fire management zone outside of the wildland-urban intermix.

Eligible and Suitable Wild and Scenic Rivers

Background

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Wild and Scenic Rivers Act,[35] which established the system, is notable for safeguarding the special character of these rivers, while recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection.

The 2012 Planning Rule requires the Forest Service to conduct an inventory of rivers and determine wild and scenic river eligibility and classification during land and resource management plan development or revision as outlined in the Wild and Scenic Rivers Act. Section 5(d)(1) of the rule states:

> In all planning for the use and development of water and related land resources, consideration shall be given by all federal agencies involved to potential national wild, scenic and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potential. The Secretary of the Interior and the Secretary of Agriculture shall make specific studies and investigations to determine which additional wild, scenic and recreational river areas within the United States shall be evaluated in planning reports by all federal agencies as potential alternative uses of the water and related land resources involved.

The Planning Rule specifically requires that during plan development or revision, river eligibility must be identified unless an inventory has been completed and no changed circumstances or new information warrant further review. The rule also requires the Forest Service to manage those eligible and suitable rivers to protect the values that support their inclusion in the National Wild and Scenic River System until Congress makes a final determination on their designation.

Analysis and Methods

The process used to identify and evaluate rivers for their potential eligibility is found in the Forest Service Land Management Planning Handbook 1909.12, chapter 80. This will be referred to as the Wild and Scenic Rivers Evaluation Handbook. This chapter of the handbook contains guidance and instruction the agency must use to carry out the direction contained in the Planning Rule.[36] Additional guidance can be found in the Interagency Wild and Scenic Rivers Coordinating Council technical paper: The Wild & Scenic River Study Process (1999).

The evaluation process includes a sequence of four steps, three of which are required during plan revisions. The Wild and Scenic Rivers Handbook directs interdisciplinary teams to complete the evaluation of rivers to be studied for eligibility, considering best available scientific information and public input. The four steps include:

1. **Inventory:** The staff at each national forest must develop a systematic and comprehensive inventory of rivers to consider for their potential eligibility. Unless a previous systematic inventory of study rivers has been completed and eligible rivers identified, a comprehensive inventory will be developed to evaluate which rivers are

[35] Public Law 90-542; 16 U.S.C. 1271 et seq.
[36] 36 CFR 219.7(vi)

eligible for inclusion in the National Wild and Scenic River System. If a systematic inventory of eligible rivers has been completed, the extent of the study process during plan development or revision can be limited to evaluation of any rivers that were not previously evaluated for eligibility and those with changed circumstances.

2. **Eligibility determination:** The next step is to determine stream eligibility for inclusion in the National Wild and Scenic Rivers System. To be eligible for designation, a river or stream must be free-flowing and possess one or more "outstandingly remarkable values." Thus, the eligibility analysis consists of an examination of the river's hydrology, including any man-made alterations, and an inventory of its natural, cultural and recreational resources.
3. **Classification:** After the Forest Service determines if a river or portions of a river are eligible, each inventoried segment is then assigned a preliminary classification of "wild", "scenic" or "recreational." Classification is based on the level of human development of the shoreline, watercourse, and access at the time a river is found eligible.
4. **Suitability:** The fourth step, suitability, may happen during forest plan revision but is not required. A suitability study provides the basis for determining which rivers to recommend to Congress as potential additions to the national system. This analysis and decision-making step will not be completed as part of the current forest plan revision process for the Inyo, Sequoia, and Sierra National Forests, but will be completed in a future separate National Environmental Policy Act environmental review process.

The detailed steps that were used to develop the inventory for the evaluation (step 1) and the eligibility of rivers in the inventory (step 2) are described in appendix C: Wild and Scenic River Evaluation for the Inyo, Sequoia and Sierra National Forests in the section titled "Process to Identify Rivers to be Considered for Eligibility for Inclusion in the National Wild and Scenic Rivers System." Additionally, in the "Results of the Evaluation" section of appendix C, for each national forest, the process is further explained.

Indicators and Measures

The indicator wild and scenic rivers is total miles of newly eligible rivers versus reaffirmed eligible rivers by classification.

Under current management, rivers that were identified as eligible for inclusion in the National Wild and Scenic Rivers System in previous river studies have been, and will continue to be, managed to protect their eligibility until such time as suitability can be completed. During the current comprehensive wild and scenic river evaluation, additional rivers have been determined to be eligible. This indicator identifies the increase between what is currently being managed as eligible and what would additionally be managed as eligible as a result of the current wild and scenic river evaluation.

Affected Environment

The extent of the National Wild and Scenic Rivers System currently includes 12,708.8 miles of 208 rivers designated by Congress in 39 states and the Commonwealth of Puerto Rico; this is a little more than one-quarter of one percent of the nation's rivers. The National Wild and Scenic Rivers System is managed by the Forest Service, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and portions of the National Wild and Scenic River System are also managed by states as shown in Table 128 below.

Table 128. Total miles of rivers in the National Wild and Scenic River System by managing entity and classification, nationwide

Entity	Wild Classification	Scenic Classification	Recreational Classification	Total
Forest Service	1,735.1	1,300.7	1,923.6	4,959.4
Bureau of Land Management	1,531.2	352.4	541.6	2,425.2
National Park Service	1,739.2	745.9	735.6	3,220.7
U.S. Fish and Wildlife Service	1,043.0	8.0	0	1,051.0
States	139.4	343.9	569.2	1052.5
Total	6,187.9	2,750.9	3,770	12,708.8

In California there are 22 designated wild and scenic for a total of 1,999.6 miles and the Forest Service manages about 69 percent of the total miles in all or portions of 21 of the 22 designated wild and scenic rivers in California as shown in Table 129.

Table 129. Total miles of rivers in the National Wild and Scenic River System in California by classification and miles managed by the Forest Service

Entity	Wild Classification	Scenic Classification	Recreational Classification	Total
California Total	745.5	184.8	783.3	1,713.6
Forest Service Total, Pacific Southwest Region	501.3	116.7	560.0	1,178.0

There are five new designated wild and scenic rivers on the Inyo, Sequoia and Sierra National Forests (see maps in volume 3).

1. The **Cottonwood Creek Wild and Scenic River** is 21.5 miles total length and is managed jointly with the Bureau of Land Management (BLM) with 17.4 miles on the Inyo National Forest and 4.1 miles on Bureau of Land Management-managed lands.
2. The **Kern Wild and Scenic River** is 151 miles total length and is managed jointly by the Sequoia National Forest, the Inyo National Forest and Sequoia and Kings Canyon National Parks with 124 miles on the national forests and 27 miles in Sequoia and Kings Canyon National Parks.
3. The **Kings Wild and Scenic River** is 81 miles total length and is located on both the Sierra and Sequoia National Forests and in the Sequoia and Kings Canyon National Parks with 25.5 miles on the national forests and 55.5 miles in Sequoia and Kings Canyon National Parks.
4. The **Merced Wild and Scenic River** is 122.5 miles total length and is managed jointly by the Sierra National Forest, Bureau of Land Management and Yosemite National Park with 29.5 miles on the Sierra and Stanislaus National Forests, 81 miles in Yosemite National Park, and 4 miles on Bureau of Land Management-managed lands.
5. The **Owens River Headwaters Wild and Scenic River** is 19.5 miles total length and is managed by the Inyo National Forest.

There are also five rivers or portions of rivers that have been found to be suitable in previous wild and scenic river studies and have previously been recommended by the Forest Service for

inclusion in the National Wild and Scenic River System. These will continue to be managed as "recommended" wild and scenic rivers until a decision through an Act of Congress is made.

1. The **Middle Fork San Joaquin Recommended Wild and Scenic River** is 22 miles from its headwaters at Thousand Island Lake to the Confluence with the North Fork San Joaquin River. Segment 1 (6 miles) and Segment 2 (4.5 miles) are managed by the Inyo National Forest, Segment 3 (2.5 miles) is jointly managed by the Inyo National Forest and Devil's Postpile National Monument, and Segment 4 (9 miles) is managed by the Inyo and Sierra National Forests.

The **North Fork San Joaquin Recommended Wild and Scenic River** is 14 miles from its headwaters to its confluence with the San Joaquin River and includes three segments managed by the Sierra National Forest.

The **San Joaquin Recommended Wild and Scenic River** is 12 miles from its confluence with North Fork San Joaquin River to Hells Half Acre and is managed by the Sierra National Forest.

The **South Fork San Joaquin Recommended Wild and Scenic River** is 17 miles from its headwaters to the south end of Florence Lake. It includes four segments. Segment 1 is managed by Sequoia and Kings Canyon National Parks. Segments 1-3 are managed by the Sierra National Forest.

The **South Fork Kern Recommended Wild and Scenic River** is 1 mile from the southern boundary of the Kern Wild and Scenic River to the national forest boundary and is managed by the Sequoia National Forest.

Environmental Consequences to Eligible and Suitable Wild and Scenic Rivers

Resource Protection Methods

The 2012 Planning Rule specifically requires the Forest Service to manage those rivers that are found to be eligible and suitable to protect the values that provide the basis for their inclusion in the National Wild and Scenic River System until Congress makes a final determination on their designation. It requires that the forest plan provide plan components, including standards and guidelines, to provide for the protection of designated wild and scenic rivers as well as management of rivers found eligible or determined suitable for the National Wild and Scenic River system to protect the values that provide the basis for their suitability for inclusion in the system.[37]

The Forest Service Handbook 1909.12, chapter 80, section 84.2 states,

> "A Responsible Official may authorize site-specific projects and activities on National Forest System lands within eligible or suitable river corridors only where the project and activities are consistent with all of the following:
>
> a) The free-flowing character of the identified river is not adversely modified by the construction or development of stream impoundments, diversions, or other water resources projects.
>
> b) Outstandingly remarkable values of the identified river area are protected.

[37] 36 CFR 219.10

c) For all Forest Service-identified study rivers, classification of an eligible river must be maintained as inventoried unless a suitability study is completed that recommends management at a less restrictive classification (such as from wild to scenic or scenic to recreational)."

Any site-specific projects and activities that a responsible official authorizes on National Forest System lands within Forest Service-identified eligible or suitable river corridors must also be consistent with the interim protection measures outlined in section 84.3 of the handbook. These interim protection measures have been incorporated into the draft forest plans for the Inyo, Sequoia and Sierra National Forests. Additionally, the set of plan components developed for other aspects of the plan, such as riparian area plan components, will likely also provide for management of eligible and suitable rivers consistent with some parts of the interim protection measures. The eligible corridors include one-quarter mile from the normal high-water mark on each side of the river.

Consequences Common to all Alternatives

A total of approximately 3,754.4 miles of river were included in the current inventory that was evaluated for wild and scenic river eligibility by the Inyo, Sequoia, and Sierra National Forests. Of that inventory, approximately 1,294.4 miles of river had been evaluated in previous efforts and approximately 200.4 miles had previously been determined to be eligible and have been managed to protect their eligibility. Of those eligible rivers, approximately 102.7 miles were assigned a preliminary classification of wild, approximately 29.9 miles were assigned a preliminary classification of scenic, and 64.3 miles were assigned a preliminary classification of recreational.

The current effort included development of a comprehensive inventory of rivers on all three national forests. Rivers that had been previously evaluated for eligibility in earlier efforts were given a refreshed look to determine if there were any changed conditions or new information, and findings were adjusted accordingly. Of the 200.4 miles that had previously been determined to be eligible, all were reaffirmed as eligible. Classifications were reviewed and adjusted if changed conditions were present. The updated classification findings on the previously evaluated rivers determined approximately 103.6 miles were assigned a preliminary classification of wild, approximately 32.5 miles were assigned a preliminary classification of scenic, and 64.2 miles were assigned a preliminary classification of recreational.

New inventory was evaluated to determine if free flow and any outstandingly remarkable values were present. Of the 2,462.7 miles of new inventory that were evaluated for eligibility, approximately 669.0 miles were determined to be eligible. The classification findings on the newly evaluated rivers determined approximately 372.0 miles were assigned a preliminary classification of wild, approximately 75.5 miles were assigned a preliminary classification of scenic, and 221.4 miles were assigned a preliminary classification of recreational. The detailed results of these evaluations can be viewed in "Appendix C: Wild and Scenic River Evaluation for the Inyo, Sequoia and Sierra National Forests." The total miles of river currently determined to be eligible for inclusion in the National Wild and Scenic Rivers System is approximately 897.2 miles. Miles evaluated are summarized by forest in Table 130, Table 131, and Table 132.

Inyo National Forest

Table 130. Comparison of past and current wild and scenic river eligibility review findings in miles for the Inyo National Forest

Miles	Past Wild and Scenic Eligibility Review Findings	Updated Findings on Previously Evaluated Rivers	Findings for New Inventory Evaluated for Wild and Scenic Eligibility	Total Updated Findings	Change from Current Wild and Scenic Evaluation
Inventoried	245.5	245.5	973.4	1,218.9	+1,218.9
Total Found Eligible	128.3	128.2	31.6	159.8	+31.5
Preliminary Classification: Wild	70.9	72.2	27.7	99.9	+29.0
Preliminary Classification: Scenic	9.7	8.4	none	8.4	- 1.3
Preliminary Classification: Recreational	47.7	47.6	3.9	51.5	+3.8

Sequoia National Forest

Table 131. Comparison of past and current Wild and Scenic River eligibility review findings in miles for the Sequoia National Forest

Miles	Past Wild and Scenic Eligibility Review Findings	Updated Findings on Previously Evaluated Rivers	Findings for New Inventory Evaluated for Wild and Scenic Eligibility	Total Updated Findings	Change from Current Wild and Scenic Evaluation
Inventoried	1,045.7	1,045.7	6.9	1052.6	+6.9
Total Found Eligible	75.9	75.9	None	75.9	None
Preliminary Classification: Wild	35.2	35.2	n/a	35.2	None
Preliminary Classification: Scenic	20.2	20.2	n/a	20.2	None
Preliminary Classification: Recreational	20.5	20.5	n/a	20.5	None

Sierra National Forest

Table 132. Comparison of past and current Wild and Scenic River eligibility review findings in miles for the Sierra National Forest

Miles	Past Wild and Scenic Eligibility Review Findings	Updated Findings on Previously Evaluated Rivers	Findings for New Inventory Evaluated for Wild and Scenic Eligibility	Total Updated Findings	Change from Current Wild and Scenic Evaluation
Inventoried	None	None	1,482.4	1,482.4	+1,482.4
Total Found Eligible	None	None	633.5	633.5	+633.5
Preliminary Classification: Wild	None	None	344.4	344.4	+344.4
Preliminary Classification: Scenic	None	None	75.5	75.5	+75.5
Preliminary Classification: Recreational	None	None	213.6	213.6	+213.6

Cumulative Effects

Additional eligible rivers may be identified in existing or future planning efforts or through separate river studies on adjacent national forests and for other agencies (Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service) that manage the National Wild and Scenic Rivers System.

Analytical Conclusions

Inyo National Forest

For the Inyo National Forest, the required wild and scenic evaluation process resulted in 24.6 percent (31.5 miles) increase in the miles of river determined to be eligible. The results of the classification findings show a 40.9 percent (29.0 miles) increase in the miles of eligible rivers that will be managed as wild, a 13.4 percent (1.3 miles) decrease in the miles of eligible rivers that will be managed as scenic and an 8.0 percent (3.8 miles) increase in the miles of eligible rivers that will be managed as recreational. Since the majority of the increase in eligible miles are classified as wild and occur in areas designated as wilderness, there would be little to no effect on other activities as a result of the eligibility and classification findings compared to how these areas have been managed in the past. The increase in the miles of eligible rivers that would be managed as recreational and scenic would likely have no or negligible increased effects on other activities when looking at the national forest as a whole. Any project level planning in these eligible river corridors will need to be consistent with their preliminary classification and protect the values that provide the basis for their inclusion in the National Wild and Scenic River System by following forest plan direction until such time as a negative suitability determination is made or Congress makes a final determination on their designation.

Sequoia National Forest

For the Sequoia National Forest, the required wild and scenic evaluation process did not result in any changes to either the miles of eligible rivers or the assigned preliminary classifications. A comprehensive inventory and evaluation process had already been completed on this national forest. The 6.9 miles of new inventory that was evaluated was not found to be eligible. Project-level planning in these eligible river corridors would continue to need to be consistent with their preliminary classification and protect the values that provide the basis for their inclusion in the National Wild and Scenic River System by following forest plan direction until such time as a negative suitability determination is made or Congress makes a final determination on their designation.

Sierra National Forest

For the Sierra National Forest, the required wild and scenic evaluation process resulted in a 100 percent increase in the miles of river determined to be eligible. All previously studied rivers are already designated or have already been determined to be suitable and recommended; therefore, all the currently eligible rivers are new as a result of the current evaluation. The results of the classification findings show that 344.4 miles of the newly eligible rivers would be managed as wild, 75.5 miles of the newly eligible rivers would be managed as scenic, and 213.6 miles of the newly eligible rivers would be managed as recreational. Since the majority of the increase in eligible miles are classified as wild and generally occur in areas designated as wilderness, there would be little to no effect on other activities as a result of the eligibility and classification findings compared to how these areas have been managed in the past. Although there is a significant increase in the miles of eligible rivers that would be managed as recreational and scenic, this would likely have no or negligible increased effects on other activities when looking at the national forest as a whole. Project-level planning in these eligible river corridors would need to be consistent with their preliminary classification and protect the values that provide the basis for their inclusion in the National Wild and Scenic River System by following forest plan direction until such time as a negative suitability determination is made or Congress makes a final determination on their designation.

Pacific Crest National Scenic Trail

Background

The National Trail System is composed of 30 congressionally designated trails (11 national scenic trails and 19 national historic trails), which stretch for a hundred or thousands of miles each and more than 55,000 miles in total. National scenic and historic trails traverse wilderness, rural, suburban, and urban areas in 49 states connecting with every distinct ecological area or biome in the U.S. They protect crucial conservation areas and provide wildlife migration corridors, as well as education, recreation, and fitness for people of all ages.

The Pacific Crest National Scenic Trail was designated in 1968 by Congress as one of the original national scenic trails. The National Trails System Act[38] directed that these long distance trails provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass. Citizen stewardship and volunteerism were recognized in the Act and have been an integral component of the planning, management, and maintenance of the trail.

[38] Public Law 90-543

Figure 42. The Pacific Crest National Scenic Trail

Beginning in southern California at the Mexican border, the Pacific Crest Trail travels 2,650 miles through California, Oregon, and Washington until reaching the Canadian border (Figure 42). First conceived in the 1930s, the trail traverses the highest elevations of the Sierra and Cascade mountain ranges and was designed to include portions of the historic John Muir and Skyline Trails. The Pacific Crest Trail is one of 11 national scenic trails and it is considered one of the most remote long distance trails with over 54 percent of its path in designated wilderness. Oriented in a north-south direction, the Pacific Crest Trail is the only completed west coast national scenic trail.

The selected route location for the Pacific Crest Trail was published in the Federal Register on January 30, 1973. The route traverses portions of 25 national forests, six national parks, seven Bureau of Land Management Field Offices, four national monuments, one national scenic area, as well as, state and private lands in the states of California, Oregon, and Washington. The Regional Forester of the Pacific Southwest Region is the lead official for coordinating matters concerning the study, planning, and operation of the Pacific Crest Trail (Forest Service Manual 2353.04).

The "Pacific Crest National Scenic Trail Comprehensive Plan" was signed by the Chief of the Forest Service in 1982 and set forth direction to guide the development and management of the Pacific Crest Trail (USDA FS 1982a). The primary policy is to administer the Pacific Crest Trail consistent with the nature and purposes for which this National Scenic Trail was established—to provide for high-quality scenic, primitive hiking and horseback riding opportunities and to conserve natural, historic, and cultural resources along the corridor.

The Comprehensive Plan directed that each "National Park, Bureau of Land Management District and National Forest will integrate the direction and guidance provided by the Comprehensive Plan into their respective land management planning processes." Executive Order No. 13195, Trails for America in the 21st Century (2001), recognized the importance of "Protecting the trail corridors associated with national scenic trails …to the degrees necessary to ensure that the values for which each trail was established remain intact."

The Pacific Crest Trail Association, a 501(c)(3) nonprofit, is recognized as the Federal Government's major partner in managing and maintaining the Pacific Crest Trail. The tenants of the U.S. Forest Service, Bureau of Land Management, National Park Service and the Pacific Crest Trail Association's relationship are outlined in a memorandum of understanding (2015).[39] The Pacific Crest Trail Association serves to recruit, train, and supervise volunteers to assist with trail management and maintenance. The collaborative work focuses on engaging youth and developing citizen stewardship, providing quality recreation experiences for hikers and equestrians, and ecosystem restoration and is funded, in part, through cooperative agreements with federal agencies.

Analysis and Methods

Analysis Area

Pacific Crest Trail recreationists have three distinct travel use patterns:

1. **Day use:** The largest user group, these travelers typically originate from within a 75-mile (1.25 hour driving time) radius;

2. **Section use:** The second largest user group, these travelers typically live on the west coast in one of the three states the trail travels through; and

3. **Entire trail:** These thru-hikers and equestrians have a broad geographic draw from across the United States and abroad and share the goal of completing the entire trail.

The analysis area for the Pacific Crest Trail considers local, regional and national scales based on the unique and distinctive role and contributions the trail plays providing recreation opportunities and connecting three states and numerous public land entities.[40]

Methods

To identify the management area boundaries for each alternative, a geographic information systems model was constructed with the following criteria (see maps in volume 3).

- Alternative A: Established based on mileage of trail multiplied by 6 feet in width (general trail clearing width for 24-inch trail with packstock).
- Alternative B: Established using what topography is seen from the trail platform at 5 feet height up to one-half mile of centerline (foreground).
- Alternative C: Established using alternative B plus the Scenic Attractiveness A inventory layer up to 4 miles (middleground).

[39] Memorandum of Understanding between USDA Forest Service, National Park Service, Bureau of Land Management California and Oregon/Washington State Offices, California State Parks and the Pacific Crest Trail Association, May 21, 2015.
[40] Forest Service Handbook 1909.12, chapter 20, section 22.32 3(f)

- Alternative D: Established using one-quarter mile management area from centerline of the trail.

In this section, key components for the environmental consequence analysis for the Pacific Crest Trail are based on the scenic and recreation resources. The recreation opportunity spectrum provides for the varied recreation opportunities along the trail in terms of setting, activity, and experience (USDA FS 1982b).

Scenic resources are analyzed based on scenic integrity objectives and distance zones (USDA FS 1995). Scenic integrity objectives range from very high to low. Distance zones are defined as foreground, middleground, and background. Foreground views are considered to be those within approximately one half-mile of the viewer; middleground views are views of objects or scenic resources between approximately one half-mile and four miles away from the viewer; background views are views that extend beyond four miles from the viewer, to the horizon.

Indicators and Measures

Acres allocated to Pacific Crest Trail Management Area by alternative and by national forest within designated wilderness and outside of designated wilderness: The total number of acres within the management area is a measure of the amount of surrounding area or trail corridor that provides for high-quality scenic, primitive hiking and horseback riding opportunities and conserves natural, historic, and cultural resources.

Acres within the Pacific Crest Trail Management Area by alternative and by national forest allocated to each recreation opportunity spectrum class: The number of acres of each recreation opportunity spectrum class in the management area displays the emphasis on recreation activities, setting, and experience ranging from primitive to urban.

Acres within the Pacific Crest Trail Management Area by alternative and national forest allocated to scenic integrity objectives: Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variation. The number of acres in the Management Area of each Scenic Integrity Objective displays the overall plan for the scenery surrounding the trail to have a natural appearance.

Miles of motorized roads and trails and number of crossings of Pacific Crest Trail in the Management Area: Motorized use is prohibited on the Pacific Crest Trail. The miles of motorized roads and trails within the management area and crossing the Pacific Crest Trail displays the amount and proximity of motorized use within the management area.

Assumptions

- Of the scenery management distance zones, details are more easily seen from foreground and middle ground, which usually has the most visual sensitivity (USDA FS 1995).
- The forest plan does not make site-specific decisions regarding travel management within the Pacific Crest Trail Management Area. No roads or trails would be opened or closed in this forest plan decision.
- The more acres within the Pacific Crest Trail Management Area the higher the protection of the resources, qualities, values and associated settings and the primary uses of the Pacific Crest National Scenic Trail.

Affected Environment

Recreation Opportunity

Trailwide: The Pacific Crest Trail is a long-distance trail that is designed with a native surface tread to meet pack and saddle "more difficult" design and maintenance standards for most of its length. Rustic bridges constructed of native materials may be provided where needed for resource protection or to accommodate those users with a moderate skill level. Trailwide, the Pacific Crest Trail is open to foot and horse travel and closed to motorized[41] and mechanized travel.[42]

The current Inyo, Sierra, and Sequoia forest plans recognized the Pacific Crest National Scenic Trail and defined visual management standards and guidelines but did not define a trail corridor or identify other desired conditions, resources, qualities, or values to be specifically managed.

There are locations along the Pacific Crest Trail where the trail has been located in an interim location in order to have a continuous path from Mexico to Canada. These temporary locations may be along motorized road shoulders or motorized trails with the long-term objective of relocating the trail to an optimal nonmotorized location. For example, in the Sequoia National Forest, Kiavah Wilderness, cherry-stemmed National Forest System Road 27S11 (Horse Canyon) is legally open to motorized use and the Pacific Crest Trail is currently located along part of the road. The long-term objective will be to relocate the trail to a nonmotorized location.

The "Optimal Location Review" is a project-level analysis process that ensures that the Pacific Crest Trail is located in the setting that best meets the congressional intent for location, outstanding recreation opportunities, and scenic resources. Actual relocation of the trail will require National Environmental Policy Act review and compliance, and significant relocations require Congressional approval. On private lands, easements that have been acquired may be as narrow as 10 feet and are typically insufficient to provide the optimal recreation opportunities and protect the scenic values of the trail.

Management of the Pacific Crest Trail is designed to harmonize with and complement established multiple-use plans to ensure continued benefits from the lands. Managers protect the integrity of the trail by avoidance, mitigation, and modifying management practices as needed.

Table 133 displays the number of miles[43] of the Pacific Crest Trail by national forest and within designated wilderness, and by activities outside of wilderness. The Pacific Crest Trail in the three national forests under plan revision is 89 percent within designated wilderness.

[41] 36 CFR 261.20
[42] Regional Order 88-4 and 36 CFR 212.21
[43] Miles of "standard terra" trails, which have a surface consisting predominantly of the ground and are designed and managed to accommodate use on that surface. It does not include snow or water trails.

Table 133. Number of miles of forest trails and miles of Pacific Crest Trail within and outside of designated wilderness

National Forest	Total National Forest Trail Miles	Total Wilderness Trail Miles	Total Nonwilderness National Forest Trail Miles	Nonwilderness National Forest Trail Miles Open to Motorized Use	Nonwilderness National Forest Trail Miles Open to Bicycle Use
Inyo	1,378	787	592	340	587
Inyo Pacific Crest Trail	86	81	5	0	0
Sequoia	1,044	296	748	386	735
Sequoia Pacific Crest Trail	47	34	13	0	0
Sierra	1,029	618	411	185	411
Sierra Pacific Crest Trail	27	27	0	0	0
Total – All 3 national forests	3,451	1,701	1,751	910	1,733
Total Pacific Crest Trail	160	142	18	0	0

Inyo National Forest: The Inyo National Forest manages 86 miles of the Pacific Crest Trail. Ninety-four percent of this mileage on the Inyo is located within designated wilderness, including the South Sierra, Golden Trout, John Muir, and Ansel Adams Wildernesses. The 1988 Inyo forest plan (USDA FS 1988) specifies that only nonmotorized use will occur in a primitive or semi-primitive recreation opportunity setting. The areas allocated to the primitive or semi-primitive settings are entirely located within designated wilderness. The Inyo National Forest has 592 miles of trail outside of wilderness with 57 percent of those trails open to motorized use and 99 percent open to bicycle use.

Sequoia National Forest: The Pacific Crest Trail travels through the Sequoia National Forest for 47 miles, in three segments. The trail travels 22 miles, crossing back and forth on the Inyo National Forest and Sequoia National Forest boundary, mostly in the South Sierra Wilderness, 16 miles through the Scodie Mountains in the Kiavah Wilderness, and 9 miles through the Piutes (nonwilderness). The total wilderness mileage is 34 miles. There are 7 road crossings, and 11 nonsystem off-highway vehicle route crossings in the Piutes section of the Pacific Crest Trail. Within the Piutes, there are numerous miles of nonsystem trails that are not authorized on the Sequoia Motor Vehicle Use Map but are of interest to the motorized recreation community. The Sequoia National Forest in total has 748 miles of system trail outside of wilderness. Of that, 51 percent is open to motorized use and 98 percent is open to bicycle use.

Sierra National Forest: The Pacific Crest Trail travels through the Sierra National Forest for 27 miles all in designated wilderness of the Ansel Adams and John Muir Wilderness. The Sierra national Forest has 411 miles of trail outside of wilderness and of that 45 percent is open to motorized use and 100 percent is open to bicycle use.

Visitor Use

Trailwide: There are numerous points of entry for the Pacific Crest National Scenic Trail as it travels 2,650 miles through 25 national forests, 7 Bureau of Land Management Field Offices, and 6 national parks (and 48 wilderness areas); therefore obtaining total monthly or annual trail user

numbers on all parts of the Pacific Crest Trail has been cost prohibitive.. The largest segment of the Pacific Crest Trail users is day hikers. Since the trail is within two hours travel time from the metropolitan centers of San Diego, Los Angeles, Sacramento, Portland, and Seattle, there is a high demand for day and weekend use. Interest in long-distance hiking of the Pacific Crest Trail has been increasing in the past years, and the trend is expected to continue. The New York Times Bestseller book by Cheryl Strayed, *Wild: From Lost to Found on the Pacific Crest Trail* (2012) and subsequent movie has increased the interest in the Pacific Crest Trail from a broad audience. Visitor use management is the proactive and adaptive process of planning for and managing characteristics of visitor use and its physical and social setting, using a variety of strategies and tools, to sustain desired resource conditions and visitor experiences.

The popularity of long distance trails is growing and there has been an increase in numbers of visitors for thru-hike use on the Pacific Crest Trail. This trend is expected to continue. Both section users (traveling greater than 500 miles) and entire trail users on the Pacific Crest Trail receive a permit, and the numbers of permits issued in the past two years are shown in Table 134. Preliminary reports for 2015 through June show increases in applications. In the past 10 years, permit issuance for hikers and equestrians traveling greater than 500 miles on the Pacific Crest Trail has increased significantly. Successful completion of the entire length of the trail in one season is highly dependent of snow conditions and wildfire activity. The number of completions reported in 2013 is low likely due to early season snowfall in that year. Table 134 shows that in the spring of 2015, the highest number of permits issued was 4,453. Completion rate for thru-travelers in 2015 was 19 percent of permits issued (Pacific Crest Trail Visitor Use Statistics, no date). The attrition rate and distribution has not been further analyzed to account for travelers never using the permit or the locations where trips ended.

Table 134. Section and entire permits issued for the Pacific Crest Trail 2013-2015

Year	Total Number of permits issued	Northbound thru-hike permits	Southbound thru-hike permits	Section hike permits	Thru-ride permits	Section ride permits	Completions reported
2013	1,879	988	53	834	1	3	271[1]
2014	2,655	1,367	94	1,179	7	8	472
2015	4,453	2,486	322	1,633	4	8	478

1. Low number of completions likely due to early season snowfall.

In 2015, 8 percent of the permits issued were to international travelers from 34 countries with the most number from Canada, Germany, and the United Kingdom respectively. The majority of the permits (92 percent) were to recreationists originating from the United States represented by all 50 states and the District of Columbia with the most number being issued to California, Washington, and Oregon state residents respectively.

Within the central Sierra, land managers within the Forest Service and National Park Service have been concerned about increasing visitor use on the John Muir Trail, which uses the same trail tread as the Pacific Crest Trail in the Inyo and Sierra National Forests and in Yosemite and Sequoia and Kings Canyon National Parks. Figure 43 shows from 2011 to 2015 there has been a 100 percent increase in John Muir Trail visitor use permits issued. Yosemite National Park

implemented for 2015 an exit quota permit system to address access and resource concerns related to increased use.[44]

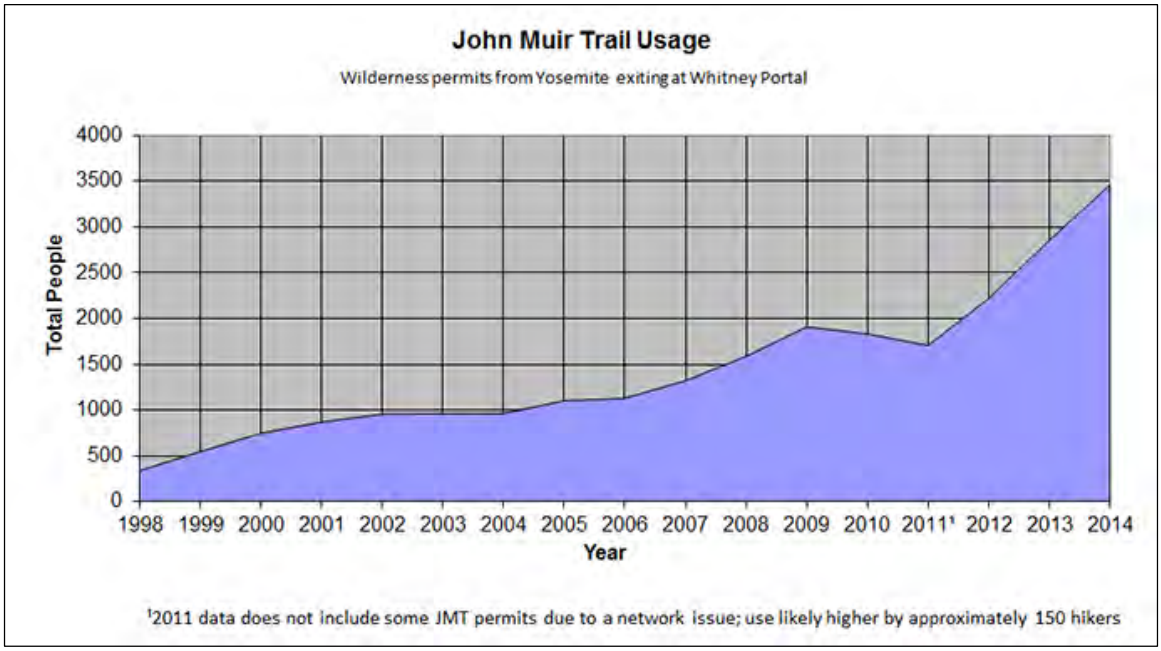

Figure 43. John Muir Trail Usage (which uses the same trail tread as the Pacific Crest Trail for most of its route)

Inyo National Forest: The number of Pacific Crest National Scenic Trail thru-hikers in early June each year is large enough that South Sierra Wilderness occupied campsite standards are occasionally exceeded. Otherwise, there are no known campsite occupancy issues within the remainder of the trail corridor associated with thru-hikers. In the area where the Pacific Crest Trail coincides with the John Muir Trail, there are known issues with capacity to accommodate large numbers of travelers on the John Muir Trail during peak wilderness use season, especially August.

Sequoia National Forest: The Sequoia National Forest is not aware of any current capacity issues. Forest Service and National Park Service managers have identified capacity issues related to the John Muir Trail, which uses the same trail tread as the Pacific Crest Trail on the Sierra National Forest and Inyo National Forests, and at Yosemite and Sequoia and Kings Canyon National Parks. This trend is expected to continue.

Sierra National Forest: The Pacific Crest Trail and John Muir Trail overlap throughout the Sierra National Forest. Because the popularity of the two trails is growing, this trend is expected to continue. There are no known capacity issues on the Pacific Crest Trail on the Sierra National Forest at this time.

[44] See the Yosemite National Park Web site at: http://www.nps.gov/yose/planyourvisit/jmtfaq.htm

Competitive Events

Trailwide: Interest in trail running has been increasing in recent years. A study completed by the 2014 Outdoor Recreation Participation Report by the Outdoor Foundation (2014) noted that 6.8 million Americans ages 6 and older participated in trail running in 2013, which is 2.3 percent of the population. The study concluded that running, including jogging and trail running, was the most popular activity among Americans when measured by number of participants and by number of total annual outings. Trail running by individuals is allowed on the Pacific Crest Trail without restrictions. Recreation special use permits are required for trail running events that charge fees for participation or have more than 75 people participating. By policy, competitive event permits are not allowed in designated wilderness.[45] The concerns regarding commercial competitive events displacing the primary users of the Pacific Crest Trail has been raised through social media in a variety of Web sites. While there is no comprehensive list of events on the Pacific Crest Trail at this time, for the races that that have been compiled, they range in participation from 75 to 800 people and total approximately 3,500 annually.

Inyo National Forest: Ninety-six percent of the Pacific Crest Trail is in designated wilderness and there are no competitive events allowed by policy. Outside of designated wilderness, there are no existing authorizations for competitive events on the trail. Recreation special uses are authorized within the Pacific Crest Trail Management Area in the Reds Meadow Valley, including Reds Meadow Resort and Pack Station, and Agnew Meadows Pack Station.

Sequoia National Forest: Seventy-two percent of the Pacific Crest Trail on the Sequoia National Forest is in designated wilderness and no competitive events are allowed. Outside of designated wilderness, no competitive events are currently permitted on the trail.

Sierra National Forest: The entire length of the Pacific Crest Trail on the Sierra National Forest is in designated wilderness and no competitive events are allowed.

Scenery

Trailwide: While on National Forest System lands, the Pacific Crest Trail may pass through a variety of management areas, with forestwide direction in place that defines the allowable uses (such as hikers and equestrians) of the trail and the visual resource objectives. The three national forests currently employ a standard for visual quality objectives of retention or partial retention in the areas viewed as foreground from the Pacific Crest Trail (approximately one-half mile of centerline of the trail) and modification in the middle and background distance zones. Since the trail crosses many national forests, it is important to note that the majority of the forest plans for the national forests the Pacific Crest Trail travels through were developed in the 1980s and are still under the visual resource management standards and have not been amended to reflect the currently used Scenery Management System.

Inyo National Forest: The Pacific Crest Trail offers outstanding scenic vistas and panoramic views along the entire 80 miles managed by the Inyo National Forest. In the South Sierra and Golden Trout Wilderness Areas, travelers on the Pacific Crest Trail enjoy views of the South Fork Kern River drainage and vast meadows located on the Kern Plateau. In the John Muir and Ansel Adams Wilderness Areas, Pacific Crest Trail visitors experience stunning vistas of glaciated landscapes, including sparkling blue lakes with a backdrop of high, rocky peaks on the Sierra Crest.

[45] Forest Service Manual 2323.13h

The forest plan for the Inyo National Forest provides direction that 94 percent of the Pacific Crest Trail corridor will be managed for preservation of the visual quality, while the remaining six percent of the corridor will be managed to retain visual quality.

Sequoia National Forest: Most of the Pacific Crest Trail visual corridor on the Sequoia National Forest is protected with a visual quality objective of retention or better. The greatest portion of the trail travels through wilderness on the Sequoia National Forest and on adjacent lands.

Sierra National Forest: Similar to the Inyo National Forest, the Pacific Crest Trail offers outstanding scenic vistas and panoramic views on the Sierra National Forest. In the John Muir and Ansel Adams Wilderness Areas, Pacific Crest Trail visitors experience similar stunning vistas of the Sierra Crest.

Vegetation Management and Wildfire

Trailwide: In the last 10 years, wildfire has played a significant role in the accessibility and scenic experience of the Pacific Crest Trail for hikers and equestrians. In the last 50 years, 235,521 acres of the Pacific Crest Trail corridor has burned, of which, almost half occurred in the past 10 years. Vegetation and grazing have been managed to reflect the underlying forestwide and management area direction along the trail.

Inyo National Forest: Vegetation within the Pacific Crest Trail corridor has been affected by disturbances associated with past wildfire and a severe wind event. Vegetation within the trail corridor has also been affected by less frequent wildfires resulting from fire suppression.

Three wildfires occurred during the past 10 to 50 years that affected the trail corridor. Portions of all these wildfires burned with high severity. Research found that wildfires historically burned every 14 to 18 years with low severity (Caprio et al. 2006). Fire suppression during the past century has resulted in the absence of such regular fire disturbance, which increased the density of smaller trees in the understory of mature forests, and led to encroachment of conifers into meadows. The increased density of trees creates high fuel loading and elevated hazard for high-severity wildfire, such as seen in the Rainbow Fire of 1992. Conifer growth in meadows poses potential for loss of grassland sites in the future. The meadow encroachment is most notable in the smaller grassland sites along the Pacific Crest Trail near Deer Creek, south of Reds Meadow. These meadows may become forested sites in the next few decades without future fire disturbance.

In November 2011, a severe wind event toppled thousands of trees within the Pacific Crest Trail corridor in areas of the Inyo National Forest. The most severe wind damage occurred in the vicinity of Reds Meadow, within the Middle Fork San Joaquin River watershed. The legacy of this wind damage is high fuel loading and increased wildfire hazard in areas with blowdown.

The current trends in ecological conditions are expected to continue, including elevated fuel loads with risk of high-severity wildfire, loss of meadows with conifer encroachment, and other ecosystem disturbance associated with climate change.

Sequoia National Forest: In the last 10 years, wildfire has played a significant role in the accessibility and scenic experience of the Pacific Crest Trail for hikers and equestrians on the Sequoia National Forest. The Clover Fire of 2012 and the Manter Fire of 2000 are examples of large, high-severity burns that have affected the recreation experience on the Pacific Crest Trail. Though the trail itself was not overly impacted by all high-severity wildfires, some of the trails that access the Pacific Crest Trail on the Sequoia National Forest were impacted, resulting in

many miles of trails closed by fallen dead trees. The current trends in ecological conditions are expected to continue, similar to the Inyo and the Sequoia National Forests.

Sierra National Forest: In the last 10 years, wildfire has played a significant role in the accessibility and scenic experience of the Pacific Crest Trail for hikers and equestrians on the Sierra National Forest. More than 10 percent of the trail has burned, but none of that was considered high-intensity fire. The scenic attractiveness of a landscape can be altered from natural events such as floods and fire.

Significant changes in the past 10 to 50 years relate to heavy precipitation followed by a significant wind event. Though the Pacific Crest Trail itself was not overly impacted in 2012, a majority of the trails that access the trail on the Sierra National Forest were impacted when a wind event caused up to 100 trees per mile to fall on these trails. The resulting issue will be the fuel loading from all the downed trees below the trail (USDA FS 2011). Current trends in ecological conditions are expected to continue, like those described for the Inyo above.

Lands Special Uses

Trailwide: The national increase in demand for renewable energy, especially wind development, has competed with the footpath of this "crest" trail, significantly changing the scenic integrity of the trail at a landscape scale in Kern County, California. Additionally, authorizations for new or larger transmission lines, pipelines, and other utilities have produced changes in the scenic integrity of the trail corridor in all three states the trail passes through. Table 135 and Table 136 summarize the number and acres of wind applications and authorizations by the Bureau of Land Management as of March 2015, which are primarily concentrated in the desert and southern areas of the state (BLM 2015). The wind testing authorizations exclude projects submitted for development. For the wind development authorizations, the Bureau of Land Management has authorized more than 3,000 wind turbines on public lands before 2003, but they are not included in this table.

Table 135. Wind renewable energy summary (number) by Bureau of Land Management in California, October 2015

Area	Testing Applications	Testing Authorizations	Development Applications	Development Authorizations
Statewide	15	13	3	3
Desert	15	9	1	3
Central CA	0	1	1	0
Northern CA	0	3	1	0

Table 136. Wind renewable energy summary (acres) by Bureau of Land Management in California, October 2015

Area	Testing Applications	Testing Authorizations	Development Applications	Development Authorizations
Statewide	219,878	93,590	26,009	26,795
Desert	219,878	52,738	6,720	26,795
Central CA	0	0	7,882	0
Northern CA	0	40,852	11,407	0

Table 137 summarizes the number and acres of solar applications and authorizations by the Bureau of Land Management as of October 2015. The Bureau of Land Management has also approved six transmission line rights-of-way associated with private land solar facilities.

Table 137. Solar renewable energy summary by Bureau of Land Management in California, Oct 2015

Area	Development Applications (numbers)	Development Applications (acres)	Development Authorizations (number)	Development Authorizations (acres)
Statewide Acres	5	34,806	8	21,091
Desert Acres	5	34,806	8	21,091
Central CA Acres	0	0	0	0
Northern CA Acres	0	0	0	0

Inyo National Forest There are no authorizations for lands special uses along the Pacific Crest Trail, such as wind turbines, utility transmission lines, or pipelines.

Sequoia National Forest: There are no known authorizations for lands special uses along the Pacific Crest Trail both inside and outside of designated wilderness.

Sierra National Forest: The Pacific Crest Trail is entirely within designated wilderness. There are no authorizations for non-recreation special uses along the trail, such as wind turbines, utility transmission lines, or pipelines.

Socio Economic Considerations

Trailwide: The Outdoor Recreation Economy Report (Outdoor Industry Association 2012) identifies that outdoor recreation creates 6.1 million American jobs and produced $646 billion in outdoor recreation spending each year and 80 billion in Federal, State, and local tax revenue. The outdoor recreation economy thrives when Americans spend their dollars in the pursuit of outdoor recreation. This spending occurs in two forms: the purchase of gear and vehicles, and dollars spent on trips and travel. It is estimated that for every dollar spent on gear and vehicles, four dollars are spent on trips and travel.

The Pacific Crest Trail resupply points within counties that the forest plan revision covers include the towns of Tehachapi, Mojave, Onyx, Lake Isabella, Lone Pine, Independence, Bishop, Mammoth Lakes, Tuolumne Meadows, and Lee Vining and the businesses of Kennedy Meadows General Store, Muir Trail Ranch, Vermillion Valley Resort, and Red's Meadow Resort. These communities receive an influx of recreation-related supply and service requests as Pacific Crest Trail hikers and equestrians travel through or near their communities. While the economic contribution of Pacific Crest Trail travelers alone has not been studied, California State Parks (2011) estimated recreational visitors to California parks and participants in the major recreation activities in California spent over $20 billion on trip expenditures and equipment. Trip expenditures include a variety of goods and services such as overnight lodging, restaurant meals, groceries, and gasoline. The sources of direct recreation expenditures vary considerably among the regions. The Sierra region had the largest direct expenditures ($3.5 billion) associated with visitation to federally managed lands (see the section on economic conditions in the "Recreation and Tourism" section on page 583).

Environmental Consequences

Recreation Opportunity (MA-PCTW-DC-02 and MA-PCT-DC-03)

Table 138 through Table 140 outline the recreation opportunity spectrum class within each alternative by national forest. The Pacific Crest Trail Comprehensive Management Plan allows for the full range of the recreation opportunity spectrum to be experienced with rural and urban sections of the trail "generally be(ing) as short as necessary to allow passage across or under highways and railroads or passage through developed areas." No acres of the Pacific Crest Trail are classified as urban in the recreation opportunity spectrum on the three national forests in any alternative.

Consequences Common to All Alternatives

Alternative A provides the least amount of acres in all categories of the recreation opportunity spectrum. Alternative C provides the most acres in the primitive class with alternative A providing the least.

Table 138. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Inyo National Forest

Alternative	Primitive	Semi-primitive Nonmotorized	Semi-primitive Motorized	Roaded Natural	Roaded Modified	Rural
Alternative A	112	0	2	2	0	0
Alternative B	37,685	359	0	320	1,610	0
Alternative C	117,002	3,720	5,640	0	2,471	1,517
Alternative D	20,975	59	0	297	721	0

Table 139. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Sequoia National Forest

Alternative	Primitive	Semi-primitive Nonmotorized	Semi-primitive Motorized	Roaded Natural	Roaded Modified	Rural
Alternative A	5	38	3	15	0	0
Alternative B	1,916	14,704	748	3,514	0	0
Alternative C	7,717	32,267	2,875	3,525	0	0
Alternative D	1,060	8,677	359	2,164	0	0

Table 140. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area, Sierra National Forest

Alternative	Primitive	Semi-primitive Nonmotorized	Semi-primitive Motorized	Roaded Natural	Roaded Modified	Rural
Alternative A	41	1	0	0	0	0
Alternative B	14,631	373	29	0	0	0
Alternative C	81,449	2,982	1,731	461	0	0
Alternative D	7,893	177	14	0	0	0

Table 141, Table 142, and Table 143 outline the management area acres by national forest and alternative with alternative C having the most number of acres, followed by B, D, and A in all alternatives.

Table 141. Acres of Pacific Crest Trail Management Area inside and outside of wilderness, Inyo National Forest

Alternative	Inside Wilderness	Outside Wilderness	Total	Percent of Acres in Wilderness
Alternative A	112	4	116	96%
Alternative B	37,519	2,455	39,973	94%
Alternative C	116,507	13,843	130,350	89%
Alternative D	20,900	1,152	22,052	95%

Table 142. Acres of the Pacific Crest Trail Management Area inside and outside of wilderness, Sequoia National Forest

Alternative	Inside Wilderness	Outside Wilderness	Total	Percent of Acres in Wilderness
Alternative A	43	18	61	70%
Alternative B	16,621	4,262	20,883	80%
Alternative C	37,621	8,763	46,384	81%
Alternative D	8,070	14	8,084	100%

Table 143. Acres of Pacific Crest Trail Management Area inside and outside of wilderness, Sierra National Forest

Alternative	Inside Wilderness	Outside Wilderness	Total	Percent of Acres in Wilderness
Alternative A	42	0	42	100%
Alternative B	15,004	29	15,033	100%
Alternative C	84,431	2,200	86,631	97%
Alternative D	9,738	2,523	12,261	79%

We received many letters expressing concerns about the loss of motorized and mechanized (bicycle) opportunities within the Pacific Crest Trail Management Area. Table 144, Table 145, and Table 146 display the miles of motorized roads and trails within the management area that occur outside of designated wilderness areas. Eighty-nine percent of the plan area and most of the Pacific Crest Trail Management Area on the Inyo and Sierra National Forests is within designated wilderness where motorized and mechanized use is prohibited and no road construction would be allowed.

Table 144. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Inyo National Forest

Alternative	Miles of System Open Road	Miles of System Motorized Trail
Alternative A	0	0
Alternative B	11.5	0
Alternative C	29.6	2.4
Alternative D	6.7	0

Table 145. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Sequoia National Forest

Alternative	System Open Road (Miles)	System Motorized Trail (Miles)
Alternative A	0	2.3
Alternative B	3.1	3.6
Alternative C	3.1	14.3
Alternative D	0.6	2.9

Table 146. Miles of motorized roads and trails within the Pacific Crest Trail Management Area (outside wilderness), Sierra National Forest

Alternative	System Open Road (Miles)	System Motorized Trail (Miles)
Alternative A	0	0
Alternative B	0	0
Alternative C	0.3	0
Alternative D	0	0

The largest area within the planning area outside wilderness is in the Piute Mountains in the most southern section of the Sequoia National Forest. Within this area numerous miles of nonsystem trails exist and advocates for off-highway vehicle and motorcycle riding have expressed their desire to have many of these added to the designated system. Some of these trails cross the Pacific Crest Trail and are not authorized in the Sequoia Motor Vehicle Use Map.[46] For these unauthorized routes to be added to the designated system of trails, they must be evaluated in a site-specific travel management analysis that is outside the scope of this forest plan revision analysis.

Consequences Common to all Alternatives (MA-PCT-SUIT-02)

Trailwide the Pacific Crest Trail is open to foot and horse travel and closed to motorized[47] and mechanized travel.[48] The existing closures would continue. There is no change proposed in travel management.

Consequences Common to Alternatives B, C, and D (MA-PCT-GDL-04, 05, 06)

There are no system roads or trails that are proposed to be closed or a change in management or use related to the Pacific Crest Trail Management Area in this forest plan revision. New permanent roads are not permitted unless required by law to provide access to private lands or documented as the only prudent and feasible alternative. New motorized and mechanized trails within the Pacific Crest Trail Management Area may be authorized in site-specific travel management and would be designed to minimize the visual, sound, and resource impacts to the Pacific Crest Trail.

Visitor Use (MAs-PCTW and Potential Management Approaches)

Consequences Common to all Alternatives

We anticipate visitor use to continue to grow based on the increased interest in the Pacific Crest Trail in the past three years and trends seen on the John Muir Trail, which uses the same trail

[46] 36 CFR 212.56
[47] 36 CFR 261.20
[48] Regional Order 88-4

tread as the Pacific Crest Trail on the Inyo and Sierra National Forests. Visitor use would not directly vary by alternative and visitor use management strategies may be used by managers in all alternatives to minimize impacts to the physical trail resource and social setting.

Competitive Events (MA-PCT-GDL-03)

Competitive events have a potential to disrupt and displace hikers and equestrians that may be using the same section of the Pacific Crest Trail when the event occurs. Some recreationists see the events in a positive manner and celebrate the activity, free food, and companionship. Others are concerned about the numbers of encounters they make over a short period of time with limited sight distance and passing zones on the trail. There are benefits, both economic and health related, from endurance running and riding that are very positive for individuals and communities.

Consequences Specific to Alternative A

Currently, there are no existing permits for competitive events on the Pacific Crest Trail on the Inyo, Sequoia, or Sierra National Forests.

Consequences Common to Alternatives B, C, and D

Competitive events are prohibited in designated wilderness by policy. In alternatives B, C, and D, competitive events may be authorized outside of wilderness to cross the Pacific Crest Trail but would not be allowed on the trail. This prohibition would decrease the potential for displacement of the primary Pacific Crest Trail users, hikers (including individual trail runners) and equestrians. The Sequoia National Forest has 13 miles of the Pacific Crest Trail outside of wilderness, followed by 5 miles on the Inyo National Forest where competitive events would not be allowed. Across the three national forests this equates to 0.08 percent of the nonwilderness trail miles.

Because there are no existing permits for competitive events on the Pacific Crest Trail, there would be no displacement of existing users and the remaining 1,751 miles of trails outside of wilderness on the national forests could be considered for that activity and provide that recreation and economic opportunity.

Scenery (MAs-PCTW and PCT and PCT-GDL-01))

Table 147, Table 148, and Table 149 outline the acres in different scenic integrity objectives by national forest and alternative in the Pacific Crest Trail Management Area. As described previously, the Forest Service is transitioning from the Visual Management System used in forest planning in the 1980s to the current Scenery Management System directed in Agricultural Handbook 701 (USDA FS 1995)

Table 147. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Inyo National Forest

Alternative	Very High	High	Moderate	Low
Alternative A	111	4	0	0
Alternative B	37,519	2,447	7	0
Alternative C	116,507	13,419	424	0
Alternative D	20,900	1,150	2	0

Table 148. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Sequoia National Forest

Alternative	Very High	High	Moderate	Low
Alternative A	43	16	2	0
Alternative B	16,621	3,376	886	0
Alternative C	37,621	7,871	892	0
Alternative D	9,738	1,922	601	0

Table 149. Acres of scenic integrity objectives within the Pacific Crest Trail Management Area, Sierra National Forest

Alternative	Very High	High	Moderate	Low
Alternative A	42	0	0	0
Alternative B	15,004	29	0	0
Alternative C	84,431	2,200	0	0
Alternative D	8,070	14	0	0

Consequences Common to Alternatives B, C, and D

Within the Pacific Crest Trail Management Areas in these alternatives, 99 percent of the scenic integrity objectives are in the very high or high categories.

Consequences Specific to Alternative A

Continuation of the use of the Visual Management System and visual quality objectives would be contrary to current Forest Service policy. The Visual Management System is not an adaptive system and does not respond to changing ecological conditions as the Scenery Management System does. The three national forests would convert to the Scenery Management System under alternative A. Alternative A provides the least scenic integrity objective acres within the very high and high categories within the Pacific Crest Trail Management Area.

Consequences Specific to Alternative B

Alternative B would provide the second most number of acres within the Pacific Crest Trail Management area for very high and high scenic integrity by identifying the width for including the visible foreground, which can be up to one-half mile of centerline of the trail.

Consequences Specific to Alternative C

Alternative C would provide the most number of acres in the very high and high categories for scenic integrity for the Pacific Crest Trail by combining visible foreground of up to one-half mile of centerline of the trail and Scenic Attractiveness A landscapes that represent the iconic views and can be up to 4 miles of centerline of the trail. Alternative C would have the most number of acres of moderate scenic integrity objectives for the Sequoia and Inyo National Forests.

Consequences Specific to Alternative D

Alternative D would provide more acres in the very high and high category within the Pacific Crest Trail Management area than alternative A but less than alternative B by protecting scenic integrity up to one-quarter mile of centerline of the trail.

Vegetation Management and Fuels Treatment (MA-PCT-DC-02 and MA-PCT-GDL-02)

Vegetation and fuels management have a high potential to alter the landscape and affect scenic resources. Activities typically reduce scenic integrity in the short term because of the associated slash prior to burning, stumps, and landing and road construction. In the long term, treatment activities may maintain or enhance scenic integrity, scenic character stability, and the ability to resist insects, disease, and large-scale wildfire. Consequently, treated areas may appear moderately to highly altered for longer periods of time, depending upon the treatment and mitigation measures implemented.

Consequences Common to all Alternatives

In all alternatives, vegetation management for ecosystem restoration would be allowed in the Pacific Crest Trail Management Area to retain the desired condition of a naturally appearing landscape. New permanent roads would not be allowed to be constructed within the Pacific Crest Trail Management Area unless they are required by law to provide access to private lands or documented as the only prudent and feasible alternative. Hauling and skidding along the trail would not be allowed to protect the trail integrity (MA-PCT-STD-01). Temporary roads would be allowed within the Pacific Crest Trail corridor and should be designed to minimize visual, sound, and resource impacts to the trail (MA-PCT-GDL-05).

Fuel reduction efforts (such as mechanical thinning) may result in short-term decreases in scenic quality because of cut vegetation, slash, and disturbed soils. Planning for scenic elements and adherence to design criteria would minimize short-term impacts and reap long-term benefits, thereby meeting scenic integrity objectives. Fuel reduction activities should result in more resilient forest conditions, which should be better able to resist uncharacteristic wildfires (MA-PCT-GDL-02).

Management efforts to control insect infestations and diseases that include removal of infected trees and a distance around them often appear as clearcutting to forest visitors. These impacts can occur in areas of high scenic value (like along scenic routes) and may reduce scenic quality in the short term (MA-PCT-GDL-02).

Consequences Common to Alternatives B, C, and D (MA-PCT-DC-02 and MA-PCT-GDL-02)

The management area acres are within the lands suitable for timber production. Management area direction supports vegetation management and fuel treatment to provide for ecosystem restoration and to enhance the trail environment. The short-term effects related to vegetation and fuels management activities may decrease scenic integrity. However, long-term effects should increase scenic integrity and scenic stability by restoring ecosystem functions.

Short-term negative effects to scenic resources would be the greatest under alternative D, which would treat more acres mechanically, with wildfire, and prescribed fire than alternatives A, B, or C. The greatest improvement to scenic integrity and scenic stability over the long term would be realized under alternative D as ecosystem function were restored or maintained.

Lands Special Uses (MA-PCT-SUIT-01 and 03)

Energy corridor rights-of-way, communication sites, and wind towers have a high potential to affect scenic resources for a long duration. Cleared rights-of-way and utility structures contrast

and may be incongruent with existing landscapes. Cleared rights-of-way generally contrast highly with the surrounding landscape.

Consequences Common to All Alternatives

New permits for mineral materials such as sand, gravel, pumice, cinders and other common variety minerals permits would not be issued. Leasable minerals such as oil, gas, and geothermal energy are available for leasing but must contain a "no surface occupancy" stipulation.

Consequences Common to Alternatives B, C, and D

Utility rights-of-way are to be located where impacts already exist and should be limited to a single crossing of the Pacific Crest Trail unless documented as the only prudent and feasible alternative.

Alternative C provides the most scenic protection to the Pacific Crest Trail Management Area from utility development, communication sites, wind towers, and mineral materials and surface occupancy for leasable minerals followed by alternatives B and D. Eighty-nine percent of the trail is within designated wilderness where these types of uses are already unsuitable because of the wilderness designation. Alternatives A and D provides the least scenic protection to the Pacific Crest Trail Management Area and the least restrictions to communication sites, energy development, mineral materials permits, and surface occupancy for leasable minerals communication sites and wind energy development.

Cumulative Environmental Consequences

The cumulative effects analysis area for the Pacific Crest Trail Management Area is all lands the trail travels through in the State of California. This area was selected because of ongoing and proposed activities on neighboring national forests, adjacent State and Bureau of Land Management lands (such as renewable energy development and energy corridor developments), and private lands that the trail traverses connecting to public lands.

Recreation Opportunities and Visitor Use (MA-PCTW and PCT-DC -01 and Potential Management Strategies)

Population growth in California is expected to grow at approximately 500,000 people each year and reach 50 million by 2050 (California 2014). Increased demand for outdoor recreation opportunities and the need for all types of recreation experiences to be improved is expected to continue. Project-level actions taken to limit visitor use on the John Muir Trail and Pacific Crest Trail long distance permits will have connected actions to nearby points of entry and visitors seeking alternative connecting routes to the Pacific Crest Trail. Visitor use management actions by Federal land management agencies to limit impacts to the trail's physical resources and social settings are likely to increase as a cumulative effect.

Competitive Events (MA-PCT-GDL-03)

Trailwide and within California, interest in competitive events for trail running is likely to continue with increases in permit applications for races primarily between Memorial Day and Labor Day. These commercial recreation special use permits are prohibited in designated wilderness and future wilderness designations would also prohibit that activity on approximately 30 percent of the Forest Service trails in California. The remaining 70 percent of the trail system (approximately 11,000 miles) would be available as potential race routes.

Vegetation Management and Fuels Treatment

Vegetation and fuels treatments are planned or proposed for much of the land within the cumulative effects analysis area outside of designated wilderness. This, combined with the planned or proposed treatments within in all alternatives, could result in cumulative effects to scenic resources. More of the landscape, in the short term, would appear to be moderately to slightly altered until the longer-term scenic integrity objective is achieved. In the long term, treatment activities may maintain or enhance scenic integrity, scenic character stability, and the ability to resist insects, disease, and large-scale wildfire.

Lands Special Uses

The trend in increased renewable energy and energy corridor developments are of particular concern south of the Sequoia National Forest and within and adjacent to existing energy projects and corridors. These would be more permanent landscape modifications. Where solar panel arrays and additional wind farms are developed, there may be dramatic changes to the existing landscape and scenic integrity from the physical structures. These types of energy developments would also require additional transmission lines to connect to existing energy corridors and could result in the creation of new energy corridors or expansion of existing energy corridors.

Analytical Conclusions

Overall, based on the amount of area identified within the Pacific Crest Trail Management Area, alternative C provides the most protection for the resources, qualities, values, and associated settings and primary uses of the Pacific Crest National Scenic Trail followed by alternative B, D and A.

Tribal Relations and Uses

Background

This section summarizes the current tribal relations programs on the Inyo, Sequoia, and Sierra National Forests and the potential environmental consequences to tribes and tribal resources of implementing the draft forest plans and the alternatives.

The indigenous peoples of the Inyo, Sequoia and Sierra National Forests have an unbroken union with this place for at least 14,000 years (Moratto 1984; Spier 1978; Jones and Klar 2007). The long-term relationship tribal people have with the landscape differs from that of most members of the public (Zedeño et al. 1997). A tribe's creation accounts, indigenous place names, sacred geography of ceremonial and religious sites, hunting-gathering and fishing areas, and valued resources all culminate to form part of the tribal identity and welfare (McAvoy et al. 2004). Changes in any proportion or condition of these closely tied people, places, and resources can result in impacts or improvements in the health of tribes and the environment. Thus, the rivers, forests, mountains, and meadows we look at on a map or experience on the national forests are intrinsic to the traditions and livelihoods to tribes, and the tribes are very concerned about impacts or changes to those areas.

The Federal government has a trust responsibility to federally recognized American Indians, as well as a public trust for the management of natural, cultural, and heritage resources. As land managers, Forest Service staff know that the areas they currently manage are also ancestral lands to many tribes, creating the need to have effective relationships with these Tribes. The agency is directed by Federal policy, laws, and associated authorities to engage in formal consultation, and to provide avenues for additional communication and collaboration with federally recognized tribes. Nearly every action undertaken by the Forest Service has the potential to affect tribal relations and uses either directly or indirectly (Toupal 2003). Effects to tribal relations and uses can be adverse or beneficial, short term or long term. Some effects may be mitigated or avoided either through tribal consultation (such as, knowledge learned regarding potential impacts or consequences of management actions) or redesign (such as, practices that avoid, reduce, or mitigate undesired impacts) (Toupal 2003; Burger 2008).

Positive relationships with tribes are important to maintain. Tribes maintain traditional ecological knowledge and pass it down through generations through oral and, in modern times, written accounts utilizing contemporary technologies and tools. Resources that are important to tribes need to be reviewed not only as individual resources, but holistically at a landscape level (Zedeño et al. 1997; Watson et al. 2011). Tribal communities are interested in consultation, collaboration, and coordination on overall resource condition of the forests. However tribes are also keenly interested in access to the forests and in vegetation management and watershed function pertaining to ecological goods and services necessary to maintain, enhance, and perpetuate tribal traditions and livelihoods. In managing tribal resources, it is important to consider the ecocultural attributes for associated ecological goods and services that may differ between the public and tribes regarding valued resources (Burger et al. 2008).

The people of various tribes rely on different ecosystems across the bioregion that provide natural and cultural resources necessary to perpetuate tribal traditions and livelihoods (Anderson and Moratto 1996; Lake and Long 2014). This includes gathering from and tending trees such as California black oaks (Haney 1992) and pinyon pines (Zeanah 2002; Farris 1982) for primary

food sources, medicinal plants, basketry and construction materials from plants, the harvesting of fish and game, and culturally important subsistence and spiritual activities (Anderson and Moratto 1996) including cross-Sierra travel and trade trips (Arkush 1994), and sacred ceremonies (Kroeber 1925; Moratto 1984).

The current degraded condition of the National Forest System lands contribute to limited or denied access to traditional foods, leading to food insecurity, increased mental and physical health problems (Jemigan et al. 2012). This also can increase the loss of intergenerational traditional knowledge and practices among tribal communities (Turner and Turner 2008), which is an international and national issue of concern for indigenous peoples (Pimentel et al. 1997; Food and Agriculture Organization of the United Nations 2015).

Analysis and Methods

No modeling was used for this analysis, but there are some frameworks and tools that can be applied for considering risk, or the consequences with alternatives regarding the change in condition or effects, on tribally valued resources and cultural practices in response to alternatives (Toupal 2003; Burger 2008; Pollard et al. 2008). This analysis was developed after a series of meetings where tribes, tribal groups and organizations, traditional cultural practitioners, and other interested individuals consulted and collaborated on the development of the plan (USDA Forest Service 2015). At these meetings, attendees were able to see draft materials and visit with Forest Service officials and staff officers and subject matter experts regarding the intent of revising the plans. Input was considered in developing the proposed action, refining the proposed action, and developing alternatives. The analysis uses a qualitative analysis of the following indicators and measures.

Indicators and Measures

For many years the Forest Service has maintained a primary suppression approach to fire management that has led to great success in initial attack and suppression of wildfires (Show and Kotok 1924; Stephens and Ruth 2005). This fire management approach has been in direct conflict with tribal efforts to continue natural and human-induced fire on the landscape to benefit and maintain tribal uses (Lake and Long 2014). Historic tribal fire use across the landscape provided for the numerous resources that were subsequently encountered by the influx of Europeans (Anderson and Moratto 1996). Ironically, those same newcomers to the Sierra Nevada chastised and subsequently criminalized the traditional practices of the Native Americans' use of fires (Timbrook et al. 1993). Fire suppression has led to excessive fuels loading in ground, surface, ladder, and canopy fuel, which has resulted in large, high-intensity wildfires (Miller et al. 2009) with increased fire intensity and severity, some of which has been attributed to recent climate change (Miller and Urban 1999). These higher severity and more extensive fires across the landscape have and are impacting natural and cultural resources, tribal values, tribal areas of importance, and sacred sites (Timmons et al. 2012; Welch 2012). Tribal values and interests are impacted by both uncharacteristic fire and fire deficits (for example, reduction in natural and tribal ignitions). This change in the frequency and extent of fire has contributed to increased forest density and homogeneity and increased fuel loading of ecosystems. This has made forests harder to travel through by the tribes and has decreased shrub and non-forest.

Tribal access can be affected by policy decisions, administrative actions, and physical impacts on the ground. Specific concerns from resource management activities, including road building or other modifications on the landscape, could affect tribal members accessing valued places

(gathering areas or sacred sites) or practicing cultural activities. These specific concerns are best addressed at the site-specific level during project or activity planning. However, designated areas located in the plan area (such as, wilderness, wild and scenic rivers, and national scenic and historic trails) and recommending additional areas for designation in forest plans might impact the reserved rights and interests of tribes. Wilderness designations are controversial with the general public as well as with tribes (Stumpff 2000). This concern was particularly expressed in tribal forums held on the Sequoia and Sierra National Forests. Forest Service staff recognizes the importance of working with tribes on protected areas, such as wilderness, to create collaborative management strategies that meet mutual interests. The idea of maintaining these areas in their "pristine" condition through a "hands off" approach lacks consideration for traditional ecological knowledge and associated practices conducted by tribes, tribal groups and organizations, and traditional cultural practitioners (Stumpff 2000; McDonald et al. 2000; Watson et al. 2011). This is especially true when it does not recognize that tribes have historically managed these "wilderness" landscapes through the introduction of fire at appropriate times of the year and in specific locations (Blackburn and Anderson 1993).

Plants and animals that are traditionally and currently important for cultural uses (for instance, food, fiber-basketry, medicinal, spiritual) are not able to be sustainably utilized at levels desired by tribes when the ecosystems they occur within are degraded, managed for other conflicting interest or values, or are not accessible to tribes for traditional cultural purposes. Planning fuels and fire treatments across the landscape typically address bio-physical aspects of fire regimes (Collins et al. 2010), but do not commonly incorporate socio-cultural values with the understanding of how tribal communities are dependent upon fire in different ecosystems, habitats, and a range of resources affected by fire in the short-and long-term necessary to perpetuate tribal traditions and cultural practices (Toupal 2003; Anderson and Moratto 1996; Raish et al. 2005; Carver et al. 2009). Traditional knowledge can inform fuels, wildfire, and forest management approaches better suited to address tribal concerns, as well as aid in fulfilling the trust responsibility for the management of natural and cultural resources (Mason et al. 2012; Lake and Long 2014)

Reduction of Threat of Wildfire to Tribal Resources

Large, high-intensity wildfires damage and destroy resources and sites important to tribes. The alternatives take different approaches to reduce fire threat across the national forest. The reduction in fire threat is evaluated in the "Fire Management" section.

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Many sites of importance to tribes and many resources of tribal interest are located in remote locations and have been used traditionally for many generations. Designating these areas as wilderness may limit or impair access to these sites or the ability of tribes to continue to conduct ceremonies and gather resources in traditional ways, including managing the land using traditional practices. The area of recommended wilderness in each alternative is used as a proxy for the potential to impact tribal use of the land and resources.

Number of Sites Restored Specifically for Tribal Resources

The environment surrounding resources of tribal importance was directly or indirectly managed for thousands of years by tribes. With modern management and the current changed environment, many resources used by tribes are in diminished quantity and quality and are in need of restoration. The alternatives vary in their approach to improving resources of tribal importance.

Assumptions

- The potential effects to tribes and tribal resources is an agency consideration at the outset of any and every project planning process.
- Each of the national forests will continue to regularly conduct Government-to-Government meetings to provide opportunities to the tribes to consult on all proposed activities on national forest lands. Consultation with tribes is guided by a variety of laws, regulations, Executive orders, and policies that provide direction for interacting with tribes on national forest lands. For example, USDA Departmental Regulation 1340-007 (USDA 2008) provides policy and implementation guidance to implement the 2000 Executive Order 13175 on Consultation and Coordination with Indian Tribal Governments. This guidance is independent from forest plan direction and does not change across alternatives.
- The Forests will continue to also include tribal groups and organizations, traditional cultural practitioners (USDA 2008) and interested individuals in discussions about tribal relations and uses.
- The tribal relations programs on each national forest may need to increase as tribal consultation increases. Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals have expressed an interest in more opportunities to consult and collaborate on proposed activities. This may be a challenge given expected budgets.

Affected Environment

Forests often serve as sources of traditional medicines, food, firewood, and basketry materials for tribes. Certain areas may also be particularly sacred and valued for their importance in sustaining cultural traditions and beliefs. When implementing the forest plan, the Forest Service may through separate decision conduct or authorize various types of activities that have a substantial impact on tribes (Vogel 2001, Toupal 2003, Burger 2008). Those impacts would vary widely depending on the level of collaboration maintained with tribal concerns. These could include grant programs, timber sales, mining, road building, recreational development and use, archaeological excavations, energy development, and other program and project activities (Yablon 2004).

Many cultural resources are both fire- and water-dependent. Basketry materials such as redbud, deer grass, willow, chaparral, and sour berry bush need fire enhancement (Anderson 1999). Mints and various teas and medicines, such as yarrow, thrive on water and are found in wetlands, meadows, and water drainages, but still need fire to maintain their health and usability (Anderson and Moratto 1996). Without an occasional burn these resources would become less abundant, have increase diseases or pests, and develop morphological characteristics unsuitable for traditional uses. Similarly, without fire, meadows, creek banks, and river and lake shores become overgrown with stronger, bigger vegetation (like willows, alders, and conifers that require more water from the water table). Acorn (oaks) and pine nuts (pines) are the least ground-water-dependent food sources, but they must be able to absorb precipitation. Without a good rainfall or when too much overhead canopy develops, acorn and pine nuts will either not grow or they will not produce at the levels desired by tribes. Fire helps to reduce the canopy, and the amount of duff on the ground, which can become breeding grounds for insects that destroy the acorn and pine nut crops (California Department of Water Resources 2014).

Environmental Consequences to Tribal Relations and Uses

Consideration of Climate Change in Alternatives

Climate change and associated disturbances (for example, drought, fire, insect outbreaks) have in the past (North et al. 2009), are now, and will likely continue (Lenihan et al. 2003; Moritz and Stephens 2008) to affect tribally valued resources (Voggesser et al. 2013; Chief et al. 2014). Several climate change-related risk and modeling assessments have been completed that include the geographic scope of the planning area (Sierra Nevada Alliance 2010).

Current and projected changes in forest and water resources affecting tribal communities are considered in the analysis of the alternatives (see the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections). Vulnerability of valued natural resources, tribal coping, and adaptive strategies can be informed by tribal consultations (traditional ecological knowledge) and available assessments specific to tribes (Alexander et al. 2011). Incorporating strategies and actions from climate vulnerability assessments and risk assessments for species and forest resources may need to be broadened to mitigate the potential impacts of climate change on tribal communities at a scale beyond the influence of the forest plan (Burger 2008; Burger et al. 2008). For example, the use of strategic vegetation restoration may reduce the spread of wildfires, and reduce threats to communities, but have little influence on drought and vegetation response in more remote areas where tribal activities occur. Similarly, focusing on increasing water availability for domestic uses in dams and reservoirs may not address the need for improving water supply in seeps and springs that have been traditionally used by tribes. Assessments and planning tools generally are not specifically applicable to tribes, as tribes are only identified as other "stakeholders" (Sierra Nevada Alliance 2010). Other Federal and state agency approaches have used tribal consultation framework to solicit and incorporate tribal traditional ecological knowledge in to climate-related assessments (California Natural Resource Agency 2014).

Consequences Common to all Alternatives

All alternatives retain and continue with existing tribal consultation, sacred site, and non-timber forest products mandates and agreements. Forest plan direction for resource management, such as heritage, vegetation, soils, water, riparian, aquatic, and wildlife, for all alternatives is designed to provide for protection of cultural resource sites or traditional cultural properties.

Resources of tribal importance, such as oaks, are indirectly benefited by restoration actions that thin trees around medium- and large-diameter oaks where they can form fuller, healthier crowns thereby improving the number and quality of acorns produced. All alternatives would also provide for habitat and watershed conditions that would greatly contribute to species viability at sustainable and harvestable levels. Invasive species would be managed to avoid encroachments on culturally significant foods, fiber/material, and medicinal resources. Also, resource conditions would be monitored.

Researchers have worked with tribes in other regions to identify and address approaches for mapping tribal landscape values related to fuels and fire management that can benefit tribes by enhancing access to and the quality for resources (Carver et al. 2009; Lake 2013). Fire can be targeted at specific locations, forest types, or habitats to promote a range of tribally valued resources. For example, in riparian areas where a decreased water supply has degraded vegetation, fire can be used to emulate flooding disturbance to enhance willows for basketry materials and wildlife habitats, burning in oak-dominated forests to increase access to acorns and

feeding locations for wild game as well as reduce insect infestations (such as, acorn weevil and moth pests) that damage traditional food sources (nuts, berries, greens) or species gathered for traditional purposes (Anderson 1999). Fire can also be used in different seasons for different objects or to align both public and tribal objectives, such as reducing hazardous fuels around communities and enhancing access to desired forests and resources (Carver et al. 2009; Lake 2013). This increased consideration of the approach and timing of restoring fire to the landscape would occur in all alternatives.

Management activities (such as, mechanical thinning, prescribed burning, managing wildfires to meet resource objectives, and recreation), implemented to avoid or mitigate adverse effects to heritage and cultural resources and tribal values (Carver et al. 2009), may afford greater protection compared to consequences from continued forest growth and increasing forest density leading to larger and higher intensity wildfires (Miller and Urban 1999; Miller et al. 2009). Activities associated with wildfire suppression under emergency conditions can inadvertently have adverse impacts to heritage and cultural resources (Welch 2012). Such impacts could result from fire suppression actions of running a dozer line through sites and areas important to tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals. Other examples are burnout or back burning that adversely affect sites, or establishing water bars on firelines and leaving excessive vegetation cover to prevent erosion during mop-up and burn area emergency response that could reduce access and mobility of tribal practitioners who use the fireline that is often along a former historic Indian trail along ridge systems (Lake 2011; Welch 2012). It is standard practice to use resource advisors during wildfires to help identify cultural resource and mitigate or avoid impacts. Additionally, national forest personnel may consider developing fire management agreements with tribes whereby tribal representatives and heritage consultants are officially designated within the incident management team organizational structure for wildfires (Lake 2011).

Consequences Common to Alternatives B, C, and D

The emphasis on variable treatment intensities and on vegetation heterogeneity in alternatives B, C, and D should provide additional opportunities for tribes to consult, collaborate, and actively participate in planning processes, as well as identify potential mechanisms for how they can be involved with the implementation of landscape restoration treatments (for instance, Tribal Forest Protection Act and along Federal/tribal jurisdictional boundaries).

The proposed forest plans would include the desired condition that “the need for tribal access to traditional sites is acknowledged and supported.” While the tribes need access to traditional areas and sites, there are some sacred sites where American Indians conduct ceremonies that require privacy and solitude and free from auditory or visual distractions and obstructions. Building roads to or near such sites may lead to increased visitation by the public or Forest Service staff that could affect ceremonies and undermine cultural practices. Roads or resource management activities may also alter the character and diminish the value of historic or cultural places. Consultation would occur to identify concerns and adjust management so that adequate access for agency management or public use does not compromise cultural practices at traditional, cultural, and spiritual places.

The forest plans would include a possible management approach recognizing that the national forests could increase their capacity to improve tribal relations by considering employee exchange opportunities carried out under “Service First” or other mechanisms, beyond standard agency workforce cultural transformation mandates that focus on hiring diverse personnel

(Brown and Harris 1993). Providing opportunities for tribal relations staff to temporarily exchange jobs would provide a better reciprocal understanding of programs and promote better utilization of tribal programs and legislation that would mutually benefit the national forests and tribe. This approach is similar to interagency details, and could extend to inter-governmental details for work assignments between tribes and the Forest Service, or at higher regional or national scales with agreements between the Bureau of Indian Affairs for tribes and the Forest Service.

Consequences Specific to Alternative A

Alternative A represents the continuing direction from the existing plans (as amended). The forest plan revision process has provided tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals additional information regarding the planning process in general. Tribes have expressed an interest in not doing business as usual. While the government-to-government meeting process improves communication and is used in alternative A, tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals may have fewer opportunities to be involved in the management process and to maintain or improve tribal values. Alternative A does not have tribal interests and values integrated explicitly into plan components as much as the other alternatives.

Reduction of Threat of Wildfire to Tribal Resources

Alternative A reduces fuels to try to reduce the impacts of large, high-severity wildfires that can affect tribal resources and values, but at a pace and scale where large fires are still likely to occur. This may benefit oak trees in the long term where large fires kill conifer trees and where oaks resprout, but it would take many decades before burned mature oak stands can recover and produce acorn crops suitable for gathering and use.

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative A would not add new areas recommended for addition to the National Wilderness Preservation System and would not contribute to the potential for reduced access. Alternative A would not add additional constraints on tribal access to gather, use resources, or hold ceremonies in these areas.

Number of Sites Restored Specifically for Tribal Resources

Under alternative A the forests opportunistically develop or design projects specifically to improve or maintain resources of tribal importance. Very few if any improvements are made specifically to benefit resources of importance to tribes.

Consequences Specific to Alternative B

Alternative B is the draft forest plans that were developed to carry forward existing direction still relevant and not in need of change and to address those identified needs for change based on comments received during the scoping process and input from tribal forums hosted by each national forest. It includes integration of tribal interests and values in desired conditions for other resources and a plan objective to restore areas of tribal interest.

Reduction of Threat of Wildfire to Tribal Resources

The proposed increase in pace and scale of ecological restoration under alternative B could improve ecological sustainability and benefit tribal interests and values when projects incorporate traditional ecological knowledge, support active involvement (such as, Government-to-Government consultation and coordination), and foster traditional management practices (Carver et al. 2009). For example, areas that are important for basketry materials or traditional food sources would benefit from hazardous fuels treatments that reduce surface and ladder fuels, or tree density that foster access and mobility, as well as increase the observation and locating of valued resources. This alternative considers opportunities for managing wildfires to meet resource objectives that can be informed by the tribal consultation process and collaborative fire planning. For example, national forest Heritage Program staff consult and communicate with Tribal Historic Preservation Officers and tribal leadership about identifying landscape values at risk, and under what conditions fire should be suppressed or managed for ecological and cultural resource objectives. See details for "Wildland Fire Decision Support System" (Noonan-Wright et al. 2011), and for "Heritage/Tribal Values" (USDI BLM 2010; Welch 2012; Timmons et al. 2012).

An increase in pace and scale that incorporates traditional ecological knowledge (Lake and Long 2014) could provide opportunities to tribes to develop tribal economies (Carver et al. 2009). In general, ecological sustainability benefits tribal interests, and can foster access to and support uses of habitats and resources for traditional cultural purposes. See sections on ecological sustainability of terrestrial, aquatic and riparian ecosystems for more detail. Most, if not all, of traditional tribal management and uses were and are compatible with modern principles of ecological sustainability. Ecological restoration projects that incorporate tribal place-based knowledge would provide tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals with opportunities to protect, restore, and preserve traditional gathering areas, ceremonial areas, and sacred sites (Watson et al. 2009).

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative B would add new areas recommended for addition to the National Wilderness Preservation System on the Inyo National Forest. While many tribal activities could still occur within areas recommended for wilderness, some activities such as gathering and ceremonial uses may be restricted or more difficult if areas are managed as wilderness.

Number of Sites Restored Specifically for Tribal Resources

The Inyo National Forest includes a plan objective to implement 1 to 5 restoration or maintenance actions to enhance resource availability for traditional tribal collection activities; the Sequoia and Sierra National Forests include a plan objective to implement restoration or maintenance actions on 3 to 10 areas of tribal importance per decade. These projects would be determined in consultation with the tribes and integrated with other restoration projects where possible. While these activities could occur under alternative A, they are more likely to occur under alternative B because of the specific plan objective.

In addition to areas improved specifically for tribal resources, alternative B includes desired conditions for tribal relations and uses that encourage the coordination with tribes to recognize traditional ecological knowledge in managing resources. This encourages silviculture and fuels managers to design mechanical treatments to restore tribally valued trees or use areas while simultaneously achieving other restoration needs. Ecological restoration of springs and meadows would consider those that are important for many tribal uses, including meadows and water

sources along cross-Sierra traditional travel routes (Arkush 1993; Chartkoff 2001). Reintroducing fire that increases ecological sustainability is beneficial to tribes when designed to avoid using diesel and gasoline such as drip torch fuel mix where basketry and food plants are gathered, as well as considering appropriate seasons and frequencies of burning.

Consequences Specific to Alternative C

Alternative C places an emphasis on providing more short-term protections for wildlife habitat by reducing the amount of mechanical thinning and emphasizing more use of fire to restore ecosystems. This alternative proposes recommending more acres of wilderness than other alternatives.

Reduction of Threat of Wildfire to Tribal Resources

Alternative C treats the least amount of area to restore vegetation and reduce the risk of large, high-intensity wildfires using mechanical treatments. Alternative C is designed to achieve a reduction in the risk of large wildfires through thinning only smaller trees and using prescribed burning. The areas with prescribed burning could benefit resources of tribal interest by restoring fire to the ecosystem. Here is the most area untreated of all the alternatives and the risk of large, high-intensity wildfires is the highest of the alternatives B, C, and D, leaving many resources of tribal interest at high risk.

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative C would add the largest number of new areas recommended for addition to the National Wilderness Preservation System. While many tribal activities could still occur within areas recommended for wilderness, some activities, such as gathering and ceremonial uses, may be restricted or more difficult if areas are managed as wilderness.

The western approach toward the adoption of wilderness has been found to be controversial in the Native American communities (Watson et al. 2011). Tribal leaders and traditional cultural practitioners are concerned that access to sacred places, traditional gathering areas, and tribal resources would be impacted with additional wilderness designation. Most of the tribal opinions are opposed to the addition of wilderness areas because, historically, the tribal communities had access to their entire ancestral territory and actively managed those lands now titled as wilderness through the use of fire for cultural subsistence, ceremonial, and livelihood objectives at the appropriate times and places (Anderson and Moratto 1996). Wilderness designation can hinder access to, and severely limit desired tribal practices in tribal cultural properties (Parker and King 1998) as well as traditional gathering areas, and may limit or potentially prevent some traditional practices from occurring (Zedeno et al. 1997). Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals also commented that additional restrictions that wilderness status and regulations impose may include the number of people who gather at a site for religious purposes may be limited and infringe upon tribal rights. Conversely, some tribes believe that designating areas as wilderness may afford those locations with what tribes would consider as “last resort” significant protections that could prevent over access and damage to sacred sites (TRIB-FW-DC-02). Management plans for wilderness areas would include tribal perspectives (TRIB-FW-DC-01) and attempt to incorporate traditional ecological knowledge (TRIB-FW-DC-04) and associated traditional practices (TRIB-FW-DC-03) to maintain the integrity of the area similar to “pristine pre-contact” conditions based upon desired conditions and goals (TRIB-FW-GOAL-01 and 04) that are common to the alternatives B, C, and D.

Number of Sites Restored Specifically for Tribal Resources

Alternative C would have the same number of sites restored specifically to benefit tribal resources as alternative B. However, more of the restoration would be accomplished with prescribed burning and with hand treatments and limited mechanical thinning to remove only small-diameter trees due to restrictions on tree removal for other wildlife species. On the Sequoia and Sierra National Forests, for example, this may limit the ability to remove encroaching conifer trees near oak trees important for gathering more than the other alternatives.

Consequences Specific to Alternative D

Alternative D is the most aggressive in terms of emphasizing an increased pace and scale of ecological restoration. Whenever there is an increase in development, such as the increase in recreation opportunities afforded under this alternative, or an increase in the scale of treatments, there is potential for increased direct and inadvertent effects to tribal resources, traditional cultural properties, and sacred sites. This is especially true given the small amount of lands on each national forest that has been inventoried for heritage resources (see "Heritage Resources" section).

Reduction of Threat of Wildfire to Tribal Resources

Alternative D reduces the threat of wildfire to tribal resources the most of all alternatives. The most areas in focus landscapes and the most strategic areas along roads and ridges would be treated. This presents a higher potential for inadvertent impacts to tribal resources in the short term, but with greater long-term benefits by restoring tribal uses areas across the landscape.

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Similar to alternative A, there are no additional areas recommended for wilderness in alternative D. Areas that are currently accessible and used by tribes would continue to be accessible.

Number of Sites Restored Specifically for Tribal Resources

The number of sites restored specifically for tribal resources would be the same as alternative B. There would be more areas restored indirectly due to the larger treated area where vegetation desired conditions could also favor improvement of conditions for resources of value to tribes such as oaks, pinyon pine, willow, or meadows.

Cumulative Effects

Tribes, tribal groups and organizations, and traditional cultural practitioners depend on the land and resources that cross multiple jurisdictions and ecosystems. Much of the lands in the analysis area is managed by Federal land management agencies which all have requirements for Government-to-Government meetings with tribes to consult and coordinate management of the land and resources to meet tribal and agency responsibilities. Land and resource management under the forest plans is generally consistent with management across the Federal agencies regarding tribal relations and uses. The increased emphasis on restoring fire to the landscape in all alternatives would complement the increased restoration of fire within adjacent national parks resulting in increased resilience of sites and resources important to tribes across a mixed-jurisdictional landscape.

Analytical Conclusion

All alternatives would continue the important Government-to-Government meetings for activities that may affect tribes. Alternatives B, C, and D include additional plan direction that improves the integration of tribal interests into restoration project planning. These alternatives would provide for increased opportunity to improve access to and use of resources important to tribes, tribal groups and organizations, and traditional cultural practitioners.

All of the alternatives could have some level of effect on tribal heritage resources given that less than one-fifth of the plan area has been systematically inventoried for heritage resources and that most known recorded sites remain unevaluated for their qualifications for inclusion in the National Register of Historic Places. Meeting the increased pace and scale of restoration treatments would require a variety of management practices to ensure compliance with section 106 of the National Historic Preservation Act. This includes pre-project surveys for heritage resources and tribal consultation and collaborative risk planning between Forest Service heritage and cultural resource staff, Tribal Historic Preservation Officers, and involved tribal practitioners, to predict where particular valued resources or potential sacred sites may occur in anticipated treatment areas (Welch 2012; Timmons et al. 2012).

Reduction of Threat of Wildfire to Tribal Resources

The amount of active vegetation management that might reduce threats from large, high-intensity wildfires to sites and resources of tribal importance increases the most in alternative D, followed by alternative B. It would remain the same as current levels in alternative A and could decrease in alternative C resulting in an incremental loss of sites or diminished access to resources used by tribes over time. The use of prescribed burning would reduce risks from future wildfire and would improve conditions for many resources of interest to tribes. All alternatives would address minimizing impacts to tribes at specific locations during project planning, and alternatives B, C, and D include specific plan direction to incorporate opportunities to improve sites and resources important to tribes during project planning.

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternatives A and D would have the least impact to access to sites and resources by tribes, tribal groups and organizations, and traditional cultural practitioners since no new areas would be recommended for wilderness designation. Alternative C would have the most potential impact because access to and use of areas may create additional barriers for tribal members. The ability to conduct ceremonies and to gather resources could be impaired or limited in areas managed to maintain their wilderness characteristics. Ground-disturbing activities associated with tribal use of these areas may be limited or perceived to be unacceptable by the public. Alternative B includes some areas recommended for wilderness designation on the Inyo National Forest. Access to and use of resources in these areas would be similar to those described for alternative C.

Number of Sites Restored Specifically for Tribal Resources

Alternatives B, C, and D include a plan objective that provides tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals with opportunities to protect and restore sacred sites and resources used traditionally by tribes, and to provide opportunities for consultation, engagement, collaboration, and tribal economic benefits and values. In addition to those specific restoration projects, alternative D would provide more opportunities to restore other sites and resources than alternative B by having more landscape

restoration treatments. Alternative D would also require more coordination to protect tribal sites and resources due to the increased amounts of mechanical treatments. Alternative C provides fewer additional opportunities to restore tribal resources because mechanical treatments are more limited and instead relies more heavily on prescribed burning. This may result in less opportunity to protect individual tribal resources such as large old oak trees on the Sierra and Sequoia National Forests from damage during burning because mechanical pre-treatment to reduce or rearrange fuels is less likely to occur.

Benefits to People and Communities

Background

This topic is divided into three sections that address the social and economic benefits derived from the national forests: forest products and management, economic conditions, and social conditions. These areas are of particularly high interest to the public and are a focus of the 2012 Planning Rule. A strong emphasis on integration of social, economic, and ecological considerations occurred during the development of the emerging plan components of the draft forest plans and the alternatives in this draft environmental impact statement. Thus, social and economic consequences are also mentioned in other revision topics, and this section, especially the economic conditions and social conditions, rely heavily upon the analysis presented in those other topic areas. This section focuses on the economic and social consequences of the alternatives.

Forest Products and Management

This section addresses the subject of providing forest products and summarizes the current environment on the Inyo, Sequoia, and Sierra National Forests in terms of estimated available forest product quantities by alternative and the resources associated with harvest of those forest products. Forest products discussed in this section include those that would be harvested on lands suitable and not suitable for timber production, as determined in the timber suitability analysis. This analysis, along with the sustained yield limit and the projected wood sale program can be found in "Appendix A: Timber Suitability and Management."

The desired conditions for forest products and management are:

1. Predictable and sustainable forest product yields contribute to maintaining and improving local and regional industry infrastructure sufficient to meet the needs of the desired pace and scale of ecological restoration over the next several decades.
2. Production of timber contributes to ecological, social and economic sustainability, and associated desired conditions. A sustainable mix of forest products (including both sawtimber and non-sawtimber) is offered under a variety of harvest and contract methods in response to market demand and restoration needs.
3. Salvage of dead and dying trees captures as much of the economic value of the wood as possible while retaining key features in quantities that provide for wildlife habitat, soil productivity, and ecosystem functions.

Further analysis related to forest products and management may also be found in the "Terrestrial Vegetation" section, "Socio-economic" section, and "Appendix A: Timber Suitability and Management."

Background

The southern Sierras have a rich history of timber production (McKelvey and Johnston 1992). Timber harvest began in the early 1800s, emerging as a core occupation following the gold rush of 1848 to support mining communities. Timber was primarily used for housing construction, mining support, and railroad ties. The most efficient mode of transportation was by river, but logs were also transported via railroad in the central Sierra Nevada and by V-shaped flumes in the

southern Sierra Nevada. Due to costly harvest and transport, only high value species such as ponderosa and sugar pine were harvested until the early 1930s, when more efficient logging equipment was available.

Concurrently, starting in the early 1900s, a shift toward suppression of wildfires occurred which allowed many seedling and sapling trees that would have been periodically thinned by fires to survive and grow (North et al. 2009). In the mixed conifer zone the seedlings and saplings were often tree species like incense cedar and white fir that grow in the shade of other trees. The ingrowth of these trees and the lack of periodic thinning by fire or management contributed to the incremental increase in forest density over time to the point that many forest stands today are substantially denser than they were historically, reducing their resilience to stressors such as drought, insects, and pathogens.

Timber harvest on national forests increased after World War II, peaking in the 1970s. Timber harvest in the 1970s to 1990s consisted primarily of even-aged management: clearcutting stands of ponderosa pine, mixed conifer, and red fir, followed by reforestation. These harvests for regeneration purposes produced larger, more valuable timber sales, which funded much of development and maintenance of the current transportation system. The retention of timber receipts in trust funds for reforestation and other resource enhancement use (specifically, the K-V funds established by the Knutson-Vandenberg Act of 1930) provided for plantation maintenance and fuel reductions in natural stands among other activities (FSH 6509.11, chapter 71.1).

In the 1990s, timber harvest methods shifted from primarily even-aged management to more stand-maintenance-thinning prescriptions, focusing on pine and mixed conifer in the lower to mid-slopes. This shift in management was the result of changing management objectives, generally geared toward reducing impacts of timber harvest on habitat for species such as the California spotted owl, and reducing fuels and the threat of wildfire in wildland-urban intermix areas. Much like thinning carrots in a garden, thinning trees in a forest reduces the number of trees on a site, allowing remaining trees to increase crown and photosynthetic production, and overall growth rate. By reducing competition the residual trees grow larger and faster than in untreated stands, allowing them to grow taller to capture more sunlight and larger to develop thicker bark to be more resilient to periodic fire and ultimately better preparing them to survive to become large and old trees.

Current thinning practices on national forests in the Sierra Nevada maintain key ecological features such as biological legacies, snags, and large down logs, favoring retention of the larger, older cohort. Biological legacies are trees that are substantially larger and older than the majority of the trees on the landscape, likely retained during previous harvests or survivors of stand-replacing disturbance events; often with cavities or other valuable wildlife characteristics. In the short term, thinning of small-diameter trees improves forest health and fire resilience of the residual forest. In the long term, favoring only larger, older trees, and removing the younger cohort, eventually results in a decline in overall stand health as older trees succumb to insects or disease in these dynamic systems. To achieve long-term sustainability, forests should be managed to provide for heterogeneity (variety) of open and dense clumps and stands of trees with abundant old trees and a mixture of age classes across the landscape. This can be accomplished in the current, more homogeneous forest by using forest management techniques such as group selection (the creation of gaps in a forest canopy by removing small patches of trees) combined with periodic selection or variable density thinning to achieve restoration objectives, maintain habitat connectivity, and contribute a dependable flow of forest products to existing and prospective local economic infrastructure (North et al. 2009; Schmidt et al. 2009).

Since adoption of the original forest plans in 1988 for the Inyo and Sequoia National Forests and 1992 for the Sierra National Forest, timber harvest from national forests has steadily declined for a number of reasons including policy and legal constraints, restrictions on harvesting in unroaded areas, prescriptive and restrictive forest plan direction that limited the intensity and extent of tree removal as a forest management tool, and appeals and litigation of individual projects. This has contributed to a loss of the forest industry infrastructure in the southern Sierra Nevada, except for one remaining mill at Terra Bella and small local operations for production of commercial firewood or other specialty wood products.

Current levels of tree mortality, linked to the collective effects of insects, pathogens, and a warming climate—all exacerbated by 4 years of below-average precipitation—appear likely to affect future yields of forest products. While projected harvests are well below annual growth rates, the sudden loss of living conifers, over extensive acreages, may result in reduced yields in areas where mortality is high. Prompt and effective reforestation can reduce this effect, but, at least in the context of watersheds, be unable to provide sawtimber-sized trees for several decades.

Analysis and Methods

Analysis Area

While the analysis area consists of all National Forest System lands within the southern Sierra forests, the primary focus includes lands identified as suitable for timber production.

Lands Suited for Timber Production

Lands identified as suitable for timber production include forested lands not administratively withdrawn that have a reasonable assurance of regeneration, and where forest management is consistent with other multiple-use management objectives. Approximately 537,000 acres within the southern Sierra Nevada forests area are considered suitable for timber production. See Table 150 and maps in volume 3 for composition of lands suitable for timber production by cover type, and appendix A for more detailed methodology on the determination of suitable lands.

Lands Not Suited for Timber Production

Timber harvest may be used as a tool for purposes other than timber production in order to enhance other multiple use values. Forest product removal from lands not suited for timber production is most common in response to salvage, hazard-tree removal or other safety concern, scenic vista enhancement, fuel reduction, wildlife habitat improvement, or access, among other reasons. In addition, timber harvest on lands not suitable for timber production may respond to restoration objectives such as conifer encroachment in meadows, aspen enhancement, or hardwood restoration. In these cases, timber harvest would be used as a tool to achieve the desired conditions, but is not part of the programed regeneration harvest plan for lands deemed suitable for timber production. As forest product removal from these lands is more responsive than proactive, these lands are not the focus of this analysis and will not be discussed further in this section.

Temporal Scale

The analysis period consists of two decades (20 years). Although the National Forest Management Act provides that forest plans are to be revised at least every 15 years, it limits the sale of timber to less than the sustained yield limit for each decade of the plan (16 U.S.C. 1611). Providing estimates of the annual projected wood sale quantity and the annual projected timber

sale quantity, for each of first two decades, aligns with the National Forest Management Act decadal periods limiting the sale of timber, and provides an estimate for the second decade, if revision of the plan is delayed beyond the 15-year period.

Indicators and Measures

- Amount of forest products removed is a measure of volume. Generally, sawtimber is measured in hundred cubic feet or million cubic feet; fuelwood volume is generally measured in cords. (*Note:* Volume calculations were determined utilizing the Forest Vegetation Simulator (Dixon 2002) to model Forest Inventory and Analysis data by vegetation type and prescription class.)
- Area restored to improve forest health and resilience to disturbance is measured in acres. (*Note:* Area treated is a function of available area and workforce capability to treat these acreages.)

Assumptions

- "Area restored" refers to areas that are treated and a commercial timber product removed. An area where prescribed burning only or other service work is performed, is not a measure under the forest products indicator.
- It is assumed that a sustainable supply of sawtimber will enable the existing mill in Terra Bella to continue to operate through the 20-year analysis period. Timber industry representatives indicate approximately a minimum of 50,000 hundred cubic feet removed annually from the Sierra and Sequoia National Forests would ensure persistence (USDA FS 2013a, 2013b).
- It is assumed that commercial forest product opportunities (beyond fuelwood and other specialty wood markets) on the Inyo National Forest will continue to be limited due to the haul distance to existing mills.
- It is assumed that opportunities to utilize biomass will remain the same for the first decade of the analysis period, but could increase in the second decade if a demonstrated consistent supply of biomass leads to new facilities or utilization opportunities.
- It is assumed the contract authorities for forest product removal will continue to include timber sales, stewardship contracts (both integrated resource service contracts and integrated resource timber contracts), and stewardship agreements.

Affected Environment

The Inyo, Sequoia, and Sierra National Forests comprise approximately 4.6 million acres of land, including approximately 60 percent forested lands. These forested lands consist primarily of Sierra mixed conifer, pine (specifically, eastside pine, ponderosa pine, Jeffrey pine), and red fir stands. Nearly 3.2 million acres are withdrawn from timber production due to administrative designations (such as, National Wilderness Preservation System, inventoried roadless area, experimental forest, research natural area, and other designated areas (appendix A). Of the remaining forested area that is not withdrawn, a total of 415,646 acres to 540,247 acres, depending on the alternative considered, have a reasonable assurance of successful conifer regeneration and are on lands with management objectives consistent with timber harvest being a primary or secondary multiple use objective. These lands are identified as suitable for timber production. Table 150 displays the percentage of area in the major California wildlife habitat relationship cover types for alternative B. The percentages do not change substantially for the

other alternatives. See appendix A for more information regarding timber suitability determinations for each alternative.

Table 150. Percent of cover type of lands suitable for timber production, combined for Inyo, Sequoia, and Sierra National Forests, alternative B

Cover Type	Percent
Sierra Mixed Conifer	41
Red Fir	12
Eastside Pine	11
Ponderosa Pine	11
Montane Hardwood-Conifer	10
Jeffrey Pine	7
Montane Hardwood	5
Lodgepole Pine	2
Other	1

The Inyo, Sequoia, and Sierra National Forests provide timber to three remaining sawmills: Sierra Forest Products in Terra Bella (Tulare County), and Sierra Pacific Industries in Chinese Camp and in Standard (both in Tuolumne County). The Terra Bella mill is the last remaining sawmill in California south of Yosemite National Park. While the Sierra Forest Products mill in Terra Bella is the closest mill to the Inyo National Forest, haul distances of over 600 miles are often cost prohibitive. The Sierra and Sequoia National Forests are the primary sources of Federal sawtimber products.

Maintenance of local forest products infrastructure is key to sustainable restoration goals. Not only does timber harvest contribute to the economy in an ecologically sustainable way, it is a tool used to improve forest health by reducing densities in a precise manner, unlike disturbance agents, such as, insects, pathogens, and wildfire and the other management tools of prescribed fire. Timber harvest can identify specific trees to remove or retain and can manipulate the distribution of fuels to influence the effects of prescribed burning or wildfire on residual trees and other desired resources, such as particular nest or denning trees or snags used by wildlife. As with all actions, timber harvest is designed to achieve desired conditions, taking into account other appropriate management objectives such as riparian habitat conservation, habitat management, and scenic stability.

The availability of sufficient sawmill infrastructure is an essential requisite for efficient timber production. The sustained supply of sawtimber likely enables business decisions that lead to maintenance and investments in infrastructure to support current deliveries. Expanded supplies may lead to expanded investments that provide for expanded timber production on related forest lands. In the absence of a consistent flow of forest products at levels that can sustain the infrastructure, the sawmill at Terra Bella is unlikely to keep operating.

On National Forest System lands, trees too small for use as sawtimber can often be removed and utilized as biomass, providing enhanced forest management capabilities. Projects that are able to efficiently remove both sawlogs and biomass products are capable of meeting a broad set of management objectives. A dependable supply of valuable forest products enhances the likelihood that infrastructure would be available to meet these needs.

Forest Products

The term "forest products" refers to sawtimber, the most common commercial wood product. The three southern Sierra forests have supplied an average of approximately 3.7 million cubic feet of sawtimber per year, with the Sierra National Forest providing approximately 90 percent of that volume. In addition to sawtimber, the forests also supply pulpwood, posts, poles, firewood/fuelwood, wood pellets (for home and industrial heating), and biomass (substituting for fossil fuel, to generate electricity). Many forest users including tribes, residents, and recreationists participate in firewood collection. This has averaged approximately 11,000 cords per year across all three forests, with the Inyo National Forest contributing over 40 percent of the total fuelwood volume sold (data derived from Region 5 Cut and Sold Reports, 2010–2014, USDA FS 2016).

Special Forest Products

The southern Sierra forests are also a source for a variety of special forest products. Special forest products are generally collected in small quantities for personal use, or larger amounts for commercial purposes, and are often authorized through a permit system. These products may include: bark, berries, boughs, bulbs, Christmas trees, cones, ferns, fungi (mushrooms), mosses, nuts, roots, seeds, transplants, and wildflowers. Forest users, including tribes, depend on many of these special forest products for their medicinal properties, decorative uses, native propagations, landscaping, family or tribal tradition, or for ceremonial purposes.

Area Restored

Many decades of fire suppression have resulted in overcrowded, dense forests, vulnerable to disease and insect infestation, uncharacteristic wildfire, and the effects of a warming climate. Many management methods (including timber harvest, prescribed fire, mastication, hand piling, and burning) can and would be utilized to restore the landscape to a more resilient condition. The most common treatment is thinning, which improves forest health and resilience and can often move treated areas more directly toward desired conditions. Group selection is utilized to promote shade-intolerant species (specifically, pine) regeneration by creating small openings that are large enough that seedlings that need sunlight can grow. Group selection also restores seral stage heterogeneity that has been lost due to the ingrowth of shade-tolerant species and the reduction in thinning that would have occurred by wildfires because of fire suppression. When available, revenue generated from timber removal may be reinvested into other more expensive restoration treatments.

Environmental Consequences

Consequences Common to all Alternatives

Special Forest Products

Utilization of special forest products and personal-use fuelwood is generally anticipated to remain consistent with current conditions into the future, with minimal increases due to population trends. It is also anticipated to be relatively consistent across all alternatives. While alternative C includes additional acres recommended for wilderness designation, this is not anticipated to play a significant role in special forest product and fuelwood availability considering the scale of remaining forested areas available for collection and the typical remoteness of these areas. There could be some consequences for tribal gathering in alternative C, which we have described in more detail in the "Tribal Relations and Uses" section. Special forest product and fuelwood removal is tied more closely with demand than locational availability. In other words, people

would travel to obtain these products. As demand is not anticipated to change across alternatives, special forest products and personal-use fuelwood will not be addressed further in relation to any alternative.

Forest Products

All alternatives assume some level of forest product removal. Table 151 displays ranges in volumes projected to be removed. All three National Forests have projected sawtimber harvests that are a very small fraction of the estimated sustained yields. If considering the projected maximum sawtimber levels associated with alternative B, the percent of the sustained yield is 4, 10, and 10 for, respectively, the Inyo, Sequoia, and Sierra National Forests. While alternative D would increase these percentages, the highest value would be 18 percent for the Sequoia National Forest.

While the harvest of sawtimber is not estimated for mortality related to high-intensity fire, droughts, and other unplanned disturbances, it can have an effect on a projected decadal harvest schedule. Initially, this mortality may displace the projected harvest of living trees. It would be expected that the quantities would range from very low with alternative C to approximately equal amounts in the remaining alternatives. In the longer term, the loss of living forests after significant disturbance events, in effect, can erase significant acreages of growing forests and reduce the total capacity of a national forest to maintain a specified harvest level.

When the number of acres affected reaches a threshold value, the capability of any specific national forest to maintain the projected yields will decline. The ability to minimize or reverse this impact is dependent on the successful reestablishment of thriving forests. Without that happening, the total available sawtimber volume that would ordinarily be able to offer projected harvests, would decline and start a trend that, in essence, reduces the total acreage available and suitable for timber production.

Projected sawtimber harvests are displayed below as a range of values. The minimum value in alternatives A and B is the current condition based upon a 5-year average, the minimum for alternative D is estimated to be the maximum for alternative B due to greater flexibility in achieving desired conditions and encouragement of larger, landscape-level projects, while the minimum range for alternative C is one-quarter the current condition due to the additional limitations on tree removal related to management for California spotted owl and Pacific fisher habitat. The maximum value in the range is the amount of sawlog volume available for removal, when consistent with management objectives, and would be part of a contract or project that is economically viable. This maximum value is based on Forest Vegetation Simulator modeling of likely prescriptions associated with each alternative utilizing Forest Inventory and Analysis plot data across the analysis area and assumes an increased agency workforce with increased funding over the current condition because of the increased effort needed for project design, analysis, and implementation over more treatment areas.

As stated above, fuelwood demand is expected to remain consistent with current conditions or increase slightly due to population trends. Fuelwood varies slightly on the Inyo National Forest because much of the fuelwood gathering opportunity is associated with piles of logs left after mechanical thinning and commercial fuelwood gathering that would vary by restrictions associated with the alternatives. It does not vary between alternatives on the Sequoia and Sierra National Forests because there is more abundant supply.

Table 151. Projected 10-year timber harvest volumes (million cubic feet) by product type and alternative

National Forest	Product	Alternative A	Alternative B	Alternative C	Alternative D
Inyo	Sawtimber	1	1–1.5	<1	1.5–3
Inyo	Fuelwood	6–8	6–9.5	4–7	9.5–14
Sequoia	Sawtimber	8	8–16	2–4	16–28
Sequoia	Fuelwood	3–5	3–5	3–5	3–5
Sierra	Sawtimber	25	25–50	5–10	50–80
Sierra	Fuelwood	5–7	5–7	5–7	5–7

Due to the long distance between the Inyo National Forest and existing mill facilities, the vast majority of local processing of forest products is for fuelwood. Milling of timber resources for products other than fuelwood is currently minimal and limited to a few local individuals who manufacture items such as posts and poles, rough siding, arts and crafts, furniture, and other products. As such, current and projected sawtimber opportunities on the Inyo National Forest are projected to remain at a smaller scale than the Sierra and Sequoia National Forests.

Area Restored

All alternatives include silvicultural practices designed to contribute to the restoration of a more resilient landscape. Acres projected for treatment over the next decade are displayed in Table 152 as a range. The minimum value for alternatives A, B, and D is projected to approximate the current level of harvest; the maximum value is the total estimated number of acres associated with the harvest volumes estimated in Table 151. Alternative C is anticipated to provide forest products over a reduced acreage due to existing and additional constraints on removal of sawlog-size trees, as well as differing treatment prioritization that emphasize the use of prescribed burning instead of tree cutting and restoring areas using wildfires that can be managed to meet resource objectives.

Table 152. Projected 10-year harvest area in acres by management practice and alternative

National Forest	Management Practice	Alternative A	Alternative B	Alternative C	Alternative D
Inyo	Thinning	8,000	8,000–11,500	2,300–4,500	11,500–16,000
Inyo	Group Selection	1,000	1,000–2,000	0	2,000–4,000
Sequoia	Thinning	6,000	6,000–9,000	2,000–5,000	9,000–12,000
Sequoia	Group Selection	1,000	1,000–1,500	0	1,500–2,000
Sierra	Thinning	19,000	19,000–28,500	5,500–11,000	38,500–38,000
Sierra	Group Selection	3,000	3,000–4,500	0	4,500–6,000

It is important to note that the treated acres in Table 152 refer to areas harvested with the removal of a timber product, which is a subset of the projected total of mechanically treated acres of each alternative. Treated areas would be managed primarily with variable density thinning which is an approach that selectively removes trees to increase spatial and structural variation, while retaining selected elements or biological legacies (large/old trees, snags, and logs) in a desired arrangement (such as aggregated in clumps, dispersed in a uniform pattern). Thinning reduces stand density

and improves overall stand health, as individual trees have increased access to available resources such as water, sunlight, and nutrients. These additional resources result in accelerated growth and canopy development, while improving the likelihood that individual trees survive, when confronted with insects and pathogens, drought, and low- to moderate-intensity wildfire (Bailey et al. 1999; Latham and Tappeiner 2002; Covington et al. 1999). Group selection openings would generally be small areas between 0.5 to 3 acres in size where most or all trees are removed to facilitate the establishment of a new age cohort. Group selection generally mimics historic disturbance processes by regenerating approximately 15 percent of the forested stand, increasing heterogeneity across the landscape and contributing early seral regeneration patches, within an overall uneven-aged landscape (Franklin et al. 2002; North et al. 2009; North 2012). In addition to providing valuable forest products for society, the precision of these treatments increases the likelihood that associated restoration goals are achieved. Fire, even if used intentionally, does not allow that level of specificity for tree arrangement, size, and species distribution.

Consequences Specific to Alternative A

Alternative A maintains the current level of activity, using existing management direction as provided by the 2004 Sierra Nevada Forest Plan Amendment Record of Decision (USDA FS 2004). Alternative A assumes future funding and project design consistent with current levels. Generally, less than 5 to 10 percent of the landscape has been restored in the last 10 years.

Forest Products

Based on historic averages, alternative A would produce approximately 28 million cubic feet of sawtimber, with an additional 9 million cubic feet in other products (miscellaneous convertible products such as biomass, posts and poles), and 11 to 17 million cubic feet in fuelwood over a 10-year period (see Table 151, and appendix A, Table A-9).

Implementation projects are generally designed to thin relatively small-diameter sawtimber trees, reducing fuel adjacent to communities at risk of loss or damage from uncharacteristic wildfire. There are some biomass removal opportunities in conjunction with sawtimber removal, but the lack of a consistent market combined with pricing structure challenges results in most biomass opportunities going unutilized. Most biomass that cannot be economically sold and removed from the forest is piled and burned to reduce fuel and meet the project objectives. Revenue generated from individual projects could be utilized to offset the costs of other restoration activities that require additional funding to implement, such as watershed or habitat improvements. This alternative produces more revenue than alternative C, but less than alternatives B and D.

Recent sawlog supplies appear to be sufficient to sustain the current operation of the related sawmills; however, the capability of continued operations, given projected supplies and future costs and product values, is unknown.

Area Restored

Alternative A, based on historic averages, would harvest timber from approximately 39,000 acres per decade across all southern Sierra Nevada forests (see Table 152, and appendix A, Table A-13). In addition to ecological restoration needs, treatments are prioritized based on proximity to the wildland-urban intermix. The majority of treatments would be in the montane ecological zone, with minor amounts in the upper montane ecological zone. Forest types in the montane zone include Sierra mixed conifer, eastside pine, ponderosa pine, and montane hardwood-conifer, while the upper montane zone includes red fir, Jeffrey pine and lodgepole pine.

Based on historic averages, projects are generally designed to treat approximately 1,000 acres across a 5,000 acre area, or approximately 20 percent of a small landscape (generally a subwatershed). At the stand level, these acres have an improved likelihood of resilience to the effects of insects and pathogens, climate change, and wildfire. This scale of treatment may result in less uncharacteristic wildfire activity at the local project scale, but by itself is not sufficient to alter the increasing trend in large wildfires expected with climate change (see "Fire Trends" section). In addition, many standards and guidelines limit tree density reduction, potentially leading to increased inter-tree competition for scarce resources and increased tree mortality. Related to thinning and improving the sustainability of forest products, this alternative restores more acres than alternative C, but less than alternatives B and D.

Consequences Specific to Alternative B

Alternative B incorporates four strategic fire management zones: community wildfire protection; general wildfire protection; wildfire restoration; and wildfire maintenance zones. Approximately half of the lands suitable for timber production are located in the two "protection" zones. Alternative B prioritizes fuel reduction and restoration treatment in the two protection zones as well as on strategic ridges and along key roads that can facilitate larger landscape prescribed burns or that can increase the opportunity to manage wildfires when they can meet resource objectives. At least 20 percent of the landscape is anticipated to be restored through various management activities, including timber harvest.

Forest Products

Based on stand modeling combined with projected capabilities, alternative B would produce approximately 28 to 55.5 million cubic feet of sawtimber, with an additional 9 to 16.5 million cubic feet in other products (miscellaneous convertible products such as biomass, posts and poles), and 11 to 17 million cubic feet in fuelwood over a 10-year period (see Table 151, and appendix A, Table A-9). This alternative is expected to produce more revenue than alternatives A and C, but less than alternative D.

Revenue generated from implementation of individual projects could be utilized to offset costs of other restoration activities that may otherwise remain unfunded. With an increase in area treated, more biomass removal opportunities, in conjunction with sawtimber removal, are available, provided a consistent market could utilize these opportunities. Larger, landscape-scale ecological restoration projects (such as whole watersheds) are encouraged under alternative B. If designed in ways to increase economic efficiencies, increased revenues may be generated per project. Through stewardship contracting, or trust funds, this revenue could be used to restore additional or more costly areas than under alternative A.

As described in the discussion related to alternative A, increased predictable supplies of economically valuable sawlogs are likely to sustain, and perhaps increase, the operation of related sawmills.

Area Restored

Alternative B would harvest timber from approximately 39,000 to 58,500 acres per decade across all southern Sierra forests based on projected Forest capabilities (see Table 152, and appendix A, Table A-13). Treatments are prioritized based on strategic fire management zone, with an emphasis on treating within the two wildfire protection zones. However, treatments are not limited to the protection zones. Vegetation types treated in alternative B would be comparable to those treated in alternative A.

Alternative B encourages larger landscape-scale projects, with the intent that greater areas would by analyzed and more area restored. Fewer limitations on tree removal compared to alternative A would increase the likelihood that thinning of dense stands would be more biologically effective at achieving resilient conditions and would result in more sustainable forest stands over increased acres. At the stand level, these acres would increase the likelihood of resilience to the effects of insects, pathogens, climate change, and wildfire, and would come closer than alternatives A and C, but would not quite be sufficient to alter the increasing trend in large wildfires expected with climate change (see "Fire Trends" section). This scale of treatment would result in less uncharacteristic wildfire activity at the project or landscape scale. This alternative restores more acres than alternatives A and C, but less than alternative D.

Consequences Specific to Alternative C

Alternative C focuses on emphasizing short-term protections for wildlife habitat, and relies more on standards and guidelines to minimize localized effects of active management on species such as the California spotted owl, Pacific fisher, listed amphibians, and other species of conservation concern. Commercial timber sales are generally limited to small-diameter sawtimber removal, with maintenance of greater stand densities and higher canopy cover. Treatments similar to alternative A could occur in portions of the wildland-urban intermix defense zone. However, it is anticipated that prescriptive constraints such as diameter limits, limited mechanical treatments in California spotted owl territories and home range areas, and retaining higher canopy cover for Pacific fisher, would reduce the area treated to one half or less of current levels.

Forest Products

Based on modeling and projected Forest capability, alternative C would produce approximately 3 to 7 million cubic feet of sawtimber, with an additional 5 to 9 million cubic feet in other products (miscellaneous convertible products such as biomass, posts and poles), and 11 to 17 million cubic feet in fuelwood over a 10-year period (see Table 151, and appendix A, Table A-9). This alternative generates the least amount of forest products, and associated revenue, of all the alternatives analyzed in detail.

The implementation of alternative C is likely to produce limited revenue, as lower-value product removals, such as biomass and small-diameter sawtimber, in generally smaller-scale projects, restrict the efficiencies more common with projects designed in other alternatives. Smaller projects, combined with smaller-diameter removal, contribute to more costly harvest operations that would likely need to be supplemented with appropriated dollars to accomplish objectives. Since budgets are expected to remain similar to those of the last 5 years, appropriated funds would offset the costs of fuel reduction on fewer acres overall.

The reduced supply of valuable sawlogs would likely affect the continued operation of related sawmills. Sawmills already operating near threshold levels would face an uncertain future. If the related sawmills close, the costs of restoration would increase substantially and would substantially limit the amount of restoration that can be accomplished.

Area Restored

Alternative C anticipates timber harvest from approximately 9,750 to 19,500 acres per decade across all southern Sierra forests (see Table 152, appendix A, Table A-13). Thinning treatments focus on small- to medium-sized trees and are focused primarily in the wildland-urban intermix defense zone immediately surrounding communities. Prescribed fires and wildfires managed to

meet resource objectives are the preferred methods of restoration treatment, thereby substantially reducing product output or timber harvest opportunities.

Alternative C encourages less intensive treatments, meant to minimize impacts to existing habitat in the short term. At the stand level, these acres would improve the likelihood of resilience to the effects of insects and disease, climate change, and wildfire. However, these effects would be to a much lesser degree than alternatives A, B and D, due to the minor density reductions associated with only small-diameter tree removal. Minor reductions in inter-tree competition are not likely to provide sufficient increased access to growing space and the related site resources and any benefits are very short term because of continued growth of trees. Limited increases in tree vigor, combined with the limited acreages affected by treatment, are unlikely to provide a significant improvement in the status of forest health. Retention of high stand densities would continue to contribute to mortality, thus increasing fuel levels and contributing to stand conditions trending away from overall desired landscape conditions.

While wildfire risk would be reduced in the short term at the stand level within the treated areas, the low levels of accompanying mechanical thinning that would assist the effectiveness and efficiency of prescribed fire or wildfire managed to meet resource objectives may actually limit fire use. This scale of treatment may result in less uncharacteristic wildfire activity at the local project scale, but would not be sufficient to alter the increasing trend in large wildfires across the landscape expected to occur due to climate change and other stressors. Under alternative C, almost all funding for vegetation treatments would have to come from congressionally appropriated funds or from partnership dollars because there is little opportunity for stewardship or trust fund support, both of which depend on the sale of commercial forest products to generate funds. This alternative mechanically restores the least amount of acres of all the alternatives analyzed in detail.

Consequences Specific to Alternative D

Alternative D includes an emphasis on an increased pace and scale of ecological restoration, including improving the resilience of forests to fire, drought, climate change, insects, and pathogens. It emphasizes long-term habitat conservation by making areas more resilient to stressors, recognizing there may be short-term impacts to habitat associated with active management. Treatments focus on effective density reductions, lengthening the time that treatments are effective before growth increases stand density to levels outside the natural range of variation. More strategic treatments in the restoration zone would occur than under alternative B. By conducting more mechanical treatments in the areas that are easy to treat with mechanical equipment, alternative D would create landscape conditions that would allow for greater use of fire (both prescribed fire and management of wildfires to meet resource objectives) in areas that are difficult to treat with mechanical equipment. This would lessen the risks from large, high-intensity wildfires to other forest stands. During thinning, increased numbers of medium and large trees would be removed to favor the development and vigor status of even larger trees. Up to 60 percent of the treated landscape is anticipated to be restored through various activities including timber harvest.

Forest Products

Based on modeling and projected capability, alternative D would produce approximately 55.5 to 91 million cubic feet of sawtimber, with an additional 16.5 to 29 million cubic feet in other products (miscellaneous convertible products such as biomass, posts and poles), and 11 to 17

million cubic feet in fuelwood over a 10-year period (see Table 151, and appendix A, Table A-9). This alternative produces the most revenue of any alternative analyzed in detail.

Revenue generated from implementation of individual projects could be utilized to offset costs of other restoration activities that may otherwise remain unfunded. Provided the existence of biomass utilization infrastructure exists, increased biomass removal, often linked with sawlog harvests, would increase. Larger, landscape-scale projects (such as whole watersheds) are encouraged under alternatives D and B, resulting in more revenue generated per project due to increased efficiencies associated with logging costs. Through stewardship contracting, or trust funds, this revenue could be utilized to treat additional or more costly areas than under alternatives A and C. For example, funds generated by the sale of forest products could be applied to road maintenance, small fuels mastication, prescribed burning, habitat enhancements, and aquatic organism passage projects.

The projected annual volume of forest product removal is anticipated to sustain and stimulate the mill at Terra Bella, as well as other forest product infrastructure over time. However, the capacity associated with the one local mill would not sustain the restoration effort associated with the projected increase in volume without incorporating additional shifts and/or longer hauls. Once the existing local mill is at capacity, haul costs associated with Chinese Camp and Standard, California (the two closest mills), may be cost prohibitive in achieving the desired conditions depending upon fluctuations in the timber markets.

Area Restored

Alternative D is anticipated to harvest timber from approximately 58,500 to 82,000 acres per decade across all southern Sierra forests (see Table 152, and appendix A, Table A-13). While treatments in the two wildfire protection zones are of higher priority, treatment may occur in all strategic fire management zones. The majority of treatments would be in the montane ecological zone, with minor amounts in the upper montane ecological zone. The montane zone consists primarily of Sierra mixed conifer, eastside pine, ponderosa pine, and montane hardwood-conifer, while the upper montane zone consists of red fir, Jeffrey pine, and lodgepole pine.

Alternative D encourages larger landscape-scale projects, with the intent that greater areas would by analyzed and more area restored. Decreased tree density and increased heterogeneity at the landscape and stand level would improve the likelihood of resilience to the effects of insects and pathogens, drought, climate change, and wildfire in montane and upper montane forests, due to increased adaptive capacity. In addition, wildfire risk would be reduced over time (see “Terrestrial Vegetation Ecology” and “Fire Trends” sections). This scale of treatment would result in less uncharacteristic wildfire activity at the project and landscape scale, extending beyond the treated areas. Of all alternatives analyzed in detail, this alternative restores the most acres and results in more resilient forested stands consistent with desired conditions.

Cumulative Environmental Consequences

Alternatives B and D project an increase in area treated and volume removed as the pace and scale of restoration expands. These alternatives would produce enough sawtimber to maintain the existing local forest products infrastructure including the mill at Terra Bella and local specialty markets. Maintenance of the existing infrastructure is important to community economic health, as well as ensuring future opportunities for restoration implementation. However, in the absence of new or expanded sawmill infrastructure, existing capacity issues may limit achievement of the desired objectives in alternative D.

New markets such as biomass or additional forest products milling facilities may further increase the pace and scale of restoration, especially under alternatives B and D. New markets allow for competition, potentially resulting in increased revenue.

Alternatives A and C are unlikely to maintain a consistent flow of sawtimber at a level that can maintain the local forest products infrastructure. Currently, the mill is relying on supplemental timber off of private lands, but does not consider this sustainable. In the absence of the mill at Terra Bella, it is unlikely that the Sierra and Sequoia National Forests would have a consistent market for forest products, thus resulting in nearly all restoration work accomplished by appropriated dollars and at a much smaller scale than at the current level (alternative A).

While alternative D projects the greatest annual volume removal, no alternative prescribes harvest at levels nearing the sustainable yield limit (see "Appendix A: Timber Suitability and Management"). This means there is more opportunity to increase pace and scale of restoration given increased fiscal and personnel capacity without jeopardizing the long-term sustainability of the forest and forest productivity.

Alternatives B and D use a variety of restoration tools, such as mechanical fuel reduction treatments, timber harvest, hand treatments, and prescribed fire, to achieve desired conditions. Under these alternatives, it is expected that substantial portions of large landscapes may be restored in the next 10 to 15 years. In addition to improved forest health, growth, and resilience to disturbance agents, treating more area (especially reducing densities in montane and upper montane forest stands) increases the likelihood that large landscape areas can withstand the adverse effects of many of the fires experienced in recent years, maintaining much of their forest structure and composition. These forests may continue to provide habitat as well as future multiple-use timber harvest opportunities into the future, without a substantial loss in social, ecological, and economic value.

Alternatives A and C are both likely to result in lower levels of restoration treatments intended to achieve desired conditions than either alternative B or D. The increased emphasis in alternative C, to utilize fire, may be more limited than intended, due to the low levels of accompanying mechanical thinning that would assist the effectiveness of prescribed fires or wildfire managed to meet resource objectives. As the trend of elevated wildfire intensities continues to increase under these alternatives, losses of forest structure to wildfire adversely impacts habitat availability, aquatic health, recreation opportunities, and future economic and multiple-use opportunities associated with timber harvest.

Analytical Conclusions

Alternative A would continue management at current levels of mechanical treatments, with limited improvements in forest health and resilience to disturbance agents and climate change at the project (stand) level. Landscape resilience would continue to decline. Supply of timber products is unlikely to sustain the existing forest products industry infrastructure, including the mill at Terra Bella.

Alternative B would increase pace and scale of mechanical treatments from the existing conditions, incrementally improving forest health and resilience to disturbance agents and climate change, and generating enough volume to sustain the needs of the existing forest products industry infrastructure, including the mill at Terra Bella.

Alternative C would decrease the pace and scale of mechanical treatments from the existing conditions; however, small improvements in forest health and resilience would occur in the short term at the project (stand) level, similar to alternative A. This alternative is unlikely to sustain the existing forest products industry infrastructure, including the mill at Terra Bella, thereby limiting restoration management options into the future to those funded by only appropriated dollars.

Alternative D would increase pace and scale of mechanical treatments from the existing conditions, improving forest health and resilience to disturbance agents and climate change, and generating enough volume to sustain the needs of the existing forest products industry infrastructure, including the mill at Terra Bella. However, in the absence of new or expanded infrastructure, capacity issues may limit achievement of desired objectives. Once the existing local mill is at capacity, haul costs associated with Chinese Camp and Standard, California (the two closest mills), may be cost prohibitive.

Economic Conditions

Background

Forest management influences the economic sustainability of the communities that surround the forests and impacts the provision of forest contributions that affect the quality of people's lives both locally and further removed from the plan area. This section examines potential effects on the benefits to people by examining potential changes in the key contributions that the forests provide (such as, recreational opportunities, clean air and water, forest products, species habitat, and energy). Current threats resulting from uncharacteristic wildfire and declining forest health bring into question the long-term sustainability of these important contributions. Plan alternatives that address these concerns are examined as to their potential to improve the sustainability of key forest contributions while also examining the short- and long-term tradeoffs associated with these management actions. The information in this section is a summary of the more detailed Economics supplemental report.

Analysis and Methods

Study Area and Data Sources

The information describing local economic conditions is obtained from "Chapter 6: Assessing Social, Cultural and Economic Conditions" in the individual national forest assessments that were written for plan revision (USDA FS 2013a, 2013b, 2013c). Key forest contributions are examined for the geographic areas where economic activities are supported by National Forest System land management. This area represents the counties where forests provide opportunity for production of commodities and forest visitation (such as, timber, range, mining, and recreation) and also those counties where forests have made direct expenditures in management (such as, spending on projects and Forest Service employee salaries).[49] This information on key economic contributions of the forests is obtained from the Forest Service Economic Contribution model (USDA FS 2014).

Forests also provide contributions to communities located further away from administrative boundaries (such as, water and energy) and moreover provide nonmarket benefits where quantifying economic contributions is difficult (such as, biodiversity). These types of benefits are

[49] These are Inyo, Mono, Esmerelda, and Mineral counties for the Inyo National Forest; Fresno, Tulare, and Kern counties for the Sequoia National Forest; and Mariposa, Merced, and Fresno counties for the Sierra National Forest.

described as well in order to provide a complete context for key forest contributions. The key forest contributions were identified using "Chapter 7: Benefits to People" in the national forest assessments referenced earlier, as well as the national forest "distinctive roles and contributions" statements that were developed for plan revision and are included in the individual forest plans.

Methodology for Analysis

Potential effects are examined for changes in the economic contributions of the forests across the four plan alternatives. Two separate analyses are conducted: (1) a financial analysis looking at the potential for funding management activities, and (2) a forest contributions analysis looking at potential short- and long-term effects on key forest contributions that provide benefits to local economies and also contribute to the quality of people's lives throughout the region.

The financial analysis is undertaken to provide decision makers with context for the challenges that the forests will face funding project implementation under each alternative. The management actions associated with each of alternatives B, C, and D have consequences for funding that present different challenges for the forests (these are highlighted).

The forest contributions analysis looks at potential changes in six key forest contributions that provide benefits to people locally and across the region (water quality and quantity, recreation, air quality, forest products, energy generation and biodiversity). This qualitative analysis examines how these key forest contributions are affected by the plan alternatives and what these potential effects mean for the benefits to people and communities. Both the potential beneficial effects and the potential adverse effects of each alternative are identified in this analysis. Important to this analysis is consideration of the tradeoffs associated with potential short- and long-term effects.

The findings of the financial analysis are also considered when evaluating alternatives in the forest contributions analysis. This is done in order to better represent the potential for beneficial effects occurring as a result of the proposed management actions. For example, an alternative found to have considerable challenges associated with the funding of management activities has a greater likelihood of these activities not being implemented or not being implemented to the extent described in the plan alternative. As a result, the potential beneficial effects are less likely to occur and outcomes would instead more closely follow the trends as identified under alternative A.

The following assumptions are made in conducting these analyses:

- forest base funding and staffing levels remain constant and representative of current trends across alternatives and for the life of the plan;
- funding for increased restoration and management activities is obtained from outside existing forest budgets through retained receipts on stewardship contracts and partnership opportunities, and thus represents new money into the local economy; and
- there are no current or expected future changes to mining or grazing activities or their associated programs as a result of the proposed plan alternatives.

Affected Environment

This section presents:

1. A description of the economic conditions within the counties that intersect the national forest administrative boundary;

2. A description of the key contributions each national forest makes that influence these economic conditions and influence economic sustainability; and
3. A description of how these key national forest contributions are currently threatened by uncharacteristic wildfire and disease and insect pathogen mortality in vegetation.

Economic Conditions

Economic conditions are described by examining three factors: economic health; economic diversity, and local fiscal conditions surrounding each national forest.

Economic health is the overall health, or prosperity, of an economy and this influences its ability to adapt to change. An economy already facing job loss and low incomes is likely to be less able to adapt to forest management changes that affect key economic sectors. Three key statistics are presented below as measures of this economic well-being; the annual unemployment rate, average earnings per job, and per capita income.

Economic diversity is the extent to which an economy is dependent on one or only a few sectors as opposed to a broad spectrum of economic activities. When determining the economic context of national forest management decision making, it is important to identify the key sectors that drive the economy and the extent to which the economies of the surrounding area are dependent on national forest land activities. Determining this level of diversification and the economy's dependence on these national forest land activities provides a good indicator of the potential effects that may result from national forest management decisions that impact these activities. That is, a more diversified economy that is supported by many different sectors is better able to withstand changes to national forest management than is an economy that is dependent mostly on forest-based commodity extraction and tourism.

Local fiscal conditions represent the finances of local governments, specifically the sources of revenue and the targets of spending. Local governments rely on revenues generated from activities on national forest lands. These revenues can be summarized in three broad categories; direct, indirect, and secondary. Direct includes the direct subventions from the Federal Government and include Federal Forest Reserve and Payment in Lieu of Taxes. Indirect revenues are the timber, sales and transient occupancy taxes collected as a direct result of timber activity on the national forest and the visitors to the national forest buying and paying sales tax and staying and paying transient occupancy taxes. Secondary revenues are those taxes collected because those businesses providing these services use a portion of the revenues received to pay their taxes. Management decisions that affect these activities have the potential to impact these revenues. To determine the context of these payments, it is necessary to understand how important these revenues are to local budgets and also understand the current overall budget conditions of local governments. Communities facing difficult fiscal conditions would feel an impact from any changes in revenues, thus leading to the potential for reduced public services provision in the area.

The context of these three factors are examined below. This information is obtained from "Chapter 6: Assessing Social, Cultural and Economic Conditions" of the individual national forest assessments that were written for plan revision (USDA FS 2013a, 2013b, 2013c).

Economic Health

With high unemployment, lower earnings, and lower per capita income than California as a whole, the counties bordering the three national forests are facing challenges to their economic

health. Thus, these communities are less able to adapt to forest management changes that would affect key economic sectors. This data from the national forest assessments (USDA FS 2013a, 2013b, 2013c) is presented in Table 153.

Table 153. Economic health surrounding the Inyo, Sequoia, and Sierra National Forests

Key Economic Measures	Inyo National Forest	Sequoia National Forest	Sierra National Forest	Bioregion	California
Unemployment rate, 2011 (%)	10.3	15.9	16.3	14.3	11.7
Average earnings, 2011 ($)	42,935	49,194	48,970	51,744	61,799
Per capita income, 2011 ($)	39,737	30,782	31,839	36,127	44,564

Economic Diversity

The economies surrounding the Sierra National Forest are diversified except in the Yosemite Valley Census County Division where the travel and tourism sectors account for more than half of all employment. The economies surrounding the Sequoia National Forest are diversified with low to no specialization across all Census County Divisions (Lin and Metcalfe 2013). Studies conducted for the area surrounding the Inyo National Forest have demonstrated that local economies are very dependent on tourism and recreational activities and any changes in the level of these activities would have an effect on the economy (Alkire 2012; Gruen Gruen and Associates 2010). In addition, a recent report examining the history and potential of economic opportunities in Mono and Inyo counties reinforces this finding, stating that, “neither county has demonstrated extensive economic diversification beyond the government and hospitality/leisure sectors” (Sierra Business Council 2012). As a result, the economies of Mono and Inyo Counties are likely susceptible to effects from changes in forest management that lead to changes in visitation to the area.

Local Fiscal Conditions

The counties bordering all three national forests receive revenues from sales taxes on timber products and on temporary lodging from visitors to the region. Available data shows that these sources are a significant portion of the tax revenue collected in Mariposa (20.4 percent of tax revenue collected), Mono (4.6 percent), and Inyo (4.3 percent) counties. Specifically in these counties, it is the transient lodging tax revenue that is the more significant contributor of the two tax sources (California State Controller’s Office 2012). One study estimated the percentage of the county sales tax revenue that was visitor related. This includes spending on goods and services while visiting an area, and this visitor spending is again identified as important to fiscal consideration for Mariposa (61.4 percent of total sales tax collected is visitor related), Mono (57.9 percent), and Inyo (20.8 percent) counties (Dean Runyan and Associates 2012). Therefore, it is important to recognize that these smaller rural counties are reliant on visitors to the national forests to contribute tax revenues essential for providing key public services.

Payments in lieu of taxes (often known as PILT or the 25 Percent Fund) are also an important consideration for local county governments. This funding source is especially important locally in Inyo County where less than 2 percent of the land in the county is privately owned. All but two counties (Inyo and Mono Counties that received payments from the 25 Percent Fund) bordering the three national forests received Secure Rural Schools Funding in 2013 that supported local services (USDA FS 2015a).

Key National Forest Contributions

Contributing to community well-being by providing a broad range of economic opportunities for national forest communities is consistent with current Forest Service direction from the U.S. Department of Agriculture to generate jobs through recreation and natural resource conservation, restoration, and management in rural areas (USDA 2015). However, Federal forest management alone cannot ensure community stability because jobs in the forest products, agricultural, mining, and recreation industries are influenced by market conditions and changes in technology outside the control of forest management. As a result, national forests cannot expect to ensure community economic wellbeing through their management actions alone (Charnley 2013).

While national forests are not the sole factor determining economic wellbeing, they do contribute economically to local communities and also to communities that are located further from the national forest. Commodity-based activities that are specifically important to local economies within the study area are forest products and recreation. Grazing and mining activities also occur on these national forests and are important to local economies and culture. However, there are no current or expected future changes to mining or grazing activities or their associated programs as a result of the proposed plan alternatives, so they are not examined in detail here. Water is also examined as a vital resource with economic value that is influenced by forest management.

Other vital national forest contributions besides these commodities may be less apparent in our daily lives and their benefits difficult to measure, but these contributions are important because they support the ecosystems and social environments in which we live (such as, biodiversity). However, there is no universally accepted methodology for how to quantify the benefits of these types of non-market contributions. Instead, the benefits provided by biodiversity are described to capture the importance of these benefits to people.

Forest Products

As of 2010, timber sector jobs in the counties bordering the Sequoia and Sierra National Forests made up a small percentage of total private sector employment. This timber employment accounted for around 0.6 percent of all private sector jobs in the counties, which is a similar percentage to the state and the bioregion. Within the timber sector, wood products manufacturing accounts for most of this employment with very few jobs occurring in sawmills and paper mills and in the growing and harvesting industries. Total employment in the timber sector has been decreasing recently from around 0.8 percent of all private sector employment in 1998 to 0.6 percent today (Headwaters Economics 2012). The closing of the North Fork Mill (with an estimated 145 employees) contributed to this decline. Current planning efforts are underway by the North Fork Community Development Council to redevelop this mill site to find uses for biomass material generated by forest management, specifically bioenergy generation (NFCDC 2013). Currently, the Sierra and Sequoia National Forests are providing timber for three remaining sawmills: Sierra Forest Products in Terra Bella, California, and Sierra Pacific Industries in Chinese Camp and Standard, California. The Sierra Forest Products mill is the last remaining mill in California south of Yosemite.

Biomass energy facilities have brought new jobs with good comparative wages into rural communities. The long-term nature of this employment provides durable improvement and added stability to the local and regional economies (Morris 2000).

As of 2010, timber activity on the Inyo National Forest is minimal and timber sector jobs in the counties bordering the Inyo made up very little of total private sector employment.

The forest products industry in California has been declining in size for the past few decades. In 2012, there were an estimated 77 active primary wood and paper products facilities in the state, down significantly from 262 in 1968 (McIver et al. 2015). This decline in infrastructure is an important development in terms of restoration activities in the region. Increasing the pace and scale of restoration is economically dependent on sustaining the necessary infrastructure and workforce to utilize the biomass removed from the forests.

Recreation and Tourism

In 2010, travel- and tourism-related industries were important in communities around all three forests, accounting for 50 percent of jobs in the counties bordering Inyo National Forest, 15.9 percent of jobs in the counties bordering Sierra National Forest, and 15.6 percent of jobs in the counties bordering the Sequoia National Forest. These percentages for the Sequoia and Sierra National Forests are similar to the bioregion (18.1 percent) and the state (15.7 percent), while the percentage for the Inyo National Forests is much greater. The number of travel- and tourism-related jobs in these counties have been relatively stable from 1998 through 2010. Average annual wages in these jobs are below the average wage for all private sector jobs, so these are relatively lower paying jobs in local communities (Headwaters Economics 2012).

A study examining the value of travel and tourism to California counties estimated the percentage of total county employment and earnings generated by all travel in the county. Travel and tourism around the Sierra National Forest is an important sector in Mariposa County, accounting for 52.0 percent of employment and 33.4 percent of earnings. These percentages are lower in Madera (5.2 percent of employment and 3.0 percent of earnings) and Fresno (2.9 percent of employment and 1.5 percent of earnings) counties. Travel and tourism around the Sequoia National Forest generates 3.7 percent of employment and 1.6 percent of earnings in Kern County, 2.9 percent of employment and 1.5 percent of earnings in Fresno County, and 2.5 percent of employment and 1.5 percent of earnings in Tulare County. Travel and tourism around the Inyo National Forest generates 48.6 percent of employment and 32.2 percent of earnings in Mono County and 23.5 percent of employment and 11.5 percent of earnings in Inyo County (Dean Runyan and Associates 2012).

Commodity-based Estimates of Contributions from the Sierra National Forest

Estimates of the jobs, compensation, and tax contributions of activities on each of the three national forests derived from the economic contribution models for each national forest (USDA FS 2015b, 2015c, 2015d) are provided in Table 154. These values should be used to gain an understanding of the relative context of national forest contributions to these sectors and not as exact measures of these contributions. Therefore, all estimates are rounded to the nearest 100. Employment, expressed as jobs, represents the average annual employment and includes a combination of full and part time, temporary, and seasonal workers. State and local government total tax impact does not include tax contributions from grazing.

Table 154. Estimates of the economic contributions, 2012

National Forest	Employment (Jobs)	State and Local Government Total Tax Impact (M$)	Federal Total Tax Impact (M$)
Inyo	2,900	$17,200	$16,200
Sequoia	1,000	$3,700	$4,100
Sierra	1,000	$4,800	$6,100

The sectors with the most jobs created from national forest contributions are: government; agriculture; retail trade; accommodations; food services; arts and entertainment; and recreation. Important to note about these estimates is that the total number of jobs created by national forest contributions is almost triple for the Inyo National Forest when compared to the two other national forests, with most of these Inyo National Forest-generated jobs resulting in sectors related to recreation and tourism. In addition, estimates of the total tax revenues generated by national forest activities are also much larger than the amounts generated by the other two national forests, with the largest contributions resulting from accommodations and food services. These findings highlight the Inyo National Forest's key contributions to local economies, primarily for the visitors it draws to the area.

The Importance of Water to Economic Sectors

The water flow the Sierra National Forest feeds 10 water storage facilities and 22 operationally active hydroelectric facilities within or near the Sierra National Forest. Water rights and entitlements delivered through the Madera and Friant-Kern canals are extremely important to the economy of the San Joaquin Valley (USDI BOR 2013). Watersheds of the Sequoia National Forest drain into the Tulare Buena Vista Lakes Hydrologic Province and contribute to municipal, agricultural, recreation, warm and cold freshwater habitat, groundwater recharge, and freshwater replacement. Hydropower generation occurs on the Kern and Tule rivers, while industrial uses and groundwater recharge are downstream of its dams. Six Federal Energy Regulatory Commission projects lie within the forest plan boundary (USDA FS 2013b). Water originating on the Inyo National Forest supplies both water and electricity for millions of people in communities as far-ranging as Los Angeles, Mammoth Lakes, and Fresno. These activities are estimated to provide upwards of approximately 300 jobs to the local Inyo County economy (Richards 2015a). In addition, the water from the Inyo National Forest and adjacent lands is used extensively for recreational activities such as fishing, boating, and swimming, and aesthetic enjoyment. These recreational activities are vital to supporting the local economy in both Mono and Inyo counties.

Biodiversity

The changing elevation across the national forests, combined with the variability in aspect and slope; the variety of geology and soils; and the amount and timing of precipitation; creates an extremely high diversity of ecosystems. These varied ecosystems across all three national forests are inhabited by over 1,300 plant species and over 300 fish and wildlife species (see "Wildlife, Fish, and Plants" section). As a result, fishing, wildlife hunting, and wildlife viewing are important contributions provided to the public by all three national forests. The national forest's terrestrial and aquatic plant and animal species are dependent on resilient, diverse ecosystems that also sustain a social and economic fabric connected to a healthy forest. Sustaining these plant and animal species contribute to local communities by providing a quality environment where visitors can enjoy these landscapes.

Important Inyo National Forest Contributions to Inyo County

Inyo County's communities have typically relied upon activities on public lands, and the Inyo National Forest in particular, for their well-being. The County's economy historically developed based on resource extraction and agriculture, which has since transitioned toward a service economy tied to tourist-oriented recreation on the Inyo National Forest. This history has shaped the society and culture of the County. In addition, more than 98 percent of Inyo County is managed by government agencies, and therefore decisions on the use of these lands have a large influence on the economy of the County. Given these critical economic and social ties between the Inyo National Forest and the County, an important part of understanding the affected

environment is identifying the key locations and activities on the Inyo National Forest and how they contribute to Inyo County.

Visitation and tourism resulting from recreational activities in the Inyo National Forest is a major contributor to the local Inyo County economy. As shown in Table 154, national forest contributions are important to the counties surrounding the Inyo National Forest. Contributions to the recreation- and service-based sectors comprise the majority of this activity. While the Forest Service Economic Contributions model is not able to break out these estimated totals by county, other available data can help to illustrate the degree to which Inyo County relies on these national forest contributions. Inyo County estimates that wilderness activities generate approximately $4.5 million in visitor spending there annually. Fishing and hunting provide additional visitor spending estimated as $2.7 million and $544,000, respectively. Off-highway vehicle users spend about $305,000 annually. Grazing on Inyo National Forest System lands in the County are estimated as providing $5 million in revenues (Inyo County 2015; Richards 2015b). Finally, the potential for future mining is also an important economic consideration because of the potential for jobs and incomes in the County (Richards 2015c). Therefore, management decisions that affect visitation, mining, and grazing would have economic consequences for Inyo County communities.

Working in collaboration with the County, we identified key locations and activities for socioeconomics; these are presented in Table 4 and figures 1 and 2 of the Economics supplemental report. These key activities focus on recreation, mining, and agriculture (grazing). Actions associated with plan revision and future national forest projects that would have implications on these important national forest contributions should be evaluated as to the significance of such effects.

Environmental Consequences to Economic Conditions

Financial Analysis

National forest project-level planning and implementation is guided by the budget as received from Congress and passed down through the Department of Agriculture to the Forest Service and then to the national forest. Therefore, to reflect this budget reality, the analysis assumes continuation of the trend of recent national forest budget obligations. Given this assumption, this section examines potential funding opportunities outside of appropriated national forest budgets that are available to achieve the increase in pace and scale of activities that are identified in each of the alternatives that revise the forest plans.

Consequences Common to Alternatives B, C, and D

There are challenges to project funding that is outside of the forest plan and the plan revision process. Increases in the pace and scale of restoration would involve increases in the costs associated with project preparation and project planning. Alternatives B, C, and D would need to identify efficiencies for these planning processes in order to reduce the increased costs associated with additional project planning and preparation. Given current budget trends, identifying and implementing these efficiencies will be critical to the success of any alternative that is chosen.

Potential increases in national forest revenues provide new opportunities for additional project funding resources. National forest revenues potentially affected by the proposed plan alternatives are associated with activities occurring in the recreation program and the forest product program on each the three national forests. Recreation staff members do not foresee significant changes in the revenues that would be generated by the recreation programs on these three national forests as

a result of alternatives B, C, or D. Therefore, new funding opportunities resulting from changes in recreation revenues are expected to be limited and to be similar across all the alternatives.

The ability to develop specific estimates of the anticipated changes in revenues from forest products is hampered by a variety of unknown future conditions. Perhaps the most significant of these conditions is the value of forest products in the global marketplace. However, it is possible to characterize differences in the potential for opportunities for new revenue generation between the alternatives. Each alternative is comprised of plan components that affect the potential economic feasibility of timber harvest activities. Since operating costs are fairly stable over a harvest area (specifically, no additional move-in move-out cost, and no additional skid roads), then increases in volume and/or value removed per acre can potentially result in a fairly substantial increase in revenue, which can then be prioritized to accelerate the achievement of priority work within designated stewardship areas. Conversely, rules that reduce the economic value of timber harvest projects, by constraining the size and/or number of sawtimber products, are less able to provide these opportunities for increases in retained receipts. Subsequently, this would reduce the likelihood that additional funding for restoration accomplishments would become available. It is this fundamental premise that distinguishes the alternatives B, C, and D from each other (and is highlighted as follows).

The effects of the ongoing mortality event have not yet been fully considered. Volumes projected in forest plans are, by definition, from scheduled harvests of living trees. Given the extent of current mortality, it may not be possible to reach the previously estimated future yields. Although events like wildfires and multi-year droughts are expected to occur in this analysis area, and commonly result in varying levels of salvage timber harvest, these unscheduled events offer no assurance of quantity over a predictable timeframe. Further, while promptly reestablished national forests can begin to offer sawtimber harvests as early as the fourth decade, there is a point when the number of acres affected by stand-replacement fire would exceed growth rates capable of sustaining currently predicted harvests. Without a more complete analysis, this is an uncertainty that cannot be reconciled at this time.

Therefore, when considering forest product value as a potential funding source for restoration activities, an important variable to consider is the magnitude and extent of tree mortality. Continued levels, due to both fire and multi-year drought effects, reduce the potential to sustain harvest levels. Inadequate levels of effective reforestation further restrict long-term harvest levels. Given the assumption that stewardship contracts, with the potential to generate and utilize credits used to increase the pace and scale of restoration, projected accomplishments may be negatively affected in both the short term and long term. This funding uncertainty, resulting from both current and future mortality, is important to consider under alternatives B, C, and D.

Consequences Specific to Alternative A

Funding for restoration activities under alternative A would be expected to continue on current trends and there are fewer opportunities for revenues to pay for these activities than under alternatives B and D, as highlighted below.

Consequences Specific to Alternatives B and D

Achieving the vegetation desired conditions that are identified under both alternatives B and D create the potential for the expanded use of “integrated resource timber contracts” to generate revenues. A benefit of expanding the use of integrated resource timber contracts is the ability of these revenues to pay not only for fuel reduction and stand density management, but also for

other types of restoration activities within designated stewardship areas (for example, meadows, heritage sites, and scenery improvements).

However, the harvest restrictions that are imposed under alternative B are intended to take a more measured approach to achieving desired conditions, and therefore would place limits on these opportunities. Alternative D, which includes fewer canopy and tree-size restrictions in order to move the national forests to their desired conditions at a faster pace, would be expected to allow harvest of an additional number of larger trees per acre. This increased ability to remove some larger trees provides more opportunities for additional funding for restoration activities and also allows for more effective treatment of project areas, thus improving residual vigor of the remaining trees and creating more resilience and improved sustainability in the forests.

The three national forests vary in their ability to design economically attractive timber harvest projects that would have the potential to generate additional retained receipts through integrated resource timber contracts. The Sequoia and Sierra National Forests differ, principally, by the area of national forest land available. The Sequoia National Forest, excluding the Giant Sequoia National Monument, is able to design and offer economically feasible timber harvest projects, but from a smaller land base than the Sierra National Forest. The sawtimber from these national forests can be transported to an accessible sawmill in the area. The Inyo National Forest is distinct from the Sequoia and Sierra National Forests in this regard, as it lacks a reasonably accessible sawmill. In addition, while it is possible to harvest sawtimber from the Inyo, it requires the uncommon condition of a large number of large logs within the project area.

Another important option would be establishing funding opportunities and partnerships with Federal, state, and local agencies as well as capable stakeholder groups. These options are critical on all three national forests, but are especially important on the Inyo National Forest where additional revenue generation from increased timber value through integrated resource timber contracts is limited. Alternatives B and D highlight working collaboratively with stakeholders to develop these types of funding opportunities. Successful implementation would require national forest project goals to align with the goals for outside agencies and stakeholder groups willing to partner to fund restoration activities. Examples of these types of opportunities include cost-share agreements, memorandums of understanding, and stewardship agreements with partners taking on active management roles that allow the Forest Service to leverage resources and staff from other organizations to conduct or assist in treatments on and adjacent to national forest lands. Developing these types of opportunities requires the additional cost of time and resources associated with engaging potential partners and establishing agreements.

Consequences Specific to Alternative C

The restoration activities proposed under alternative C do not create potential for the expanded use of integrated resource timber contracts to generate revenues. The increased focus on using managed fire in alternative C does allow for restoration to be paid for out of fire suppression funding, so these activities would not count against national forest appropriated budgets. However, alternative C does not contribute to sustaining the local forest product infrastructure and workforce, and therefore this could lead to future project cost increases since workers and equipment would need to come from farther away to do this work, and the volume of biomass removed would need to travel farther to be processed. This potential reduction in local infrastructure and workforce would result in higher costs for treating fuels, and therefore would potentially result in fewer buffers to maintain the fire in desired areas and away from structures and protected habitat. Consequently, there is potential for a longer-term reduction in the ability to use managed fire in areas that are close to structures and habitat.

Another important potential source of funding for these additional restoration costs would be partnerships. Alternative C, similar to alternatives B and D, highlights working collaboratively with stakeholders to develop these opportunities.

Forest Contributions Analysis

Wildfire, disease, and insect pathogen mortality in vegetation is increasing in severity across the bioregion, and a high percentage of the landscape that provides the key national forest contributions outlined previously are under threat in the Sierra, Sequoia, and Inyo National Forests (Metcalfe et al. 2013). As a result of these threats, there is great potential for disruption in the underlying ecological processes and for resulting loss and interruption in forest benefits. This loss of benefits has a cost to local communities and to the region as a whole. Examples of more localized costs include the loss of recreational opportunities for visitors, reductions in local employment and tax revenues from national forest commodities such as forest products, and the effects on the economies of local communities through reduced tourism in the area. When services such as water supply, electricity generation, and forest products are lost, the potential effect moves beyond the local area, and people across the state are affected by the loss of these services even if they do not live near the forests nor ever plan to visit there.

The potential effects of plan alternatives on these important forest benefits to people are examined as follows, first highlighting the similarities between the plan alternatives B, C, and D, and then highlighting their key differences. Important to this analysis is capturing the effects of plan alternatives on the economic health, diversity, and fiscal conditions that are outlined in the affected environment section above. Therefore, a local communities section highlighting these potential effects is included in each alternative description. The description of effects below is a summary of findings and a more detailed description of potential effects on forest contributions is provided in the Economics supplemental report.

Consequences Common to Alternatives B, C, and D

A summary of the potential short- and long-term effects on the six key national forest contributions is provided in Table 155 (water quality and quantity, recreation, air quality, forest products, energy generation, and biodiversity). There are two important similarities in potential effects across all three plan revision alternatives.

- Alternatives B, C, and D increase restoration activities in total (through more focus on mechanical thinning in alternatives B and D and through more focus on prescribed burning and managed fire in alternative C), and therefore provide greater potential to improve the long-term sustainability of some key national forest contributions when compared to alternative A that maintains current restoration activity levels.
- Alternatives B, C, and D have potential adverse short-term effects resulting from restoration activities that can temporarily disrupt these same national forest contributions.

There are some important differences between alternatives B, C, and D. These differences arise primarily from differences in the intensity and the approach to restoration under each alternative and are summarized below.

Table 155. Summary of short-term and long-term potential effects on key national forest contributions by alternative

National Forest Contribution	Alternative A short-term / long-term effects	Alternative B short-term / long-term effects	Alternative C short-term / long-term effects	Alternative D short-term / long-term effects
Water	adverse / adverse	adverse / beneficial	adverse / beneficial	adverse / beneficial
Sustainable recreation	adverse / adverse	uncertain / beneficial	uncertain / beneficial	uncertain / beneficial
Air quality	adverse / adverse	uncertain / beneficial	uncertain / beneficial	uncertain / beneficial
Energy generation	adverse / adverse	beneficial / beneficial	adverse / uncertain	beneficial / beneficial
Forest products	beneficial / adverse	beneficial / beneficial	adverse / adverse	beneficial / beneficial
Biodiversity	adverse / adverse	adverse / beneficial	adverse / beneficial	adverse / beneficial

Consequences Specific to Alternative A

Under alternative A, trends in current resource conditions are expected to continue, and therefore the long-term sustainability of all six key national forest contributions provided by these resources to people locally and across the region is threatened. Particularly important are the threats of uncharacteristic wildfire, disease, and insect mortality of forest vegetation that contribute to declining forest health and increase interruptions both in the short term and long term for all of these national forest contributions. Continuing current harvest levels in forest products would have the potential to contribute positively in the short term, but in the long term, forest product contributions would be adversely affected as a result of fire, disease, and insect mortality as well as from the decreases in forest product infrastructure and workforce expected to continue under current harvest trends.

Potential Implications for Local Communities

The resulting decline in the sustainability of all six key national forest contributions would result in significant adverse short- and long-term economic effects for local communities. These effects would be felt most directly through the potential loss of recreational visitation as a result of declining quality of recreational settings and increasing limits on opportunities from wildfire closures. Declining trends in species biodiversity would also adversely affect national forest visitation for important activities such as hunting, fishing, plant gathering, and wildlife watching. Rural communities located along access routes to the national forest often have a strong tie to the economic contributions that recreational visitors provide. This includes the visitor spending that supports jobs and also the contributions to local tax revenues through the sales and lodging taxes collected. These local tax revenues support important public services that improve the quality of life in these communities. The connection between recreational visitation and local economies is especially true for the Inyo National Forest and the critical importance of recreational-based, service-oriented businesses located within Inyo County. Alternative A does not contribute to improving the sustainability of this important recreational visitation.

Increases in the smoke from wildfires also contribute to this potential adverse economic effect resulting from decreasing recreational visitation. Under alternative A, trends for more and larger wildfires would be expected to continue, thus increasing the likelihood that visitors even far from the fire area would stay away due to smoke during at least some portion of the fire season, which is expected to be starting earlier and lasting later into the year. In addition, this smoke from wildfires adds to air pollution and adversely affects the health of residents in local communities.

Alternative A does not contribute to improving the sustainability of air quality benefits to people and communities.

The important local economic benefits provided by water would also decline under alternative A. The water used downstream from the forests is valuable for municipal and agricultural uses. It is also valuable for recreational and ecological uses on the national forests because this water sustains the important water-based recreational setting and forest biodiversity that draws visitors. Given expected restoration levels in alternative A, the quantity and quality of water would be expected to continue current trends in declining stream flows and increasing temperatures, thus reducing and interrupting the benefits this water provides.

There is an important economic contribution provided by forest products to local communities through job creation and the tax revenues that are generated from forest products and restoration activities. Under alternative A, there would be around 200 average annual full- and part-time jobs supported, with the majority of these jobs (approximately 150 out of the 200) resulting from forest products activity on the Sierra National Forest. Contributions to state and local tax revenues would be around $1.5 million, again with the majority of this contribution (around $1.25 million of the $1.5 million) resulting from forest products activity on the Sierra National Forest. The expected longer-term result of alternative A is continuation of declining local forest product-based infrastructure and workforce, and that would be expected to result in reduced economic health and sustainability in the local area.

Biomass provides the opportunity to generate electricity for the region and also support local job opportunities in biomass harvesting. Alternative A does not have the potential to provide any additional biomass to support current industry infrastructure. Nor does alternative A help to create an environment with a reliable supply of biomass that would be more favorable to investment in new biomass facilities, which would be necessary to increase the pace and scale of restoration. Alternative A does not contribute to improving the sustainability of contributions from energy generation from biomass.

Consequences Specific to Alternative B

The restoration activities in alternative B would be expected to help reverse current trends and to improve the long-term sustainability of all six key national forest contributions that provide benefits to people locally and across the region. In the short term, the potential effects are mixed across the different national forest contributions. These effects would be adverse for water quality, from the potential for increased sedimentation from restoration activities; and also adverse for biodiversity, from increases in disturbances related to the increasing of restoration activities. The effects are mixed for recreation and air quality. Recreation benefits in the short term from reduced wildfire, but is adversely affected by the potential for some restrictions on activities as a result of restoration projects. Air quality also benefits in the short term from reduced wildfire, but the prescribed burning under alternative B creates the potential for some short-term decreases in air quality as a result of these activities. Forest products and energy generation both benefit in the short term from increased restoration activities that yield increased sawtimber for mills as well as biomass and the potential for more water quantity for electricity generation.

Potential Implications for Local Communities

The restoration activities in alternative B would improve the long-term sustainability of all six key national forest contributions and result in significant beneficial economic effects for local

communities when compared to alternative A. These effects would be felt most directly through the potential gain in the sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important activities such as hunting, fishing, plant gathering, and wildlife watching. Alternative B contributes to improving the long-term sustainability of recreational visitation.

Given the increases in restoration activities, alternative B does have the potential to result in adverse short-term effects through closures during restoration project activities and disturbances to species diversity. This potential adverse effect is expected to be minor and is off-set by the potential for reduced wildfire when compared to alternative A, and therefore fewer related closures of recreational areas and fewer adverse wildfire effects on species would be expected to occur. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation.

Reductions in the smoke from wildfires also contribute to this potential beneficial economic effect resulting from sustaining recreational visitation. Under alternative B, restoration activities would result in fewer larger wildfires in the long term, thus reducing the likelihood that visitors stay away from the area. In addition, the reduced smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be some prescribed burning under alternative B that could lead to reduced air quality and reduced recreational access in the short term. These prescribed burns would be planned to occur under favorable conditions in order to mitigate potential adverse effects. Still, the overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis should be conducted to better understand the trade-offs to communities from these potential project economic effects on air quality.

Alternative B would contribute to sustaining the important local economic benefits provided by water from the forests. The water that is used downstream from the forests is valuable for municipal and agricultural uses, and also for recreational and ecological uses on the national forests because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternative B as compared to alternative A, as current trends in decreasing stream flows and higher temperatures could be tempered. In the short term, there would be potential adverse effects from increased sedimentation as a result of increased restoration activities. This could potentially have adverse short-term economic consequences on recreational visitation, and increase downstream costs of using water from the forests.

There is an important economic contribution provided by forest products and restoration activities to local communities through support for jobs and the tax revenues that are generated. Under alternative B, these contributions would help to reverse local infrastructure and workforce declines as well as contributions to local governmental budgets to support critical public services that would improve economic health and sustainability in the local area. Alternative B would support jobs through forest products and vegetation-based restoration activities. These are estimated at around 400 average annual full- and part-time jobs supported, with the majority of these jobs (approximately 300 out of the 400) resulting from forest products activity on the Sierra National Forest. Contributions to state and local tax revenues would be around $2.7 million, again

with the majority of this contribution (around $2.3 million of the $2.7 million) resulting from forest products activity on the Sierra National Forest.

Biomass provides the opportunity to generate electricity for the region and also support local job opportunities in harvesting. Alternative B provides the potential to contribute additional biomass to support the current industry workforce and also create a more favorable environment with a reliable biomass supply to support the investment in new biomass facilities. This investment would be required in the long term to increase the pace and scale of restoration. The restoration activities proposed under alternative B also contribute to reducing adverse effects associated with the quantity and timing of water, and as a result improves the economic contributions from electricity generation through hydropower as compared to alternative A.

Consequences Specific to Alternative C

The restoration activities proposed in alternative C focusing on managed fire and prescribed burning would be expected to help reverse current trends and to improve the long-term sustainability of four of the six key national forest contributions (water, recreation, air quality and biodiversity) that provide benefits to people locally and across the region. The long-term sustainability of forest products and energy generation from biomass would be adversely affected and would be similar to long-term effects identified under alternative A.

In the short term, the potential effects are mixed across the different national forest contributions. These effects would be adverse for water quality, from the potential for increased sedimentation from restoration activities; and also adverse for biodiversity, from increases in disturbances related to the increasing of restoration activities. Short-term effects on forest products would also be adverse given that harvest would decrease from the current levels set in alternative A. The short-term effects are mixed for recreation, energy generation, and air quality. Recreation benefits in the short term from reduced wildfire, but is adversely affected by the potential for some restrictions on activities as a result of restoration projects. The overall effect on energy generation is uncertain because, while there would be reduced biomass utilization for energy generation, there is also the potential for improvements in water quantity and timing that could improve hydropower generation. Air quality benefits in the long term from reduced wildfire, but effects are uncertain in the short term as a result of the amount of prescribed burning that is emphasized under alternative C and the fact that this burning would be used under favorable atmospheric conditions and thus effects could be mitigated.

It is important to note that there are greater challenges surrounding the ability of forests to fund management activities under alternative C than under alternatives B and D. This is detailed in the financial analysis above. As a result of these challenges, limitations in funding may result in management activities not being fully implemented to the extent described in the alternative and thus, the resulting effects would be expected to more closely follow the trends described under alternative A.

Potential Implications for Local Communities

The restoration activities in alternative C focusing on managed fire and prescribed burning would improve the long-term sustainability of four of the six key national forest contributions and result in significant beneficial economic effects for local communities. These effects would be felt most directly through the potential gain in the sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important

activities such as hunting, fishing, plant gathering, and wildlife watching. Alternative C contributes to improving the long-term sustainability of recreational visitation.

The additional areas identified in alternative C as potentially suitable for recommended wilderness would result in economic effects for local communities within Inyo County. Specifically important are current and historic grazing areas on the east side of Monache Meadow in the Inyo National Forest. Reductions in grazing opportunities in this area would impact communities because agriculture is the second highest contributing factor to the local economy. There is also concern about maintaining current authorized access on roads and trails in these areas. For example, the road into Talus Canyon currently is not excluded from additional potentially suitable areas. Access roads are important for sustaining the economic contributions that result from visitors to important recreational use areas for hiking, camping and off-highway vehicle use. There is concern about potential reductions in access to dispersed campsites that would also be lost for people who are unable to hike into them once road access is taken away. Finally, there are some active small-scale mining activities and mining claims in the areas of Redding Canyon, Marble Canyon and the Montezuma Mine. Even though these activities are currently limited, potential losses or restrictions to current and future mining opportunities would have potential effects for local communities.

Given the prescribed burning and managed fire restoration activities, alternative C does have the potential to result in adverse short-term effects through closures during restoration project activities and disturbances to species diversity. This short-term disturbance would be expected to be similar to alternative B and less than alternative D. This potential adverse effect is off-set by the potential for reduced wildfire, and therefore fewer related closures of recreational areas and fewer adverse wildfire effects on species. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation.

Alternative C emphasizes investment in dispersed recreational opportunities over developed opportunities. The types of goods and services needed by visitors to dispersed areas and the resulting spending of these visitors are different than for developed areas. Therefore, emphasis on projects that could lead to a long-term shift in the type of visitor to the national forest would be examined at the project level to determine potential economic impacts on local communities as well as on other resources.

Reductions in the smoke from wildfires also contribute to potential beneficial economic effects resulting from improved sustainability of recreational visitation. Under alternative C, restoration activities would result in fewer larger wildfires in the upper montane areas treated with managed fire and prescribed burning, thus reducing the likelihood that visitors stay away from these areas. In addition, the reduced smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be an emphasis on prescribed burning and wildfire managed to meet resource objectives under alternative C that could lead to reduced air quality and recreational access in the short term. These activities would be planned to occur under favorable conditions in order to mitigate potential adverse effects. Still, the overall effect given the dependence of alternative C on fire for restoration is for some short-term adverse effects on air quality that would have effects on human health, recreational visitation, and economic conditions in local communities.

Alternative C would contribute to sustaining the important local economic benefits provided by water from the forests. The water that is used downstream from the forests is valuable for

municipal and agricultural uses and is also valuable for recreational and ecological uses on the national forests because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternative C as compared to alternative A, given restoration activities that would reverse declining stream flows and increasing temperatures. In the short term, there would be potential adverse effects from increased sedimentation as a result of increased restoration activities; this sedimentation would be similar to alternative B and less than alternative D. This could potentially have adverse short-term economic consequences on recreational visitation, and increase downstream costs of using water from the forests.

Under alternative C, sawtimber harvest would be below current levels and this would result in short- and long-term adverse effects on local forest-product-based infrastructure and workforce as well as on contributions to local governmental budgets supporting critical public services that would reduce economic health and sustainability in the local area. Alternative C would support jobs from forest products and vegetation-based restoration activities estimated at around 100 average annual full- and part-time jobs, with the majority of these jobs (approximately 75 out of the 100) resulting from forest products activity on the Sierra National Forest. Contributions to state and local tax revenues would be around $750,000, again with the majority of this contribution (around $550,000 of the $750,000) resulting from forest products activity on the Sierra National Forest.

Biomass provides the opportunity to generate electricity for the region and also supports local job opportunities in harvesting. However, the focus on fire for restoration and the lack of higher value timber harvests to subsidize biomass removal results in expected decreases in biomass utilization for energy generation. Long-term local job creation from hydropower generation is less than it is from biomass energy given there is no need for continual harvesting and processing of materials. Restoration activities proposed under alternative C contribute to reducing adverse effects associated with the quantity and timing of water, and as a result improves the local economic contributions from electricity generation through hydropower as compared to alternative A.

Consequences Specific to Alternative D

The restoration activities in alternative D would be expected to help reverse current trends and improve the long-term sustainability of all six key national forest contributions that provide benefits to people locally and across the region. These effects would be similar to the effects outlined in alternative B above. Key differences with alternative B would be that the increased pace and scale of restoration in alternative D would be expected to provide greater potential contributions to the long-term sustainability of these six national forest contributions, but also lead to potential increases in adverse short-term effects resulting from increased restoration activities.

Potential Implications for Local Communities

The restoration activities in alternative D would improve the long-term sustainability of all six key national forest contributions and result in significant beneficial economic effects for local communities. These effects would be felt most directly through the potential gain in the sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important activities such as hunting, fishing, plant gathering, and wildlife watching. Alternative D contributes to improving the long-term sustainability of recreational visitation.

Given the increases in restoration activities, alternative D does have the potential to result in adverse short-term effects through closures during restoration project activities and disturbances to species diversity. This short-term disturbance would be expected to be larger than in alternative B. This potential greater adverse effect is off-set by the greater potential for reduced wildfire, and therefore fewer related closures of recreational areas and fewer adverse wildfire effects on species. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation.

Alternative D emphasizes investment in developed recreational opportunities over dispersed opportunities. The types of goods and services needed for developed activities and the spending patterns of these visitors are different than they are for dispersed visitors. Therefore, emphasis on projects that could lead to a long-term shift in the type of visitor to the national forest should be examined at the project level to determine potential economic impacts on local communities as well as on other resources.

Reductions in the smoke from wildfires also contribute to potential beneficial economic effect resulting from sustaining recreational visitation. Under alternative D, restoration activities would result in fewer larger wildfires, thus reducing the likelihood that visitors stay away from the area. In addition, the reduced smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be some prescribed burning under alternative D that could lead to reduced air quality and recreational access, but increased mechanical thinning before burning would help to limit this potential effect. In addition, these prescribed burns would be planned to occur under favorable conditions in order to mitigate potential adverse air quality effects. Still, the overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on air quality.

Alternative D would contribute to sustaining the important local economic benefits provided by water from the forests. The water that is used downstream from the forests is valuable for municipal and agricultural uses. It is also valuable for recreational and ecological uses on the national forests because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternative D as compared to alternative A. In the short term, there would be potential adverse effects from increased sedimentation as a result of increased restoration activities and this sedimentation would be greater than under alternative B. This could potentially have adverse short-term economic consequences on recreational visitation as well as on the downstream costs of using water from the forests.

There is an important economic contribution provided by forest products and restoration activities to local communities through support for jobs and the tax revenues that are generated. Under alternative D, these contributions would help to reverse local infrastructure and workforce declines as well as contributions to local governmental budgets to support critical public services that would improve economic health and sustainability in the local area. Alternative D would support jobs through forest products and vegetation-based restoration activities estimated at around 550 average annual full- and part-time jobs supported, with the majority of these jobs (approximately 450 out of the 500) resulting from forest products activity on the Sierra National Forest. Contributions to state and local tax revenues would be around $4 million, again with the

majority of this contribution (around $3.3 million of the $4 million) resulting from forest products activity on the Sierra National Forest.

Biomass provides the opportunity to generate electricity for the region and also supports local job opportunities in harvesting. Alternative D provides the potential to contribute additional biomass to support the current industry workforce and also support the investment in new biomass facilities. This investment would be required in the long term if the state is to establish a market for biomass, which would be necessary in order to increase the pace and scale of restoration. Long-term local job creation from hydropower generation is less than it is from biomass energy, given there is no need for continual harvesting and processing of materials. Restoration activities proposed under alternative D contribute to reducing adverse effects associated with the quantity and timing of water and as a result, improves the economic contributions from electricity generation through hydropower as compared to alternative A.

Cumulative Effects

The three forests are only a portion of the landscape that comprises the southern Sierra. The resources throughout this entire region provide economic contributions to local communities and regional benefits that improve the quality of people's lives. The management actions and policies on these other lands, in conjunction with management on the national forests, have cumulative effects that need to be considered.

Current trends in declining forest product infrastructure and workforce has resulted in only one sawmill remaining south of Yosemite National Park. The management of all the lands in this area affects future trends in the harvesting of forest products and all of these other contributions need to be considered in conjunction with any changes in these forests' plans. The resulting cumulative effects on communities are critical in maintaining economic health, diversity of economic activity, and sustainable fiscal conditions for counties and local municipalities. In addition, increases in the pace and scale of forest restoration require sustainability of the infrastructure and workforce needed to engage in these activities. Activities on all lands would be required to contribute to this sustainability.

Recreation in and surrounding the three national forests does not follow administrative boundaries, and therefore changes in management of recreation on all of these lands together affects economic conditions in local communities. Visitors are drawn to the entire recreational experience of the area and spend time and money near their destinations as well as in communities on the way to their destinations. Therefore, events like wildfire that result in closure of areas and in smoke that reduces enjoyment of visiting the area would adversely affect communities whether the fire is burning on the national forests or on neighboring Federal, state, or private lands. In addition, the changes to allowable recreational use and activities through management, such as wilderness designation and limitations placed on land use that increases permitting (such as through species conservation management strategies), need to be considered across all lands in order to accurately understand the potential impact for visitation and the economic consequences for local communities.

Analytical Conclusions

Alternative A adversely affects the long-term sustainability of all six key national forest contributions that are examined. The continuation of current management activities in the face of current resource conditions and trends is expected to result in more disruptive events, such as uncharacteristic wildfire, and additional declines in forest health that would interrupt and eliminate the benefits provided by these contributions. This would have adverse short- and long-

term effects on social and economic conditions in local communities and on people's lives, both those located near the national forest and those across the region that enjoy these benefits.

Alternative B would be expected to help reverse current trends and to improve the long-term sustainability of all six key national forest contributions that provide benefits to people locally and across the region. In the short term, effects are mixed across the different national forest contributions. These short-term effects would be adverse for water quality, given the potential for increased sedimentation, and also adverse for biodiversity, from increases in disturbances related to the increasing of restoration activities. The effects are mixed (both adverse and beneficial) for recreation and air quality. Recreation receives benefits in the short term from reduced wildfire, but is adversely affected by the potential for restrictions on activities resulting from restoration project activities. Air quality also benefits in the short term from reduced wildfire, but the prescribed burning under alternative B creates the potential for some short-term decreases in air quality as a result of these activities. Forest products and energy generation both benefit from increased restoration activities that yield sawtimber for mills as well as biomass and the potential for more water quantity for electricity production. Overall, alternative B would have long-term beneficial effects on economic conditions in local communities and on the national forests' contributions to people's lives, both those located near the national forest and those across the region that enjoy these benefits. In the short term, there is the potential for disruption to some of these contributions from increased activities, but this potential is less than in alternative D.

Alternative C would be expected to help reverse current trends and to improve the long-term sustainability of only four of the six key national forest contributions (water, recreation, air quality and biodiversity) that provide benefits to people locally and across the region. This is because the emphasis on fire for restoration instead of mechanical treatments means that the long-term sustainability of forest products and biomass utilization for energy generation would be adversely affected and long-term effects would be similar to those highlighted under alternative A. In the short term, the potential effects are similar to those in alternative B with one important difference. Air quality is expected to be adversely affected in the short term as a result of the increased amount of prescribed burning emphasized under alternative C, but given that these events would be planned to occur under favorable conditions, the overall effect is uncertain. Overall, alternative C would have some long-term beneficial effects on economic conditions in local communities and on the national forests' contributions to people's lives. However, there is long-term loss in the forest products and biomass industries as a result of this alternative.

It is also important to note that there are considerable challenges surrounding the ability of forests to fund management activities under alternative C, more so than under alternatives B and D. As a result, limitations in funding may result in management activities not being fully implemented to the extent described in the alternative. In that case, the resulting long-term effect on the sustainability of national forest contributions would be expected to more closely follow the adverse trends as described under alternative A.

Alternative D would be similar to alternative B and expected to help reverse current trends and improve the long-term sustainability of all six key national forest contributions that provide benefits to people locally and across the region. Key differences with alternative B result from the increased pace and scale of restoration through mechanical treatments in alternative D that could potentially provide even greater contributions to the long-term sustainability of these six national forest contributions. However, this increased intensity would also lead to potential increases in the short term adverse effects resulting from these restoration activities.

Social Conditions

Background

This section summarizes current social conditions in the analysis area for the Inyo, Sequoia, and Sierra National Forests and potential impacts of implementing the revised plans or alternatives on these conditions.

The 2012 planning rule requires that plans contain guidance that helps a national forest contribute to social sustainability. In this plan revision effort, desired conditions were developed for the three national forests to address the following identified needs: supporting the long-term sustainability of forest benefits to people, encouraging the use of partnerships, and improving communication and outreach to the public, including underrepresented populations.

Many of the challenges we face in managing National Forest System lands are rooted in the values that people hold, which influence what is desired from forest management and also help define the quality of life that is important to individuals and communities (Allen et al. 2009). People are often concerned with the potential impacts of changes in land management on their quality of life and at the same time, shifting population demographics also influence value orientations and what is considered important to individuals and communities. This plan revision effort aims to develop plans that emphasize working together with and understanding the needs of the public in order to manage forests in a way that contributes to social sustainability.

Analysis and Methods

This analysis focuses on three key indicators to examine impacts of alternatives on social conditions: values, civil rights, and environmental justice. While social conditions include a wide range of factors, values were chosen as an indicator because they effectively help us understand differences among alternatives from a social perspective, as well as concerns raised by the public. In addition, examining impacts of alternatives on civil rights and environmental justice are a required part of an environmental impact statement and help ensure more vulnerable populations are considered in land management decisions. These three indicators are described below.

Indicators and Methods

Values

Understanding how people are potentially affected by different alternatives includes looking at what those changes mean in terms of people's different value sets. Several comments received during scoping reveal the diverse values that stakeholders have regarding the management of National Forest System lands. People would be impacted differently because certain alternatives would align more closely with personal values compared to other alternatives. This analysis qualitatively examines potential impacts of alternatives on different value sets.

Based on scoping comments and previous input, including a stakeholder analysis conducted by the Center for Collaborative Policy prior to the assessment phase, we developed broad categories of forest management values that may be affected by different alternatives. We then took these categories along with analyses from other resources areas to summarize the extent to which the different alternatives aligned with different values. This analysis does not discuss every aspect of these very broad values. Rather, it focuses on those aspects that best help us understand differences across alternatives and concerns raised by the public.

The area of focus for this indicator includes the Inyo, Sequoia, and Sierra National Forests. We used information provided by the public regardless of location to examine people's values toward the management of these three forests. This includes viewpoints from both local and regional stakeholders, as well as stakeholders in more distant locations.

Civil Rights

USDA civil rights policy (USDA 2003) requires each agency to analyze the civil rights impact(s) of policies, actions, or decisions that will affect the USDA workforce or federally conducted and federally assisted programs and activities. A civil rights impact analysis facilitates the identification of the effects of agency actions that may adversely and disproportionately impact employees or program beneficiaries based on their membership in a protected group.

A protected group is any person, group, or class of persons protected under Federal law and Executive order from discrimination on any prohibited basis, that is, discrimination based on race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance programs (USDA 2003).

For environmental or natural resources actions, civil rights impact analyses are not separate reports, but are an integral part of the social impact analysis in the environmental impact statement (USDA FS 1986).

The theory of "disparate impact" is used in this civil rights impact analysis. Disparate impact is the evenhanded application of neutral policies, actions, or decisions that have the effect of excluding or otherwise adversely and disproportionately affecting protected groups. This analysis qualitatively describes whether:

- Protected groups were provided the same opportunities to participate in the forest plan revision process as others.
- Management under the draft forest plans has the effect of excluding or otherwise adversely and disproportionately impacting protected groups.

The area of focus for this indicator includes the Inyo, Sequoia, and Sierra National Forests. The analysis examines any potential civil rights impacts as a result of the three national forests' plan revision process or revised plans. A qualitative analysis of public engagement and review of the scope and nature of public comments was used to assess potential disproportionate impacts to protected groups.

Environmental Justice

Environmental justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment (USDA 1997).

In 1994, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed requiring that each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs,

policies, and activities on minority populations and low-income populations (Council on Environmental Quality 1997).

The memorandum specifically recognized the role of the National Environmental Policy Act (NEPA) in identifying and addressing environmental justice concerns, particularly related to analyzing environmental effects on minority populations, low-income populations, and Indian tribes; identifying mitigation measures as appropriate; and providing opportunities for community participation in the NEPA process (Council on Environmental Quality 1997).

This analysis examines whether there may be disproportionately high and adverse environmental effects on minority and low-income populations across alternatives. Environmental effects include human health, economic, and social effects. This is done qualitatively by examining who and where these environmental justice communities may be, describing how they interact with the national forests, and, as a result, how they may be disproportionately and adversely impacted by the different alternatives.

The Council on Environmental Quality has oversight of the Federal government's compliance with Executive Order 12898 and NEPA. They have defined "minority" and "low-income" populations as follows (Council on Environmental Quality 1997):

> Low-income Populations: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.
>
> Minority: Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
>
> Minority Populations: Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent (may be made up of one minority or a sum of all minorities together) or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

To identify potential environmental justice populations, we used demographic data from the 2011 American Community Survey (ACS) 5-year estimates from the U.S. Census Bureau. 2011 ACS 5-year estimates were the most recent data available when originally collected, analyzed, and mapped during the assessment phase. The 5-year estimates were chosen over the 3- or 1-year estimates because they provide information for smaller geographies, are more precise, and better for small populations.

We used the area of influence previously defined for each national forest in the assessment phase. For each national forest this is the set of census county divisions (CCD) that intersects the national forest administrative boundary. CCDs are county subdivisions delineated by the United States Census Bureau in cooperation with state, tribal, and local officials for statistical purposes (U.S. Census Bureau 2015). The CCDs and counties associated with each national forest are listed below.

Inyo National Forest: North Mono and Mammoth Lakes CCDs in Mono County; Bishop, Independence, and Lone Pine CCDs in Inyo County; Mina CCD in Mineral County; and Silver Peak CCD in Esmeralda County (see Figure 44).

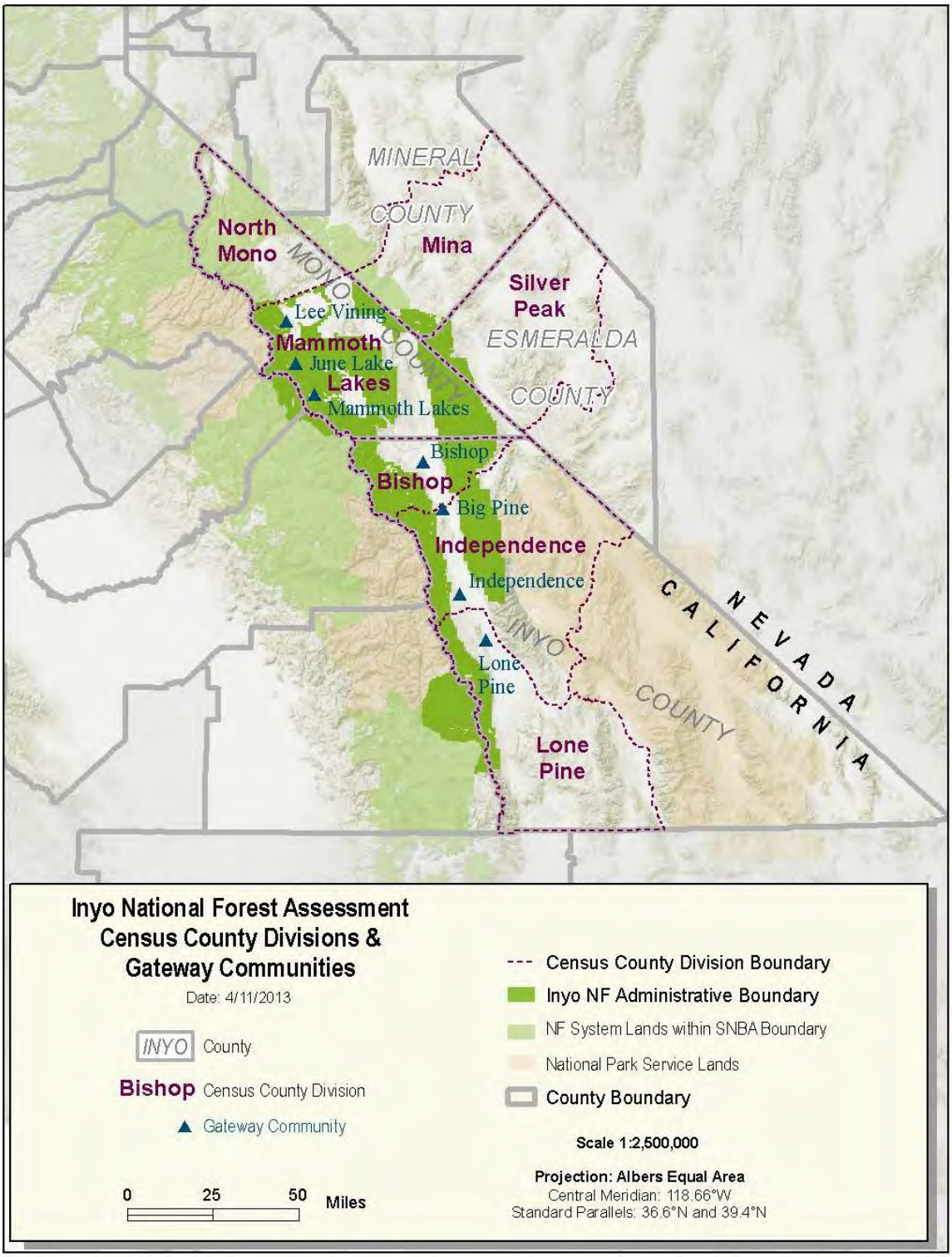

Figure 44. Census county divisions that intersect the Inyo National Forest administrative boundary

Sequoia National Forest: Sierra CCD in Fresno County; Woodlake-Three Rivers and Springville-Johnsondale CCDs in Tulare County; and Lake Isabella, Bakersfield, and Tehachapi CCDs in Kern County (see Figure 45).

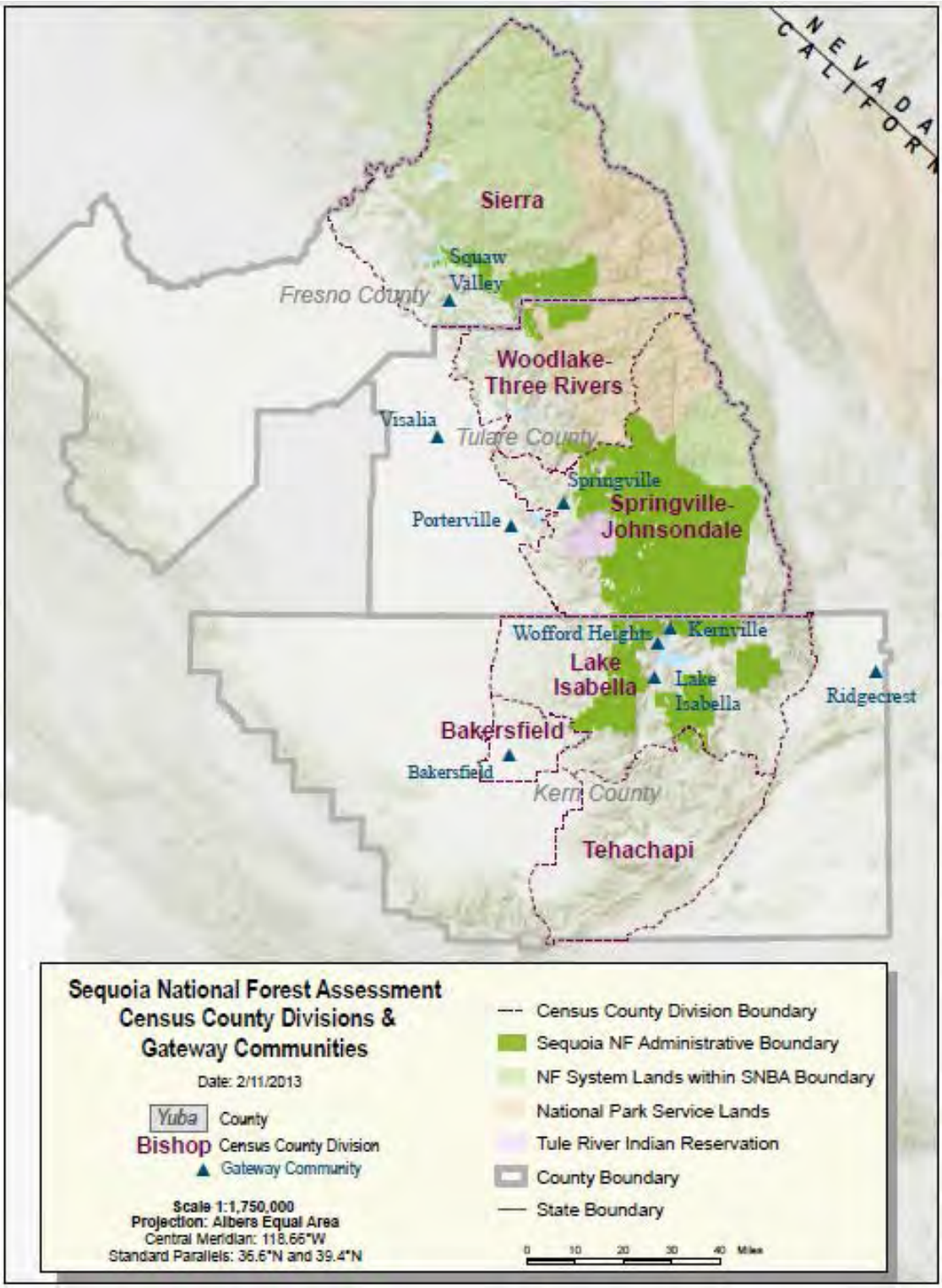

Figure 45. Census county divisions that intersect the Sequoia National Forest administrative boundary

Sierra National Forest: Coulterville, Mariposa, and Yosemite Valley CCDs in Mariposa County; Yosemite Lakes and Oakhurst-North Fork CCDs in Madera County; and Sierra CCD in Fresno County (see Figure 46).

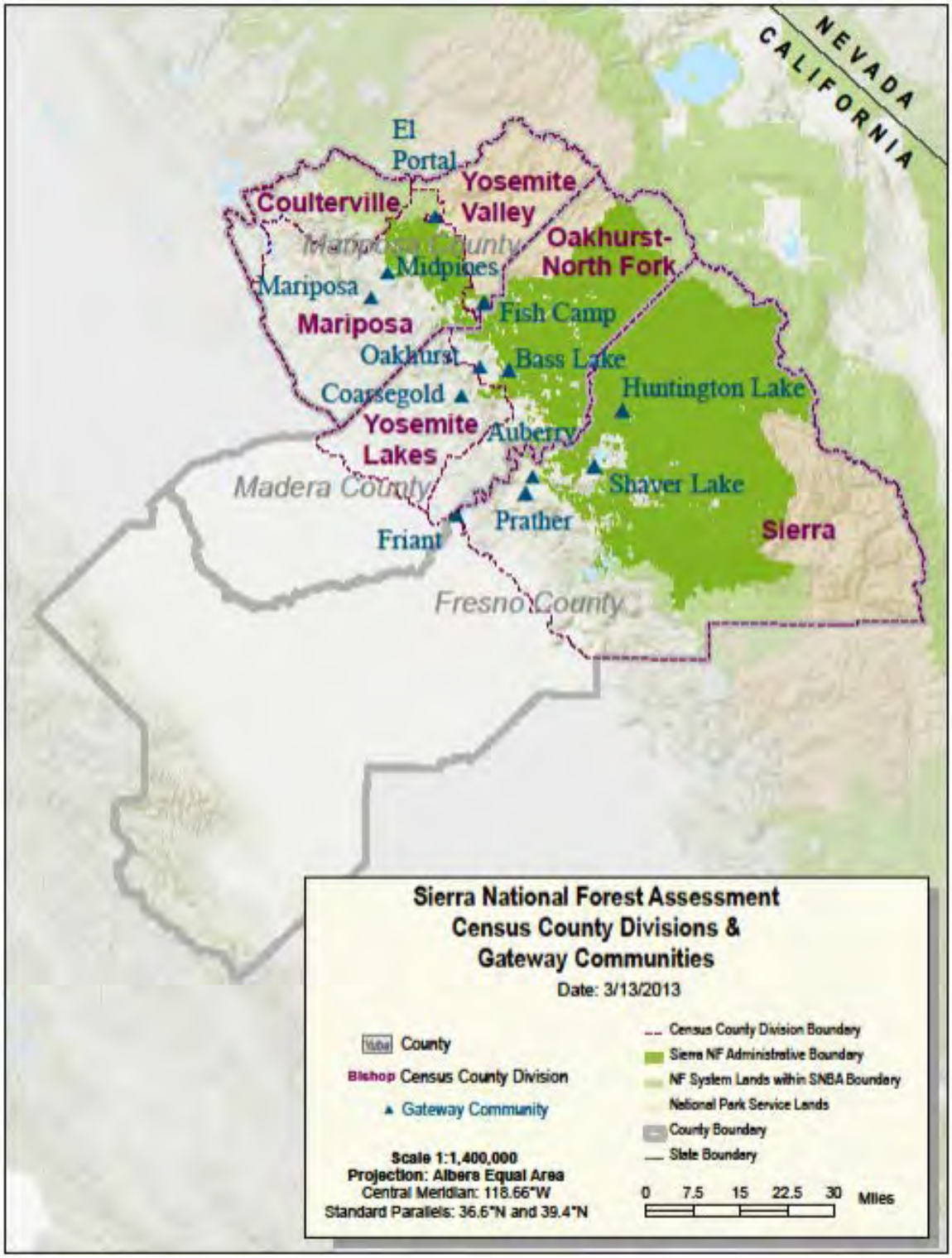

Figure 46. Census county divisions that intersect the Sierra National Forest administrative boundary

We considered a census county division a minority population if greater than 50 percent of the population identified as non-white or Hispanic/Latino. We considered a census county division a low-income population if the percentage of people below the poverty threshold was substantially greater than at the county level.

In determining the poverty status of families and individuals, the Census Bureau uses income cutoffs that vary by family size, number of children, and age. If the total income of a person's family in the last 12 months is less than the threshold appropriate for that person's family size and composition, then that person is considered "below the poverty level" together with every family member.

To better understand the geographic location of potential environmental justice communities and more specific information regarding race and ethnicity, we examined census block-group-population demographics for the following categories: American Indian and Alaska Native; Asian; Black or African American; Native Hawaiian and Other Pacific Islander; Hispanic or Latino; and Poverty (percent of people whose income is below the poverty level). Census block groups are the second to smallest geographical unit used by the Census Bureau and are generally defined to contain between 600 and 3,000 people (U.S. Census Bureau 2015). We used this information to identify more specific places that had relatively large minority populations and where outreach efforts could be targeted.

Assumptions

- The framework for the social analysis uses generalities. Area residents and national forest visitors have diverse preferences and values that may not be fully captured in the description of social consequences. The general categories are useful for assessing social impacts based on particular forest-related values.
- Individuals may hold one or more of the values described in this section. As a result, the impacts of alternatives on specific individuals may be cumulative or mixed, depending on the values they hold.
- Demographics are generally the same at the time of writing this analysis as they were during the assessment.

Affected Environment

This section describes the social environment of the area relevant to the indicators used in the social impact analysis. More general, comprehensive background information regarding social conditions and trends related to the Inyo, Sequoia, and Sierra National Forests can be found in the national forest assessments.

Values

Values are relatively enduring concepts that people hold and often share within a given society or culture about important life principles, including what is good or bad and desirable or undesirable (Allen et al. 2009). People's values influence how they use national forests, as well as their expectations regarding how National Forest System lands should be managed. The values that people in the Sierra Nevada hold have been passed on through generations. However, values have also been changing over time due to new knowledge, recreation and tourism growth, migration from urban areas, and demographic shifts.

The diverse values that people hold can create complex situations for national forest land management. In addition, many communities outside a national forest's immediate area of influence have an interest in how it is managed, whether they directly use the forests (such as, recreation and tourism) or not (such as, water demand from urban and agricultural areas, concern for endangered species) (Long et al. 2014).

Baseline, representative data regarding public values for these three forests are unavailable, so it is not possible to describe what values are most important to the public when it comes to managing the Inyo, Sequoia, and Sierra National Forests. However, based on what we heard from stakeholders throughout the revision process, we extracted the broad value categories described below. Because the viewpoints used to establish different value categories came from volunteered stakeholder responses, they are not necessarily representative of the general public. Brown et al. (2013) reveal differences in forest values between people who volunteered to participate in a values mapping exercise versus those who were randomly selected to participate. Still, interviews, meetings, and submitted comments often provide the only source of information regarding the forest values that people hold and help us better understand how national forest management decisions may have an impact on those values.

Aesthetic – Manage for the Scenery, Sights, Sounds, and Smells of Nature

As described in the national forest assessments, scenery is a major component of people's recreation experience on the Inyo, Sequoia, and Sierra National Forests and greatly contributes to their sense of place and connection with the land. Ecosystem stressors such as excessively dense vegetative conditions, fire-return-interval conditions susceptible to severe wildfire, and insect and disease outbreaks continue to diminish valued scenery attributes, particularly socially valued large trees and diverse vegetation.

Biodiversity – Protect Animal and Plant Species and Their Habitat

The diverse landscapes of the Inyo, Sequoia, and Sierra National Forests provide a rich array of ecosystems and habitat types that support hundreds of wildlife, fish, and plant species. These species contribute to the lifestyles, cultures, and traditions of many national forest users through activities such as hunting, fishing, plant gathering, and nature viewing. People have also expressed concern regarding adequate protection of habitat for species that are "at-risk," as described in the "At-risk Species" section.

Cultural – Protect Forest Uses that Help Maintain Traditions and Cultures

Native American culture is inextricably connected to the land. Many Native Americans participate in traditional activities that carry on family and tribal traditions, provide sustenance for families, and continue a spiritual connection to the land and to animal and plant resources (McAvoy et al. 2004). Tribal members have expressed concern about continued use of and access to areas on the Inyo, Sequoia, and Sierra National Forests that support their cultural traditions.

Learning – Support Opportunities to Learn About the Environment, History, and People

The Inyo, Sequoia, and Sierra National Forests foster people's connection to nature and each other through education and interpretation. People have expressed a desire to increase outreach, education, and interpretation efforts, particularly related to issues such as fire, invasive species, cultural resources, tribal histories and uses, and recreation etiquette and impacts.

Recreation – Maintain and Enhance a Diverse Set of Recreation Activities

Outdoor recreation is a large part of the culture and lifestyle in the Sierra Nevada and one of the main ways that residents and visitors connect to the land and enjoy the natural world.

Recreational trends and the mix of outdoor activities chosen by the public evolve over time, and these demands influence national forest lands and management decisions (USDA FS 2012). Because everyone recreates on the Inyo, Sequoia, and Sierra National Forests in a wide variety of ways, people also have expressed a wide range of concerns regarding potential impacts to their preferred recreation activities. In addition, many people would like to see more opportunities on these forests for the types of recreation activities in which they participate.

Wellbeing – Promote and Protect Human Health and Safety

The Inyo, Sequoia, and Sierra National Forests contribute to the well-being of human populations in a variety of ways, including basic life necessities such as clean air and water, physical and mental health benefits, and protection from the spread of fire into communities. People are concerned about the impacts of national forest management decisions on their health and safety, particularly in regard to climate change and expected increases in the occurrence and severity of drought and fire. Many stakeholders are concerned with impacts to water supply, including downstream agricultural and urban communities.

Stakeholders have expressed concerns regarding health impacts associated with increased prescribed fire and wildfire managed to meet resource objectives. People are concerned that these actions would result in prolonged days of smoke exposure, affecting human health, people's ability to recreate and go about daily activities, and tourism. This is of particular concern to the Inyo National Forest and people living in the eastern Sierra. In addition, people have expressed safety concerns about using prescribed fire or wildfire managed to meet resource objectives near communities, particularly where fuels loads are high. Concerns have been raised regarding impacts to access for fire suppression activities and public evacuation routes in the community wildfire protection zone.

Civil Rights

All members of the public were invited to participate in the plan revision process. The main public notices and meetings held by all three forests are listed below. No specific information concerning respondents' race, sex, national origin, or age was collected from public comments or meetings.

- On December 26, 2013, the Federal Register published the Forest Service's notice to initiate plan revision for the Inyo, Sequoia, and Sierra National Forests. The public was also notified in the newspapers of record for the Inyo, Sequoia, and Sierra National Forests: the *Inyo Register*, *Porterville Recorder*, and *Fresno Bee*, respectively.
- In January 2014, public meetings were held in Bishop, Bakersfield, and Fresno on the preliminary need to change, desired conditions, and forest roles and contributions. Based on sign-in records, at least 75 people attended the meeting in Bishop, 26 people in Bakersfield, and 93 people in Fresno.
- In June 2014, public meetings were held in Bishop, Lake Isabella, and Fresno on the updated need to change, desired conditions, wilderness inventory, and timber suitability. Based on sign-in records, at least 80 people attended the meeting in Bishop, 30 people in Lake Isabella, and 122 people in Fresno.
- The notice of intent to prepare an environmental impact statement for revised forest plans was published in the *Federal Register* on August 29, 2014. The scoping comment period concerning the proposed action in the notice of intent ended on September 29, 2014. The public was also notified in the newspapers of record for the Inyo, Sequoia, and Sierra

National Forests. The notice of intent and supporting documents were available to the public on the Forest Service project website. Scoping comments were accepted through the project website, email, hard copy, or fax.

- In September 2014, public meetings were held in Bishop, Porterville, and Fresno to answer questions about the notice of intent and proposed action and to receive scoping comments. Based on sign-in records, at least 76 people attended the meeting in Bishop, 29 people in Porterville, and 79 people in Fresno. During the scoping period, we received more than 7,200 separate public comment letters or emails from tribes, Federal agencies, state agencies, county governments and agencies, local agencies and organizations, and other groups and individuals.
- In November 2014, public meetings were held in Bishop, Porterville, and Fresno on scoping issues and the conceptual range of alternatives. Based on sign-in records, at least 80 people attended the meeting in Bishop, 20 people in Porterville, and 36 people in Fresno.
- In June 2015, the Inyo National Forest held an additional public meeting in Bishop to share information on the wilderness evaluation. Based on sign-in records, at least 50 people attended the meeting.

Beyond these general public notifications and meetings, the "Environmental Justice" section describes additional efforts the forests made to reach out to more diverse audiences.

There were no comments received that indicated concerns about discrimination based on race, sex, national origin, age, or disabilities during the plan revision process for the Inyo, Sequoia, and Sierra National Forests. The forests offered accommodations and provided paper copies of forest plan revision materials to people who requested them due to disabilities or other reasons. All web-based materials were developed to be accessible for people with disabilities as required by section 508 of the Rehabilitation Act.

Some senior citizens expressed a desire for meetings closer to home to avoid long drives at night. We also heard this from members of the public from rural mountain communities. Meeting locations and times were based on the availability of meeting space and trying to find centralized locations and times that accommodate the greatest possible attendance. Meetings were adjusted to end earlier over the course of the plan revision process. Forest staffs were also available to answer questions or provide information to those people who could not attend the meetings.

Some comments received during scoping suggest concerns regarding potentially disparate impacts from the proposed action and are further examined in the "Environmental Consequences" section. These include the following:

- Concerns that new wilderness recommendations would result in road and trail closures that would impact seniors, children, and people with disabilities who rely on motorized or mechanized travel to access the national forest.
- Concerns that new wilderness recommendations would add areas predominantly used by white males and that exclude minorities and women.
- Concerns that prohibiting pack goats in wilderness, particularly on the Inyo National Forest, would impact seniors, children, and people with disabilities who rely on pack goats to access these areas.

- Concerns that prohibiting bicycles on the Pacific Coast Trail impact people with disabilities who can bike but not walk for long distances.
- Concerns with health impacts of wildfire smoke on seniors, children, and people with health problems.

Environmental Justice

None of the seven CCDs (census county divisions) that make up the Inyo National Forest's area of influence have minority populations over 50 percent (Table 156). However, certain areas within or near Bishop, Mammoth Lakes, and Lee Vining have relatively large proportions of their populations who identified as minorities, particularly people who identified as American Indian/Alaska Native and/or Hispanic/Latino.

Of the seven census county divisions that make up the Inyo National Forest's area of influence, the Lone Pine CCD in Inyo County and the Mina CCD in Mineral County have substantially greater percentages of people who are below poverty compared to county levels (Table 156). In addition, certain areas within or near Sonora Junction, Mammoth Lakes, and Bishop have relatively large proportions of their populations that are low-income.

Table 156. Percent of minority populations and people living below the poverty level in the area of influence for the Inyo National Forest

Area	Minority Population	People Below Poverty Level
Mono County	31%	11%
North Mono Census County Division (CCD)	27%	12%
Mammoth Lakes CCD	32%	11%
Inyo County	33%	12%
Bishop CCD	35%	11%
Independence CCD	26%	7%
Lone Pine CCD	35%	18%
Mineral County	27%	22%
Mina CCD	0%	63%
Esmeralda County	20%	22%
Silver Peak CCD	32%	21%

Of the six census county divisions that make up the Sequoia National Forest's area of influence, the Woodlake-Three Rivers CCD in Tulare County and the Bakersfield CCD in Kern County have minority populations over 50 percent (Table 157), mostly accounted for by people who identified as Hispanic/Latino. In addition, a relatively large proportion of the population around the Tule River Indian Reservation and South Lake identified as American Indian/Alaska Native. Although not within the Sequoia National Forest's immediate area of influence, about 60 percent of the population in the Visalia-Porterville metro area is estimated to be part of a minority population, almost entirely accounted for by people who identified as Hispanic/Latino.

None of the six census county divisions that make up the Sequoia National Forest's area of influence have substantially greater percentages of people who are below poverty compared to county levels (Table 157). However, certain areas within or near the following places have

relatively large low-income populations compared to county levels: Woodlake, Wofford Heights, South Lake, Tehachapi, Bakersfield, and the Visalia-Porterville metro area.

Table 157. Percent of minority populations and people living below the poverty level in the area of influence for the Sequoia National Forest

Area	Minority Population	People Below Poverty Level
Fresno County	67%	23%
Sierra Census County Division (CCD)	24%	10%
Tulare County	60%	24%
Woodlake-Three Rivers CCD	60%	21%
Springville-Johnsondale CCD	41%	13%
Kern County	49%	21%
Lake Isabella CCD	15%	22%
Bakersfield CCD	63%	24%
Tehachapi CCD	31%	13%

None of the six census county divisions that make up the Sierra National Forest's area of influence have minority populations over 50 percent (Table 158). Although not within the Sierra National Forest's immediate area of influence, several areas within or near Fresno, Madera, and Chowchilla have relatively large proportions of their populations who identified as minorities, particularly people who identified as Hispanic/Latino, Asian, and Black/African American.

None of the six census county divisions that make up the Sierra National Forest's area of influence have substantially greater percentages of people who are below poverty compared to county levels (Table 158). However, certain areas within or near the following places have relatively large low-income populations compared to county levels: Coulterville, Mariposa, Fresno, Madera, and Chowchilla.

Table 158. Percent of minority populations and people living below the poverty level in the area of influence for the Sierra National Forest

Area	Minority Population	People Below Poverty Level
Mariposa County	**17%**	**14%**
Coulterville Census County Division (CCD)	14%	16%
Mariposa CCD	17%	14%
Yosemite Valley CCD	26%	17%
Madera County	**61%**	**20%**
Oakhurst-North Fork CCD	16%	11%
Yosemite Lakes CCD	19%	7%
Fresno County	**67%**	**23%**
Sierra CCD	24%	10%

Meaningful involvement in decision-making processes is an important part of environmental justice considerations. This includes reaching out to potential environmental justice communities

and inviting them to participate in the plan revision process so we can better understand their concerns.

Efforts have been made to engage tribes early and throughout the plan revision process. In fall 2012, prior to the official start of plan revision, the Center for Collaborative Policy conducted informational interviews with 31 tribal members representing 14 tribes and tribal organizations associated with the Inyo, Sequoia, and Sierra National Forests. The purpose of the interviews was to better understand tribal concerns that may be relevant to national forest planning, better understand how to improve tribal consultation and involvement, and develop recommendations for tribal involvement during the plan revision process. A Tribal Collaboration and Communication Plan was developed from the results of these interviews to inform how the three national forests would interact with tribes during the plan revision process.

The Sierra and Sequoia National Forests have been hosting quarterly tribal forums since 2008 for information sharing between the forests and tribes. Tribal forums have helped meet the needs of tribes and national forest leadership by allowing everyone the opportunity to meet at annual forecasted dates and times to discuss topics of mutual interest, including forest plan revision.

Tribal forums specific to plan revision have been held on all three forests as described below.

- In January 2014, we held tribal forums in Bishop, Bakersfield, and Clovis on the preliminary need to change, desired conditions, and forest roles and contributions. At least 28 tribal representatives attended these forums.
- In June 2014, we held tribal forums in Bishop, Kernville, and Fresno on the updated need to change, desired conditions, wilderness inventory, and timber suitability. At least 26 tribal representatives attended these forums.
- In September 2014, we held tribal forums in Bishop, Porterville, and Fresno on the notice of intent and proposed action. At least 31 tribal representatives attended these forums.
- In November 2014, we held a tribal forum in Prather on scoping issues and the conceptual range of alternatives. Approximately 15 tribal representatives attended.

In addition to the meetings above, the three national forests have had several meetings with individual tribes and tribal groups throughout the process that have included forest plan revision as an agenda topic.

In their work and interactions with tribes and tribal organizations, the three national forests have gained a better understanding of tribal interests and concerns related to plan revision. Broad categories of concern include protection of and access to sacred sites, gathering areas, and ceremonial areas; traditional land uses and management, including the role of fire on the landscape; tribal economies; traditional knowledge and education; conflict between recreation uses and traditional tribal activities; and overall forest resilience and sustainability. Further discussion of tribal interests and concerns can be found in the “Tribal Relations and Uses” section.

Aside from tribal communities, limited information is available regarding how minority and low-income populations use and interact with the Inyo, Sequoia, and Sierra National Forests.

National and regional information about how minority populations recreate can provide some insights regarding potential uses of the Inyo, Sequoia, and Sierra National Forests. Despite a U.S. population that is becoming increasingly ethnically diverse, minority populations are still

underrepresented in outdoor recreation (Cordell 2012). Based on national outdoor recreation trends (Mahler 2012), running is the most popular outdoor recreation activity among African Americans, Asian/Pacific Islanders, and Hispanics. Biking is the second most popular activity among African Americans and Asian/Pacific Islanders, while fishing is the second most popular activity among Hispanics. Studies have found that Latinos are primarily day-use visitors, recreate in larger groups, prefer developed sites with amenities and facilities, and often spend extended periods at picnic sites cooking several meals throughout the day (Chavez 2012). Studies on four national forests in southern California show that picnic/barbecues and playing in streams were among the activities in which Latino visitors usually engaged (Chavez and Olson 2008).

In addition to general public notification, the forests have been trying to find new ways to reach out to more diverse audiences to better understand their concerns and how they use these forests.

The Sequoia National Forest has been working to translate more materials into Spanish and managed a Latino Awareness booth at a local festival, sharing information about fire awareness, forest plan revision, and environmental restoration.

The Forest Service's Central California Consortium based in Clovis, California, has worked on various efforts over the past several years to engage diverse youth and underserved communities in national forest planning. The Central California Consortium is a minority outreach and recruitment program serving the greater San Joaquin Valley. They aim to not only create jobs for underserved communities, but to educate the public on natural resources issues and encourage diverse communities to enjoy public lands. This has resulted in participation by diverse high school and college students in plan revision meetings on the Sierra National Forest, as well as efforts to translate plan revision meeting announcements into Spanish. The forests aim to continue to build on these efforts and develop relationships with groups that tend to be underrepresented in meetings and as national forest users.

On the east side of the Sierra, the Inyo National Forest has expanded outreach to their Spanish language newspaper and are working on coordinating localized interpretation and outreach to the Spanish speaking population. Programs are expected to start late summer to fall that involved several long-term ideas into the upcoming years. The Inyo National Forest is also starting work with Outdoor Afro, which aims to connect African-Americans with natural spaces and one another through recreational activities.

Continuing to build on this outreach work can help increase diversity in participants in future efforts, particularly projects and activities developed under the revised plans. During this plan revision effort, we have developed a better understanding of where potential environmental justice communities may be located. Forests have started to do some work on identifying trusted community contacts who can help provide a bridge between the forests and these communities. This information can further assist in developing outreach efforts when we are developing projects in certain areas.

Environmental Consequences to Social Conditions (All Alternatives)

Values

Aesthetic – Manage for the Scenery, Sights, Sounds, and Smells of Nature

Scenery is closely tied to vegetation and fire management as described under the "Sustainable Recreation" section. The alternatives differ in terms of ecological restoration objectives, which define the rate at which we aim to move vegetation toward desired conditions. As vegetation and fire-return intervals across more landscapes are restored toward their natural range of variation, the degree to which valued scenic attributes can be sustained through time is expected to increase as well. In the short term, however, some people may perceive restoration activities as having a negative impact to scenery.

Long-term sustainability of scenic character would be at greater risk under alternative A compared to alternatives B or D. Alternative A continues to use the existing visual management system for managing scenery and does not include evaluating the sustainability of scenic character as part of project planning. As described in the "Terrestrial Ecosystems" section, alternative A provides limited treatments across ecological zones.

Alternative B better aligns with aesthetic values in the long term compared to alternatives A and C, but less than alternative D. It includes evaluating sustainability of scenic character as part of project planning. Alternative B is expected to better integrate management across resources compared to alternative A, particularly in places that are of high recreation importance and where protection of scenic character is especially critical. This alternative provides more potential for increasing ecological restoration opportunities across ecological zones than alternatives A and C.

Similar to alternatives B and D, alternative C includes evaluating sustainability of scenic character as part of project planning. However, this alternative is more restrictive in terms of ecological restoration opportunities compared to all other alternatives. Therefore, long-term sustainability of scenic character is likely to be at greatest risk under alternative C compared to all other alternatives.

Similar to alternatives B and C, alternative D includes evaluating sustainability of scenic character as part of project planning and is expected to better integrate management across resources compared to alternative A. Compared to all other alternatives, alternative D is expected to best align with aesthetic values in the long term, because it provides the most potential for increasing ecological restoration opportunities across ecological zones.

Biodiversity – Protect Animal and Plant Species and Their Habitat

Fishing, hunting, plant collection, and nature viewing are important activities to people who use the Inyo, Sequoia, and Sierra National Forests. The Forest Service is responsible for managing wildlife habitats on national forest lands whereas individual species are managed by California Department of Fish and Wildlife.

As described in the "Aquatics and Riparian Ecosystems" section, the slow pace of restoration of habitats for aquatic at-risk species under alternative A would result in a continuing risk of downward trend for aquatic species diversity. The goal to increase restoration of aquatic habitats under alternatives B, C, and D is expected to address species needs and improve aquatic biodiversity compared to alternative A. While there are different tradeoffs between short-term

consequences of restoration and long-term risk of intense wildfire among the alternatives B, C, and D, over the long term, they are expected to have similar effects on aquatics species diversity.

As described in the "At-risk Plant Species" section, because broad-scale restoration of ecosystem structure and function would be more limited under alternative A, there may be long-term negative effects to federally listed plant species under this alternative compared to the other alternatives. In comparison to alternatives B, C, and D, alternative A would least provide the ecological conditions necessary to conserve candidate species and to maintain or restore their habitats in the plan area, which would contribute to preventing them from being federally listed. Alternative A would consider fewer rare plants in the project planning process, as compared to alternatives B, C, and D. Each of the three alternatives would provide for ecological conditions necessary for the viability of at-risk plant species. However, alternative B would provide the most long-term benefits to species of conservation concern habitat extent and quality. Alternative B would also have the most beneficial short- and long-term effects for whitebark pine.

Ecological restoration and use of wildfire primarily to meet resource objectives is limited in alternative A, providing for less opportunity to create habitat heterogeneity that is needed for many of the hunted and viewable wildlife species. Alternative B continues to provide for large tree and forest canopy cover, as with alternative A, but with additional emphasis to increase the amount of forest restoration treatments to create greater habitat resiliency and heterogeneity. The consequences to many hunted and viewable species are expected to be mixed in alternative C with some benefits due to less disturbance, but also less benefit from more limited habitat restoration opportunities compared to alternatives B and D. There is a higher likelihood of very large, high-intensity fires with implementation of alternative C, according to the fire-climate scenario predictions (Westerling et al. 2015), which can have a long-term negative impact on the distribution and sustainability of habitat. Alternative D would have the greatest increase in the pace and scale of ecological restoration of all alternatives, and would provide the most areas with increased vegetation resilience and heterogeneity, which would generally benefit hunted and viewable species. The increased pace and scale of mechanical thinning and use of strategic treatments along ridgetops in alternative D would be expected to produce greater forage for herbivores. The increased restoration of fire as an ecological process would also provide more sustainable forage. This influx of forage also could help bolster predator populations, such as mountain lions, bobcats, and coyotes and other viewable wildlife species.

Cultural – Protect Forest Uses that Help Maintain Traditions and Cultures

All alternatives contribute to the cultural connections that people have with the Inyo, Sequoia, and Sierra National Forests through the various uses and activities that the forests provide.

Alternative A does not provide the level of integration of tribal interests and values into project considerations that alternatives B, C, and D do. Alternative A only includes existing designated wilderness and does not recommend new areas for inclusion in the National Wilderness Preservation System, allowing for the same level of tribal access to areas traditionally used by tribes and that may have been part of the wilderness evaluation.

Alternatives B, C, and D provide a greater level of integration of tribal interests and values into project considerations than alternative A, due to the addition of new plan components that would be included in each alternative. The increased opportunities for ecological restoration in alternative B are expected to benefit tribal interests by incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects. By working with tribes, more ecological restoration activities are expected to lead to more

opportunities that benefit habitats and resources used for traditional purposes. Alternative B recommends new areas for inclusion in the National Wilderness Preservation System on the Inyo National Forest. As described in the "Tribal Relations and Uses" section, while many tribal activities could still occur within areas recommended for wilderness, some activities such as gathering and ceremonial uses may be restricted or more difficult if areas are managed as wilderness.

Due to the limited opportunities for ecological restoration in alternative C, areas and resources of tribal interest are at greatest risk to large, high-intensity wildfire under this alternative. Alternative C recommends the most new areas for inclusion in the National Wilderness Preservation System across all three forests, which could potentially lead to the most restrictions on traditional tribal uses.

The increased opportunities for ecological restoration in alternative D are expected to benefit tribal interests by incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects. By working with tribes, more ecological restoration activities are expected to lead to more opportunities that benefit habitats and resources used for traditional purposes. Because alternative D provides the most ecological restoration activities, there may be greater risks to inadvertently impacting tribal resources, traditional cultural properties, and sacred sites. However, this is expected to be mitigated through close coordination with tribes. Alternative D does not recommend new areas for inclusion in the National Wilderness Preservation System, allowing for the same level of tribal access to areas traditionally used by tribes and that may have been part of the wilderness evaluation.

Learning – Support Opportunities to Learn About the Environment, History, and People

Under alternative A, forests would continue to provide opportunities for people to learn about the environment and the history of the land and its people. However, more opportunities are expected under alternatives B, C, and D because of added plan direction related to volunteering, interpretation, partnerships, and stewardship. New plan direction emphasizes the delivery of effective messaging regarding natural and cultural resources, climate change, land stewardship, responsible recreation use, and Native American heritage and culture, as well as communicating regularly with the public about Forest Service projects, management activities, and volunteer and partnership opportunities. This includes consideration of the diverse backgrounds and needs of visitors in developing communication materials. In addition, alternatives B, C, and D would include an objective to generate cultural resources products, providing for more cultural learning opportunities. This objective would not vary across alternatives B, C, and D and does not exist in current forest plans under alternative A.

Across alternatives B, C, and D, there is an increased emphasis on partnerships. Partnerships not only help us do our work, but also create opportunities for learning. While emphasis on partnerships across these alternatives is basically the same, the focus of the partnerships may vary across them. For example, there would be more opportunities for partnerships around primitive recreation in alternative C compared to developed recreation in alternative D.

There is an also and increased emphasis on working with tribes in alternatives B, C, and D compared to alternative A. An important aspect of this coordination is finding opportunities for increased learning and understanding between the agency and tribes as we carry out projects and activities. Another important aspect includes incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects, which may not

only improve land management decisions, but also promote transmission of traditions and knowledge to younger generations.

Recreation – Maintain and Enhance a Diverse Set of Recreation Activities

Demand for outdoor recreation opportunities is expected to increase, while the types of recreation activities and experiences that people are seeking would continue to shift. With expected stable or declining agency budgets in the future, the Forest Service would need to rely on volunteers and partners to continue to provide a set of recreation opportunities that meet the need of a growing and changing public. Over the past 15 years, there have been significant declines nationally in programs that contribute to providing recreation opportunities as financial and human resources have been shifted to wildfire management (USDA FS 2015). This has resulted in the agency being unable to more fully implement sustainable recreation, heritage, volunteer services, wilderness, and wild and scenic rivers programs to provide consistent, quality recreation opportunities to the public. The reductions in funding and staff have also impacted the agency's ability to work with partners and volunteers, as well as to manage permits needed by outfitters and guides and other recreation-focused small business to provide recreation opportunities on National Forest System lands.

Alternatives B, C, and D better emphasize sustainable recreation concepts and integrated resource management compared to alternative A. In addition, these alternatives emphasize increasing the sustainability of recreation through stewardship and partnership opportunities with local communities, engaging diverse populations, and targeting highest priority recreation needs to help focus limited resources. However, the types of recreation opportunities that are emphasized varies across alternatives.

The threat of large, high-intensity fire is greater under alternative A compared to alternatives B or D due to limited ecological restoration treatments and limited ability to use wildfire to restore and maintain landscapes. As a result, recreation opportunities and access are expected to be more at risk under alternative A, increasing the potential for closures and displacement and associated overcrowding in the long term. The deferred maintenance backlog would continue to grow, further increasing the potential for site and infrastructure closures. Under alternative B, strategic treatment of fuels and treatment of focus landscapes is expected to improve sustainability of recreation infrastructure and limit losses and damage due to wildfire, allowing more recreation resources to go toward reducing the deferred maintenance backlog over the long-term. Alternative D includes more opportunities for ecological restoration than B, further decreasing the risk to recreation opportunities from high-intensity wildfires and reducing the potential for closures and displacement over the long term, as well as further reductions in the deferred maintenance backlog compared to B. Additionally, alternative D may have the greatest potential to reduce overcrowding compared to other alternatives because it best addresses the growing demand for developed recreation opportunities. Under alternative C, restoration is most limited and recreation opportunities are at greatest risk to negative impacts from high-intensity wildfire. As a result, alternative C has the most potential for increasing overcrowding due to closures and displacement. Under alternative C, the deferred maintenance backlog would increase more than all other alternatives due to its focus on dispersed and undeveloped recreation and more limited opportunities for fuels treatments.

Wellbeing – Promote and Protect Human Health and Safety

There are several aspects of human and community wellbeing that may be influenced by national forest management. This analysis focuses on health and safety related to wildfire. These aspects

of wellbeing highlight the main differences expected to occur across alternatives for this value category. As described in the affected environment section, these are some of the most important areas of concern that stakeholders have raised regarding human and community wellbeing. Wildfires are growing larger, becoming more destructive, and occurring more frequently outside the traditional fire season due to vegetation buildup from years of suppression, climate change, and drought. Large, high-intensity wildfires have the potential to negatively affect stream and watershed quality, reduce air quality with increased smoke, and destroy nearby homes and communities.

As described in the "Fire Management" section, managing fires more holistically, rather than trying to emphasize suppression only, is the most effective and efficient way to reduce fuels, reduce impacts to resources and communities, and restore and maintain landscapes. Not enough resources are available to reduce fuels with mechanical or prescribed fire treatments alone on enough areas to effectively reduce the risk to communities. As a result, safety concerns regarding the direct impacts of wildfire are best addressed by alternatives B and D, which both use a four-zone approach to categorize risk and remove many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets. This allows for more use of wildfire to meet resource objectives and ability to meet overall restoration goals, which ultimately reduces risks to communities. The greater amounts of ecological restoration and the enhancement of strategic fire management features in alternatives B and D, compared to alternatives A and C, further contribute to reducing fire risk to communities and allow for more opportunities for implementing large, prescribed fires or managing wildfire to meet resource objectives. More ecological restoration treatments in alternative D than B are expected to further reduce fire risk to communities.

Under all alternatives, there would be continued coordination with local partners and communities for protection and prevention in high wildfire risk areas to enhance the effectiveness of initial response. All alternatives prioritize fuel reduction treatments around communities. However, alternatives A and C do not account for the likelihood of fires to spread from adjacent areas that contribute to the risk to communities or infrastructure. Because risk-based zones are not used in alternative A, opportunities for using wildfire to restore and maintain landscapes are greatly limited. Additionally, mechanical fuels treatments are more limited under alternative A than alternatives B and D. Alternative C includes the risk-based wildfire maintenance zone that alternatives B and D have, allowing for more wildfire managed to meet resource objectives within this zone. However, this alternative has the least amount of mechanical fuel reduction, as well as higher uncertainty of where risk resides, so there are less options for fire management outside this zone.

As described in the "Aquatic and Riparian Ecosystems" section, the risk to water quality over the long term increases as the risk of large, high-intensity wildfire increases. The risk of these types of fires is most reduced under alternative D, because the greatest amount of ecological restoration is expected to occur under this alternative, followed by alternative B, A, and C, respectively. While fuels management activities such as mechanical treatment and prescribed fire can have a variety of negative, short-term impacts to soil and water quality, implementation of best management practices can effectively mitigate potential impacts from these actions. In addition, alternative D is expected to have the greatest number of properly functioning watersheds that are resilient to the impacts of climate change due to the amount of ecological restoration in aquatic and riparian systems that is expected to occur.

As described in the "Fire Management" section, smoke management opportunities are limited during large wildfires and can result in serious air quality impacts, disrupting the lives of residents and adversely impacting human health. The level of smoke emissions from large wildfires is expected to double over the next half a century, given current vegetation conditions and trends in climate and fire ignitions. Under alternative A, there would generally be a continuation of current trends in large wildfires that produce large smoke emissions. Alternative A does not contribute to altering current trends or improving the long-term sustainability of air quality benefits that these forests provide to people. Under alternatives B and D, there would be more prescribed fire, thinning, and in some areas wildfires managed to meet resource objectives. All of these restoration activities would reduce potential emissions from large, undesirable wildfires. There would be increased smoke emissions from prescribed fires, but prescribed fires are generally planned under favorable conditions for smoke dispersion to limit human health impacts, impacts to transportation corridors, and smoke sensitive populations. Emissions from prescribed fire can be managed more effectively than those of wildfire to reduce the short-term impacts on air quality. Alternatives B, C, and D contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. However, under alternative C, there is less mechanical thinning proposed than in alternatives B and D. As a result, prescribed fires would have a greater quantity of smoke associated with restoration activities because more fuels are available to burn. In addition, the ability of alternative C to alter current trends depends on the extent to which larger, landscape prescribed burning occurs.

Civil Rights

The three forests are open to all groups for activities allowed under existing laws, regulations, and policies. This will not change under any alternative. Specific concerns described in the affected environment section that were raised during the public scoping period are further discussed below.

Members of the public expressed several concerns regarding potential wilderness recommendations. Alternative B includes the addition of recommended wilderness on the Inyo National Forest. Alternative C includes the addition of recommended wilderness on all three forests. Alternative D does not include any recommended wilderness on any of the three national forests.

The concerns expressed were that potential wilderness recommendations would result in road and trail closures that would impact seniors, children, and people with disabilities who rely on motorized or mechanized travel to access the national forest. Changes to the trail and road system are project-level decisions and are not part of the plan revision process. While motorized and mechanized travel is considered unsuitable in recommended wilderness areas, current, authorized uses of roads and trails will not change under any alternative.

Unless restricted by law or regulation, the plan alone cannot prohibit public uses without a closure order from the responsible official. To prohibit a use, the responsible official needs to analyze the effects of a proposed closure and issue a project decision. Without a closure order, public uses may continue even if the uses are not considered suitable on the lands where they are occurring. Plan components can, however, bar the Forest Service from authorizing such uses, for example, when they would be conducted as an event requiring a special use authorization.

Proposed changes to roads and trails within recommended wilderness areas would need to be analyzed at the project level for adverse and disproportionate impacts on seniors, children, and people with disabilities.

Concerns were also raised that prohibiting pack goats in wilderness, particularly on the Inyo National Forest, would impact seniors, children, and people with disabilities who rely on pack goats to access these areas. No changes regarding the use of pack goats within wilderness are being made under the current forest plan revision process. Wilderness areas are currently open to the use of pack goats. However, further determinations of the appropriate use of pack goats within certain areas may be made at the project level.

The final wilderness concerns raised were that new wilderness recommendations would add areas predominantly used by white males and that exclude minorities and women. All areas on the national forest, including recommended wilderness, are open to all members of the public. Based on the latest national visitor use monitoring data for each national forest, people from culturally diverse backgrounds are generally underrepresented as visitors to the Inyo, Sequoia, and Sierra National Forests. The vast majority of visitors are white, non-Hispanic, and male. The Forest Service recognizes the demographic shifts that are occurring locally and regionally and is working to better understand how and why people do and do not visit national forests, as well as outreach to underrepresented populations. Research has shown that people from culturally diverse backgrounds may not be visiting national forests for a variety of reasons, including comfort and safety, accessibility, strong and positive connections, and lack of information (Roberts et al. 2009). Under alternatives B, C, and D, we have plan components to consider diverse backgrounds in designing communication and interpretive messages, as well as to actively engage urban populations, youth, and underserved communities in educational and community outreach programs. In general, there is more emphasis within plan components on connecting people with nature.

In addition to concerns related to wilderness, members of the public expressed concerns that prohibiting bicycles on the Pacific Crest National Scenic Trail would impact people with disabilities who can bike but not walk for long distances. No changes regarding bicycle use on the Pacific Crest National Scenic Trail are being made under the current forest plan revision process. Regional Order 88-4 currently prohibits using or possessing bicycles on the Pacific Crest National Scenic Trail along the entire length of the trail.

Other concerns regarding potential health impacts of wildfire smoke on more vulnerable populations, including seniors, children, and people with health problems were also expressed. While most healthy adults and children are expected to recover quickly from smoke exposure and not have long-term consequences, certain sensitive populations may experience more severe short-term and chronic symptoms, including people with respiratory problems, the elderly, and children (California Air Response Planning Alliance 2008). As described above and in the “Fire Management” section, the level of smoke emissions from large wildfires is expected to double over the next half a century, given current vegetation conditions and trends in climate and fire ignitions. No alternative offers both short-term and long-term improvements to air resource indicators. Restoration treatments would slow the progress of increasing wildfire emissions. As a result, alternative D has the highest short-term emissions from treatments followed by alternative B and C. In the long term, alternative D would result in the greatest reduction in emissions from wildfires followed by alternative B, C, and lastly A. Alternative B, C, and D also include goals to help the public reduce smoke exposure through early notification and outreach efforts and participation in interagency collaborative smoke management. In addition, alternatives B, C, and

D include a guideline to identify mitigation actions for smoke-sensitive areas when managing wildfires and prescribed burns.

Environmental Justice

Because we do not have good data on how low-income populations use the Inyo, Sequoia, and Sierra National Forests, it is difficult to examine how the alternatives may impact them. As described above in the "Economic Conditions" section, the counties bordering the Inyo, Sequoia, and Sierra National Forests have higher unemployment, lower earnings, and lower per capita income compared to California as whole. They are likely more vulnerable to national forest management changes that affect key economic sectors, as well as the impacts of large, high-intensity wildfires. While there is no indication that any alternative disproportionately impacts low-income populations, the alternatives have varying effects on improving economic conditions locally and creating more resilient landscapes. As described in the "Economics" section, over the long term, alternatives B and D are likely to have beneficial effects on economic conditions in local communities. As such, these alternatives are not expected to exacerbate the poverty rate or disproportionately worsen the economic well-being of low income individuals over the long term. Alternative C is likely to have some beneficial effects, but with losses in the forest products and biomass industries. Alternative A is expected to have overall adverse effects on economic conditions in local communities. It will be important to better understand how low-income populations are using the Inyo, Sequoia, and Sierra National Forests and how management actions impact them. This may be particularly true for projects that occur near key places where relatively large proportions of the population are low-income, as described in the affected environment section.

Native American tribes have integral connections to the Inyo, Sequoia, and Sierra National Forests that cross an array of social institutions, including family, government, economy, education, and religion. Areas across these forests play a key role in defining these institutions. As a result, all aspects of national forest management are generally of great interest to tribes. As described in the "Tribal Relations and Uses" section, alternative C is the only alternative that may result in an incremental loss of sites or diminished access to resources used by tribes over time due to the high risk of large, high-intensity wildfires. In addition, alternative C includes new recommended wilderness areas across all three forests, potentially impacting tribal access to and use of culturally important areas. Alternative D provides the most opportunities to restore sites and resources important to tribes and to reduce the threats from large, high-intensity wildfires due to the increased amount of vegetation management treatments. At the same time, alternative D would require additional coordination to protect these sites and resources due to the increased amount of mechanical treatments. All alternatives would address minimizing impacts to tribes at specific locations during project planning, and alternatives B, C, and D include specific plan direction to incorporate opportunities to improve sites and resources important to tribes during project planning.

There is limited information regarding the use of the Inyo, Sequoia, and Sierra National Forests by other minority populations. Currently, people from culturally diverse backgrounds are still underrepresented as national forest visitors according to the Forest Service national visitor use monitoring data. This may be due to language barriers, lack of information, or other constraints (Roberts et al. 2009). Based on the lack of information about how minority groups use the national forest, it is difficult to determine how the alternatives could impact them. However, there is no indication that the alternatives are expected to disproportionately and adversely impact minority populations.

Based on general observation at public meetings, there has been limited involvement by minority populations, aside from tribes, during the plan revision effort. In order to have more involvement from culturally diverse stakeholders in processes such as plan revision, a relationship first needs to exist between the forests and minority populations to provide a foundation to work from and build on. During the plan revision process, the three national forests have pursued efforts to start building those relationships and to outreach in new ways that may be more effective at reaching minority populations.

Cumulative Effects

Other federally managed lands in the area, including lands managed by the National Park Service and Bureau of Land Management, support the diversity of values that people hold for the natural landscapes in the southern Sierra Nevada. Restoration efforts across all lands would be important to sustaining these landscapes and how they contribute to people's lives. As described in the "Terrestrial Ecosystems" section, under all alternatives, the impacts of climate change and increased probability of large, high-intensity fires may override the beneficial impacts of restoration treatments, particularly in the near term while projects are being planned and implemented. There is uncertainty as to when or where large, high-intensity fires may occur or severe drought. The role that the Inyo, Sequoia, and Sierra National Forests will play in the future in supporting certain values may change over time as the landscape changes. In addition, demographic, cultural, and societal changes will continue to influence how people use their national forests and what is important to them in terms of forest management.

Analytical Conclusions

Alternative A does not contribute to sustaining a diverse set of forest-related values in the long term as much as alternatives B and D. Current trends of increasing fire activity, drought, and insect outbreaks pose the greatest threat to many of the values people have related to the Inyo, Sequoia, and Sierra National Forests because these values are heavily dependent on resilient ecosystems that can support a variety of uses and needs in the long term. Because ecological restoration treatments are limited under alternative A, values are more at risk to negative impacts over the long term.

Alternative B effectively supports a diverse set of forest-related values in the long term. Alternative B provides for increased ecological restoration over the planning period compared to alternative A and C, though less than D. As a result, alternative B effectively moves forest conditions closer to ecosystem desired conditions and fire resilient landscapes, though not as quickly as alternative D. By moving toward these desired conditions, aesthetic, biodiversity, cultural, economic, learning, recreation, and wellbeing values are sustained over the long term. In terms of biodiversity values, alternative B is expected to provide more long-term benefit for plant species of conservation concern habitat than all other alternatives.

Similar to alternative A, alternative C does not contribute to sustaining a diverse set of forest-related values in the long term as much as alternatives B and D because ecological restoration treatments are also limited under alternative C. Values are more at risk to negative impacts over the long term. Biodiversity and learning value sets under alternative C are better aligned than continuing with current management direction under alternative A.

Alternative D best supports a diverse set of forest-related values in the long term compared to all other alternatives. Alternative D provides for the greatest amount of ecological restoration over the planning period, moving us closer than other alternatives to ecosystem desired conditions and fire-resilient landscapes. As a result, alternative D best aligns with sustaining aesthetic, cultural,

economic, learning, recreation, and wellbeing values over the long term. Alignment with biodiversity values are somewhat mixed. Alternative D best aligns with values related to hunting and viewing terrestrial wildlife. Alternatives B, C, and D provide similar alignment with values related to aquatic species. Alternatives D and C provide more long-term benefits to plant species of conservation concern habitat than alternative A, but less than alternative B.

Management direction under all alternatives is not expected to adversely or disproportionately impact protected groups. In addition, alternatives B, C, and D include plan components to improve communication with and outreach to more diverse audiences and often underrepresented populations, as well as to increase connections between the forests and people in general. Through this effort, we have heard concerns in particular related to impacts to seniors, children, and people with disabilities. Future projects will need to evaluate whether there may be adverse and disproportionate impacts to these and other protected groups. It will be important to continue to learn about how these groups use the national forest and potential impacts of the forests on them.

Other Required Disclosures

Unavoidable Adverse Effects

The revised forest plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Therefore, decisions made in the land management plan do not cause, or have the potential to result in, actual irreversible or irretrievable commitment of resources (see next section). Application of the land management plan standards and guidelines during future project and activity decision-making would provide resource protection measures and limit the extent and duration of any adverse environmental impacts. For a detailed discussion of types of consequences expected from future activities, see specific topic areas in this chapter.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road.

The revised plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act (NEPA) requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress, this includes using "all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (NEPA, section 101). Short term uses are those that generally occur for a finite time period. Long term productivity refers to the ability of the land to produce a continuous supply of a resource.

The change in the programmatic management of the three national forests under alternatives B, C, or D would not jeopardize the short-term or long-term productivity of the lands and resources of the national forests. Discussion of short- and long-term effects is included in the analysis of the environmental consequence for each need for change.

Laws Requiring Consultation

The regulations for implementing the National Environmental Policy Act at 40 CFR 1502.25(a) direct "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review laws and executive orders." As a proposed Federal project, the revised plan decisions are subject to compliance with other Federal and State laws. Determinations and decisions made in the revised plans have been

evaluated in the context of relevant laws and executive orders. Throughout the development of the revised plans, there has been collaboration with various State and Federal agencies. The following actions have been taken to document and ensure compliance with laws that require consultation and/or concurrence with other Federal agencies.

- Endangered Species Act, Section 7: Consultation with the U.S. Department of the Interior, Fish and Wildlife Service, regarding federally listed threatened, endangered, and proposed species, and designated and proposed critical habitat is in progress. A biological assessment for federally listed species will be prepared and submitted to the U.S. Fish and Wildlife Service for consultation according to the Endangered Species Act.
- National Historic Preservation Act: Consultation with the California and Nevada State Historic Preservation Officers is mandated by section 106 of the National Historic Preservation Act. The Programmatic Agreement Among The USDA Forest Service, Pacific Southwest Region (Region 5), California State Historic Preservation Officer, Nevada State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties by the National Forests of the Pacific Southwest Region was executed in December 2012. This Programmatic Agreement prescribes the manner in which Region 5 and the State Historic Preservation Officer shall cooperatively implement this Programmatic Agreement in California and portions of Nevada. It is intended to ensure that Region 5 organizes its programs to operate efficiently and effectively in accordance with the intent and requirements of the National Historic Preservation Act and that Region 5 integrates its historic preservation planning and management decisions with other policy and program requirements. The Programmatic Agreement streamlines the National Historic Preservation Act section 106 process by eliminating case-by-case consultation with the State Historic Preservation Officer on undertakings for which there is no or little potential to affect historic properties and for undertakings that either culminate in no historic properties affected or no historic properties adversely affected with approved Standard Protection Measures (36 CFR 800.4(d)(1) and 800.5(d)(1).
- Government-to-government consultation was completed with American Indian tribes who have aboriginal territory within the lands now part of the Inyo, Sequoia, and Sierra National Forests, as required by the National Historic Preservation Act; Executive Orders 13007 and 13175; and the Programmatic Agreement cited above.

Chapter 4.
Preparers, Consultation, and Coordination

Preparers and Contributors

The following individuals and Forest Service staff groups contributed to development of this environmental impact statement. A steering committee guided the plan revision process comprised of: the Forest Supervisors of the Inyo, Sequoia, and Sierra National Forests; the Regional Office Directors of Ecosystem Planning, Ecosystem Management, and Public Services; and a representative from the Forest Service Office of General Council.

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The interdisciplinary team was comprised of a core team and an extended team. While all interdisciplinary team members contributed to the development of the draft environmental impact statement (DEIS) and draft forest plans, the core team members and primary authors of the statement are listed below and their major contributions are noted in parentheses in the "DEIS Contributions" section. The term "detail" indicates a formal or informal temporary work assignment to the interdisciplinary team.

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Yasuda, Don	Regional Analyst (Co-lead for DEIS development)	• B.S., Wildlife and Fisheries Biology, University of California, Davis • Certified Wildlife Biologist, 15 years • 27 years with the Forest Service
York, Judy	Writer-Editor (Writer-Editor for DEIS)	• B.S., Wildlife Resources, University of Idaho • M.S., Natural Resources Communications, University of Idaho • 27 years with the Forest Service

Support to the Interdisciplinary Team

Review and input to the development of the draft revised plans and draft environmental impact statement were received from the staffs of the Inyo, Sequoia, and Sierra National Forests Supervisor's Office and Ranger Districts, and the Pacific Southwest Regional Office. Additional Geographic Information System support was provided by staff on the three national forests, the Pacific Southwest Regional Office, and the Pacific Southwest Region Remote Sensing Laboratory. Many other staff and contractors have contributed support to the development of the proposed forest plans and the draft environmental impact statement and are not listed.

Inyo National Forest

Jaqueline Beidl, Forest Archaeologist and Tribal Liaison
Jennifer Ebert, Recreation Support
Sue Farley, Interagency Vegetation Management Team Leader/Acting Recreation Staff Officer
Jeff Novak, Wilderness Manager, White Mountain and Mount Whitney Ranger Districts
Richard Perloff, Wildlife Biologist, Mono Lake and Mammoth Ranger Districts
Diana Pietrasanta, Forest Recreation and Lands Staff Officer
Kary Schlick, Forest Wildlife Biologist
Deb Schweizer, Forest Public Affairs Officer
Lisa Sims, Forest Rangeland Management Specialist
Dan Yarborough, GIS Coordinator
Lesley Yen, Forest Planner

Sequoia National Forest

Steve Anderson, Wildlife Biologist
Jeff Cordes, Wildlife Biologist
Alicia Embry, Forest Public Affairs Officer
Annette Fredette, Environmental Coordinator, currently Coconino Forest Planning Team Lead
Robin Galloway, Western Divide District Wildlife Biologist
Paul Gibbs, Deputy Forest Fire Management Officer
Heidi Hosler, Forest GIS Coordinator
Carol Hallacy, Hume Lake District Recreation Officer
Emilie Lang, Forest Wildlife Biologist
Fletcher Linton, Forest Botanist
Tricia Maki, Kern River District Recreation Officer
Karen Miller, Forest Recreation and Lands Officer (Archaeology)
Chris Sanders, Western Divide District Recreation Officer
Brent Skaggs, Forest Fire Chief
Jim Whitfield, Forest Ecosystem Management
Barbara Johnston, Forest Resource Specialist

Sierra National Forest

Adam Barnett, Wilderness Manager
Susan Burkindine, Forest Assistant Recreation Officer
Antonio Cabrera, Forest Engineer
Carlos Cabrera, GIS Coordinator
Joanna Clines, Forest Botanist

Aimee Cox, Rangeland Management Specialist, Bass Lake Ranger District
Alan Gallegos, Geologist
Iveth Hernandez, Acting Forest Public Affairs Officer
Meredith Hollowell, High Sierra Ranger District Recreation Officer
Tom Lowe, Forest Road Manager
Steve Marsh, Acting Forest Archeologist
Doug McKay, Forest Archeologist
Steve Ostoja, Natural Resources Staff Officer
Mike Price, Forest Timber Management Officer
Cliff Raley, Forest Hydrologist
Cesar Sanchez, Forest Landscape Architect
Denise Tolmie, former Fuels Planning Officer, currently Bass Lake District Ranger
Alex Wilkens, Aquatics Biologist

Pacific Southwest Region of the Forest Service

David Bakke, Pesticide-Use Specialist, Invasive Plants Program Manager
Danielle Chi, Regional Planner (temporary detail)
Arthur Duggan, Appeals and Litigation Analyst (transferred)
Thomas Flowe, GIS Analyst
Tom Frolli, Regional Range Program Manager
Joseph Furnish, Regional Aquatic Ecologist (retired)
MaryBeth Hennessy, Deputy Director, Ecosystem Planning
Laura Hierholzer, Regional Environmental Coordinator
Crispin Holland, Acting Regional Rangeland Program Manager (detailed)
Trini Juarez, Landscape Architect
Patti Krueger, Regional Threatened and Endangered Species Coordinator
Kathy Mick, Recreation Management Program Manager
Jules Riley, Hydrologist (detailed)
Rebecca Robinson, GIS Analyst
Sheri Smith, Regional Entomologist
Neil Sugihara, Regional Fire Ecologist
Denise Tolmie, Fire Management Specialist
Jamie Tripp, Regional Fuels Operation Specialist

Pacific Southwest Region, Remote Sensing Laboratory

Tanya Kohler, GIS Programmer and Analyst (contract)
Carlos Ramirez, Vegetation Mapping and Inventory Lead

Consultation and Coordination

The Forest Service consulted the following tribes; Federal, State, and local agencies; groups; and individuals during development of this environmental impact statement. Tribes, agencies, and others who provided comments during the scoping period are indicated with an asterisk following their name.

Tribes and Tribal Organizations

The following tribes and tribal organizations or associations were consulted:

American Indian Council of Mariposa
Antelope Valley Indian Community
Benton Paiute Reservation Utu Utu Gwaitu Paiute Tribe
Big Pine Paiute Tribe of Owens Valley
Big Sandy Rancheria
Bishop Paiute Indian Tribal Council
Bridgeport Paiute Indian Colony
Chaushilha Yokuts
Cold Springs Rancheria
Council for the Interpretation of Native Peoples
Dumna Wo-Wah Tribal Government
Dunlap Band of Mono Indians
Ft. Independence Community of Paiute Indians
Haslett Basin Traditional Committee
Kawaiisu Tribal Council
Kern River Paiute Council
Kern Valley Indian Community
Kern Valley Indian Council
Kitanemuk & Yowlumne Tejon Indians
Lone Pine Paiute-Shoshone Reservation
Monache Inter-Tribal Association
Mono Lake Kutzadika'a Tribe
Mono Nation
North Fork Mono Tribe
North Fork Rancheria
Picayune Rancheria of Chukchansi Indians
Sierra Mono Museum
Sierra Nevada Native American Coalition
Southern Sierra Miwuk Nation
Table Mountain Rancheria
Tachi-Yokuts- Santa Rosa
Tejon Indian Tribe
Timbisha Shoshone of Death Valley
Timbisha Shoshone Tribe (Bishop)
Tubatulabel Tribe of Kern Valley
Tule River Indian Tribe
Walker River Paiute Tribe
Washoe Tribe of Nevada and California
Wukchuni Tribal Council
Wuksachi Tribe
Yurok Tribe

Federal, State, County, and Local Agencies and Organizations

Numerous Federal, State, county, and local agencies and organizations have been consulted in development of the revised plan and this environmental impact statement. Complete mailing lists for the scoping periods are available in the planning record. Some of the agencies consulted include:

Federal Agencies and Representatives

The U.S. Environmental Protection Agency is a cooperating agency for all three national forests.

National Park Service, Death Valley National Park

National Park Service, Devils Postpile National Monument

National Park Service, Sequoia and Kings Canyon National Parks

National Park Service, Yosemite National Park

U.S. Army Corp of Engineers

U.S. Department of Transportation, Federal Highways Administration

USDA, Forest Service, Humboldt-Toiyabe National Forest

USDA, Natural Resource Conservation Service

USDA, Pacific Southwest Research Station

USDA, Pacific Southwest Research Station, Redwood Science Lab

USDI, Bureau of Land Management

USDI, Bureau of Reclamation

USDI, Office of Environmental Policy and Compliance

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

U.S. Geological Survey

U.S. Marine Corps, Mountain Warfare Training Center

U.S. Navy, China Lake Naval Air Warfare Center

U.S. Navy, Naval Air Station Lemoore

U.S. Navy, Naval Facilities Engineering Command Southwest Division

U.S. Representative 4th District

U.S. Representative 8th District

U.S. Representative 20nd District

U.S. Representative 21nd District

U.S. Representative 22nd District

U.S. Representative 23rd District

U.S. Senator, Barbara Boxer

U.S. Senator, Dianne Feinstein

State Agencies

California Air Resources Board

California Department of Fish and Wildlife

California Department of Forestry and Fire Protection

California Department of Justice

California Department of Parks and Recreation, Office of Historic Preservation

California Department of Transportation

California Regional Water Quality Control Board

Lahontan Regional Water Quality Control Board

Nevada Department of Wildlife

Nevada Division of Environmental Protection

Nevada Division of Forestry

County Governments and Agencies

Inyo County is a cooperating agency for the Inyo National Forest.

California Assemblywoman 32nd District
California Assemblywoman 34th District
California Governor
California Senator 14th District
California Senator 16th District
California Senator 18th District
Fresno County Board of Supervisors
Fresno County Department of Public Works
Inyo County Agricultural Commissioner
Inyo County Board of Supervisors
Inyo County Planning Department
Inyo County Public Works Department
Inyo County Water Department
Esmeralda County Commissioners
Esmeralda County Road Department
Kern County Air Pollution Control District
Kern County Board of Supervisors
Kern County Board of Trade
Kern County Fire Department
Kern County Parks and Recreation
Kern County Planning Department
Madera County Board of Supervisors
Mariposa County Board of Supervisors
Mineral County Commissioners
Mineral County Public Works Department
Mono County Community Development
Mono County Environmental Health
Mono County Local Transportation Commission
Mono County Public Works Department
Tulare County Board of Supervisors
Tulare County Office of Education
Tulare County Parks & Recreation
Tulare County Planning Department
Tulare County Resource Management Agency
Tuolumne County Board of Supervisors

Local Agencies and Organizations

Apple Valley Town Hall
Bakersfield City Council
Bakersfield College Library
Bakersfield Convention and Visitors Bureau
Big Pine Community Services District
Carlton College, Gould Library
City of Bishop
City of Bishop, Chambers of Commerce
College of the Sequoias Library
CSU Bakersfield, Walter W. Stiern Library
CSU Fresno, Henry Madden Library
Eastern Sierra Transit Authority
Fresno City College Library
Fresno City Council
Fresno County Public Library
Independence - Chamber of Commerce
June Lake - Chambers of Commerce
June Lake Public Utility District
Kings River Conservation District
Kings River Water Association
Kern County Black Chamber of Commerce
Kern County Hispanic Chamber of Commerce
Kern County Library
Kern River Valley Chamber
Kern River Valley Council
Kern River Valley Fire Safe Council
Kern River Watermaster
Kings County Public Library
Lake Isabella Public Library
Lee Vining Public Utility District
Lone Pine - Chamber of Commerce
Los Angeles Department of Water and Power

Mammoth Community Water District
Mammoth Lakes Chamber of Commerce
Mammoth Lakes Fire Protection District
Merced County Public Library
Midland School
Mojave Desert-Mountain RC&D
Montana State University
Porterville City Library
Porterville City Planning Department
Porterville College Library
Reedley College
Ridgecrest Chamber of Commerce
Ridgecrest Public Library
Rolling Green Utilities
San Joaquin Valley Air Pollution Control District
Shafter-Wasco Irrigation District
Town of Mammoth Lakes
Town of Mammoth Lakes Public Works
Tulare County Library
Tulare Kings Hispanic Chamber of Commerce
University of Arizona
University of California, Berkeley
University of California, San Diego
University of California, Stanislaus
Visalia City Council

Others

Numerous groups and individuals participated in the process through written comments and by attending public meetings. Complete mailing lists are available in the public record. Some of the groups that provided comment include:

Alliance for Environmental Concerns
American Forest Resource Council
American Lands Access Association
American Whitewater
Back Country Horsemen
Bakersfield Californian
Bakersfield Trailblazers
Bakersfield Yamaha
Baymiller Family Trust
Blue Ribbon Coalition, Inc.
Brechbuehl Timber
The Bristlecone Chapter of the CNPS
Brown-Berry Biological Consulting
Californians for Alternative to Toxics
California Association of 4WD Clubs, Inc.
California Cattlemen's Association
California Equestrian Trails Coalition
California Forestry Association
California Indian Basketweavers Association
California Institute of Technology, Combined Array for Research in Millimeter-wave Astronomy (CARMA)
California Land Management
California Native Plant Society
California Off-Road Vehicle Association
California Trail Users Coalition
California Trout, Inc.
California Wilderness Coalition
CalWild
Camp Max Straus
Camp Nelson Mutual Water Company
Camp San Joaquin
Carver Bowen Ranch
Cedarbrook Cabin Owners
Center for Biological Diversity
Church of Jesus Christ of Latter Day Saints
Concerned Citizens – Piutes
Cyrus Partners
D&B Partnership
The Daily Independent
David Wood Ranches

Dinuba Centinel
Dowville Tract Association
Dunn School
Eagle Rafting
Eastern Sierra Audubon Society
Eastern Sierra Interpretive Association
Eastern Sierra Recreation Collaborative
Equestrian Trails and Lands
Eshom-Kaweah Ranch
Evergreen Helicopter, Inc.
Far Horizons, Inc.
Fresno Bee
Friends of the Inyo
Geos Institute
Giant Sequoia National Monument Assn
Guest Services, Inc.
Hafenfeld Ranch
High Desert Multi Coalition
High Sierra Guide Service
HMS Veterinary Development, Inc.
Hume Lake Christian Camps
Huntington Lake Association
Inland Valley Mountain Bike Association
International Mountain Bicycling Association
John Muir Project
Kern River Courier
Kern River Revitalization
Kern River Tours
Kerncrest Audubon
Kiper & Kiper
Klamath Forest Alliance
KMPH TV Channel 26
Lake Isabella-Bodfish Property Owners Assn
Mammoth Lakes Recreation
Mammoth Mountain Ski Area, LLC
Mammoth Times
McGee Creek Pack Station
Mammoth Lakes Trails and Public Access Foundation
Mike Berry Guide Service
Mono Hot Springs Resort
Mono Lake Committee
National Forest Recreation Association
Natural Resources Defense Council
News Review (Ridgecrest)
North American Packgoat Association
Northern California Society of American Foresters
OA Outfitting Inc., KR Outfitter
Off Road Vehicle Watch
Outdoor Alliance
Pacific Crest Trail Association
Pacific Crest Trail Reassessment Initiative
Pacific Gas and Electric
Pacific Rivers Council
Particle Media Group
Pecks Camp
Ponderosa Lodge
Ponderosa Property Owners
Q.A.B. Media
Quaker Meadow Ministries
Recreational Aviation Foundation
R.M. Pyles Boys Camp
Roger Camp Homeowners Association
Sageland Ranch
San Joaquin Houndsmen Club
San Joaquin River Trails Council
Santiago Outfitter Fishing
Sequoia Crest
Sequoia Forest Alliance
Sequoia Forest Keeper
Sequoia Lake Conference of YMCA
Sequoia Snowmobilers
Sierra Club
Sierra Forest Legacy
Sierra Forest Products
Sierra Reader
Snowlands Network
Southern California Edison

Southern Mono Historical Society
Southern Sierra Fat Tire Association
Spanish Radio Group
Stewards of the Sequoia
Stewards of the Sierra
Sugarloaf Community Group
Sugarloaf Mountain Park
Sustainable Forest Action Coalition
Tehachapi Mountain Trails Association
Track and Trail Publications
Trout Unlimited
Tulare County Audubon Society
Tulare County Sportsman
United Church of God
United Trail Maintainers of California
Upper Tule Association, Inc.
Upper Tule News
Visalia Times Delta
West Coast Development Co.
Western Watersheds Project
White Mountain Research Center
Whitewater Voyages
WildEarth Guardians
The Wilderness Society
Winter Wildlands Alliance
W.M. Beaty & Associates, Inc.

Agencies, Organizations and Persons Sent Copies of the Draft Environmental Impact Statement

This environmental impact statement has been distributed to, or made electronically available to, over 3,300 individuals and groups who specifically requested a copy of the document or commented during public involvement opportunities. In addition, copies have been sent (or in some cases made electronically available) to Federal agencies, federally recognized tribes, State and local governments, and organizations that have requested to be involved in the development of this analysis. Some of these entities include the U.S. Environmental Protection Agency; U.S. Department of the Interior; Advisory Council on Historic Preservation; USDA National Agricultural Library; State wildlife and fisheries management agencies; tribes; county supervisors; and local community governments. Due to the number of people, agencies, and organizations, a complete listing has been omitted from this environmental impact statement, but is available upon request.

Glossary

Active management: Planned, intentional actions in an area that are specifically designed to obtain or move toward a desired objective or result.

Adaptive management: An approach to natural resource management in which decisions are made as part of an ongoing process. Adaptive management involves planning, implementing, monitoring, evaluating, and incorporating new knowledge into management approaches based on scientific findings and the needs of society. Effects are monitored for the purpose of learning and adjusting future management actions, which improves the efficiency and responsiveness of management.

Administrative site: Areas such as work centers, fire lookouts, permitted ranch headquarters, seed orchards, communication sites, utility corridors, developed campgrounds, and other areas that are occupied or used by the Forest Service during the administration of work associated with national forest lands.

Administrative use: Use by the Forest Service.

Allowable sale quantity (ASQ): The quantity of timber that may be sold from the area of suitable land covered by the land management plan for a time period specified by the plan. This allowable sale quantity (ASQ) is usually expressed on an annual basis as the "average annual allowable sale quantity." For timber resource planning purposes, the allowable sale quantity applies to each decade over the planning horizon and includes only chargeable volume. Consistent with the definition of timber production, ASQ does not include firewood or other nonindustrial wood in the allowable sale quantity.

Aspen clone: A genetically identical set of aspen trees all connected by the same root system, as in vegetative reproduction. A clone is a distinct aspen stand, or it may be a smaller inclusion within a conifer stand, or it may cover an entire mountainside as a large stand or patch.

Available forage: That amount of growth of a vigorous and healthy plant that can be utilized as feed (regardless of what animal is using it) without impairing the plant's long-term health and productivity or other uses such as riparian filtering. The amount of available forage may be less where there is a need to restore health and vigor of forage plants. That amount may also depend on time of year and plant physiological stage, or other conditions such as drought.

Basal area: The common term used to describe the average amount of an **area** (usually an acre) occupied by tree stems. It is defined as the total cross-sectional **area** of all stems in a stand measured at breast height, and expressed as per unit of land **area** (typically square feet per acre).

Beneficial use: Any of the various uses which may be made of the water, including, but not limited to, domestic water supplies, fisheries and other aquatic life, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Best management practices (BMPs) for water quality: Methods, measures or practices selected by an agency to meet its nonpoint source control needs. Best management practices for water quality include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Best management practices for water quality can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19).

Biocultural diversity: In this document, the diversity of plants, animals, insects, fungi and other natural and cultural resources found across the landscape that provide for the diversity of cultural and traditional uses, knowledge systems and practices of Native American Tribes.

California spotted owl protected activity center (PAC): An area established around an occupied California spotted owl site to help ensure successful reproduction and species viability. A protected activity center is approximately 300 acres in size and includes the best owl nesting and roosting habitat. Management in protected activity centers is limited except in the community wildfire protection zone where it is focused on reduction of surface and ladder fuels and includes retention of key habitat elements such as higher levels of basal area and canopy cover to provide the cool understory conditions owls need, and the down woody debris and forage (cover, fungi, seeds) needed by their prey. Management may involve limited thinning and/or burning to reduce the risk of high-intensity wildfire, often with timing restrictions to prevent disturbance to owls during the breeding season.

Candidate species: Candidate species are plants and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Canopy: In a forest, the branches from the uppermost layer of trees; on rangeland, the vertical projection downward of the aerial portion of vegetation.

Canopy closure: The percentage of the sky hemisphere obscured by vegetation when viewed from a single point.

Canopy cover: The proportion of the forest floor covered by the vertical projection of the tree crowns (Jennings et al. 1999).

Cavity: The hollow excavated in a tree that is used by birds or mammals for roosting and/or reproduction.

CCF: Hundred cubic feet.

Class I airshed: An airshed classification where areas require the highest level of protection under the Clean Air Act of 1963.

Class II airshed: An airshed classification representing National Forest System land that is not classified as a Class I airshed. These areas may receive a greater amount of human-caused pollution than Class I areas.

Climate refugia: Locations where taxa survive periods of regionally adverse climate; locations that provide habitats for the long-term persistence of populations. These areas more buffered against climate change and climate-related disturbances than others. These refugia have resisted climate changes occurring elsewhere, often providing suitable habitat for relict populations of species that were previously more widespread.

Clump: A tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees, but a stand-alone clump of trees can function as a tree group.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the Federal Register (FR) by the executive departments and agencies of the Federal Government.

Complex early seral forests or habitat: Complex early seral habitat consists of areas where vegetation is dominated by young, lower growing shrubs, grasses, flowering plants and small trees that have developed after stand-replacing or partial disturbance events such as high- or moderate-severity fire, insects, pathogens, wind, avalanche, or drought-related tree mortality (Swanson et al. 2010). Complex early seral habitats contain residual components from previous older forests, such as large snags and logs and residual plants.

Critical habitat: For a threatened or endangered species is**:** (1) the specific areas within the geographical area occupied by the species, at the time it is listed and in accordance with the provisions of section 4 of the Endangered Species Act (16 U.S.C. 1533), on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protections; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. 1532 (3)(5)(A)). Critical habitat is designated through rulemaking by the Secretary of the Interior or Commerce (16 U.S.C.1533 (a)(3) and (b)(2)).

Coarse woody debris: Woody material, including logs, on the ground greater than 3 inches in diameter—a component of litter. Large coarse woody debris is often considered to be downed logs at least 12 inches in diameter and 8 feet in length.

Communications site: An area of National Forest System land used for telecommunications services. A communications site may be limited to a single communications facility, but most often encompasses more than one facility.

Community wildfire protection plans (CWPP): Plans for at-risk communities that identify and prioritize areas for hazardous fuels treatments. Several communities adjacent to the national forests have developed these plans.

Connectivity: The ecological conditions that exist at several spatial and temporal scales to provide landscape linkages, including to**:** permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change.

Conservation Agreement or Conservation Strategy: Plans to remove or reduce threats to candidate and sensitive species of plants and animals so that a listing as threatened or endangered is unnecessary.

Consultation:

(1) An active, affirmative process that (a) identifies issues and seeks input from appropriate American Indian governments, community groups, and individuals; and (b) considers their interests as a necessary and integral part of the Forest Service's decisionmaking process;

(2) the Federal government has a legal obligation to consult with American Indian tribes. This legal obligation is based in such laws as the Native American Graves Protection and Repatriation Act, the American Indian Religious Freedom Act, and numerous other executive orders and statutes. This legal responsibility is, through consultation, to consider Indian interests and account for those interests in the decision;

(3) the term also refers to a requirement under section 7 of the Endangered Species Act (ESA) for Federal agencies to consult with the U.S. Fish and Wildlife Service with regard to Federal actions that may affect listed threatened and endangered species or critical habitat.

Cumulative effects or impacts: Cumulative effects or impacts are the impacts on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Effects and impact are synonymous (40 CFR 1508.7).

Desired condition: A desired condition is a description of specific social, economic, and/or ecological characteristics if the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow progress toward achievement to be determined but does not include a completion date.

Developed recreation site: A distinctly defined area where facilities are provided by the Forest Service for concentrated public use (campgrounds, picnic areas, and swimming areas).

Diameter at breast height (d.b.h.): The diameter of a forest tree species at the bole (or trunk) typically measured at 4.5 feet above ground level.

Dispersed recreation: Outdoor recreation in which visitors are spread over relatively large areas. Where facilities or developments are provided, they are more for access and protection of the environment than for the comfort or convenience of the visitors.

Ecological integrity: The quality or condition of an ecosystem when its dominant ecological characteristics (such as composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future condition.

Ecoregion: Ecoregion sections and subsections are units in the National Hierarchy of Ecological Units ranging in size from 13 million acres (section) down to 10,000 acres (subsection) that describe areas of similar environmental and biological features.

Ecosystem: A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its**:** (1) composition or the biological elements within the different levels of biological organization, from genes and species to communities and ecosystems; (2) structure or the organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern and connectivity; (3) function or the ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire and floods; and (4) connectivity.

Ecosystem diversity: The variety and relative extent of ecosystem types, including their composition, structure, and processes within all or a part of an area of analysis.

Ecosystem management: The use of an ecological approach to achieve multiple-use management of public lands by blending the needs of people and environmental values in such a way that lands represent diverse, healthy, productive, and sustainable ecosystems.

Ecosystem function (processes): The major process of ecosystems that regulate or influence the structure, composition, and pattern. These include nutrient cycles, energy flows, trophic levels (food chains), diversity patterns in time/space development and evolution, cybernetics (control), hydrologic cycles and weathering processes.

Ecosystem services: Benefits people obtain from ecosystems**:** (1) provisioning services, such as clean air and fresh water, energy, food, fuel, forage, wood products or fiber, and minerals; (2) regulating services, such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood and drought control; and disease regulation; (3) supporting services, such as pollination, seed dispersal, soil formation and nutrient cycling; and (4) cultural services, such as educational, aesthetic, spiritual, and cultural heritage values, recreational experiences, and tourism opportunities.

Ecosystem sustainability: The ability to sustain diversity, productivity, resilience to stress, health, renewability and/or yield of desired values, resource uses, products, or services from an ecosystem, while maintaining the integrity of the ecosystem over time.

Eligible wild and scenic rivers: River segments that have been identified as eligible for inclusion in the national Wild and Scenic Rivers System under the authority of the Wild and Scenic Rivers Act. The river segment must be free-flowing and it must possess one or more outstandingly remarkable scenic, recreational, geological, fish and wildlife, historical, cultural, ecological or other value. See *wild and scenic rivers*.

Endangered species: Species that the Secretary of the Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Endemic: Populations of native insects, diseases, plants, or animals which perform a functional role in the ecosystem when they are present at low levels, or constantly attack just a few hosts throughout an area, but can become potentially injurious when they increase or spread to reach outbreak (epidemic) levels.

Energy corridor: A linear strip of land identified for the present or future location of utility right-of-way (such as above or belowground electric transmission line, gas pipeline).

Energy development: Infrastructure associated with the provision or transport of energy (biomass power generation, wind turbines, and solar panels).

Environmental impact statement (EIS): A statement of the environmental effects of a proposed action and alternatives to it. It is required for major Federal actions under section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. A draft EIS is released to the public and other agencies for review and comment. A final EIS is issued after consideration of public comments. A record of decision is based on the information and analysis in the final EIS.

Environmental justice: To the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.

Evapotranspiration: Loss of water from a land area through evaporation from the soil and surface-waterbodies and transpiration by plants.

Federal reserved water rights (reserved rights): When Congress designates Federal lands for a specific purpose it also reserves sufficient water to serve the purposes of that designation. These water rights are known as "Federal reserved water rights" or simply, reserved rights. Reserved rights are implied rights, meaning that Congress need not expressly state in a bill that it intends to reserve Federal water right. The right exists whether or not Congress explicitly mentions it.

Federally listed species: Threatened or endangered species listed under the Endangered Species Act, as amended. Candidate and proposed species are species which are being considered for Federal listing.

Fire intensity: The degree of energy and heat released from a fire

Fire regime: The patterns, frequency, and severity of fire that occur over a long period of time across a landscape and its immediate effects on the ecosystem in which it occurs. There are five fire regimes which are classified based on frequency (average number of years between fires) and severity (amount of replacement of the dominant overstory vegetation) of the fire. These five regimes are**:**

> **Fire regime I:** 0- to 35-year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced)
>
> **Fire regime II:** 0- to 35-year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced)
>
> **Fire regime III:** 35- to 100+-year frequency and mixed severity
>
> **Fire regime IV:** 35- to 100+-year frequency and high severity
>
> **Fire regime V:** 200+-year frequency and high severity.

Fire regime condition class: A classification of the degree of departure from the natural fire regime. The fire regime condition class classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure can result in changes (or risks) to one, or more, of the following ecological components**:** vegetation (species composition, structural stages, stand age, canopy cover, and mosaic pattern across the landscape); fuel composition; fire frequency, severity, and pattern; and other associated disturbances.

> **Condition class 1:** Fire regimes are within the natural (historical) range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range.
>
> **Condition class 2:** Fire regimes have been moderately altered from their natural (historical) range. Risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This result in moderate changes to one or more of the following**:** fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range.
>
> **Condition class 3:** Fire regimes have been substantially altered from their natural (historical) range. The risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or more of the following**:** fire size, intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from their natural (historical) range.

Fire severity: Degree to which a site has been altered or disrupted by fire; also used to describe the product of fire intensity and residence time; usually defined by the degree of soil heating or mortality of vegetation. In this document, fire severity refers to vegetation burn severity unless otherwise specified.

Focus landscapes: Defined during project planning, these are large areas generally from 10,000 to 80,000 acres in size where mechanical thinning and prescribed burning are strategically located to treat enough of the landscape to change potential wildfire behavior and to improve the resilience of vegetation within the landscape. Treatments would focus especially on areas most departed from vegetation desired conditions and where there is negative fire risk to highly valued resources and assets. Focus landscapes are only applicable to the draft revised plans for the Sequoia and Sierra National Forests.

Foliar: Pertaining to foliage (green tree leaves or needles).

Forest Service Handbook (FSH): Directives that provide detailed instructions on how to proceed with a specialized phase of a program or activity.

Forest Service Manual (FSM): A system of manuals that provides direction for Forest Service activities.

Fragmentation: The break-up of a large continuous land area by reducing and dividing into smaller patches isolated by areas converted to a different land type. Habitat can be fragmented by natural events or development activities. It is the opposite of connectivity.

Free-flowing: Water existing or flowing in natural conditions without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.

Fuel: Plants, both living and dead, and woody vegetative materials capable of burning.

Fuel load: The dry weight of combustible materials per unit area; usually expressed as tons per acre.

Fuel treatment: Any manipulation or removal of fuels to reduce the likelihood of ignition or to lessen potential damage and resistance to control.

Fugitive dust: Fine particulate matter from windblown soil and dust which becomes airborne.

Geographic Information System (GIS): An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

Geomorphic: Refers to the process of erosion and sediment transport and deposition.

Global climate models (GCMs): Climate models are a mathematical representation of the climate. The models divide the earth, ocean and atmosphere into a grid. The values of the predicted variables, such as surface pressure, wind, temperature, humidity and rainfall are calculated at each grid point over time, to predict their future values. The GCMs used in the Fire-Climate section examined the expected change in large fire size with different future climate and vegetation restoration scenarios, and are defined below**:**

- **CCSM:** Community Climate system Model
- **GFDL:** Geophysical Fluids Dynamic Laboratory
- **CNRM:** Centre National de Recherches Météorologiques

Government-to-Government Consultation: The active and continuous process of contacting tribal leadership, soliciting their participation, involvement, comments, concerns, contributions,

and traditional knowledge that will assist the agency in making informed decisions in planning, managing and decision-making actions.

Guideline: A guideline is a constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met. (§ 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Habitat: A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Hazard Tree Removal: The abatement of tree hazards, generally near roads, trails and facilities. Tree hazards include dead or dying trees, dead parts of live trees, or unstable live trees (due to structural defects or other factors) that are within striking distance of people or property (a target). Hazard trees have the potential to cause property damage, personal injury or fatality in the event of a failure.

Herbaceous: Grass and/or forb vegetation.

Herbivory: Loss of vegetation due to consumption by another organism.

Historic range of variation: Description of the change over time and space in the ecological condition of vegetation types and the ecological processes that shape those types (Schussman and Smith, 2006).

Home range core area (HRCA): Areas established surrounding each territorial California spotted owl activity center detected after 1986. The core area amounts to 20 percent of the area described by the sum of the average breeding pair home range plus one standard error. For the Sierra National Forest, the home range core area size is 600 acres. Aerial photography is used to delineate the core area. Acreage for the entire core area is identified on national forest lands. Core areas encompass the best available California spotted owl habitat in the closest proximity to the owl activity center. The acreage in the 300-acre protected activity center counts toward the total home range core area. Core areas are delineated within 1.5 miles of the activity center. When activities are planned adjacent to non-national forest lands, 1.5-mile-circular core areas are delineated around California spotted owl activity centers on non-national forest lands. Using the best available habitat as described above, any part of the circular core area that lies on national forest lands is designated and managed as a California spotted owl home range core area.

Hydrologic: Refers to the movement, distribution, and quality of water.

Hydrologic function: The behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of waterflow. Favorable conditions of waterflow are defined in terms of water quality, quantity, and timing.

Hydrologic Unit Code (HUC): The U.S. is divided and subdivided into successively smaller hydrologic units (watersheds), which are identified by unique hydrologic unit codes (HUCs). The average size of a 4th level HUC watershed is 1 million acres, 5th level HUC watersheds are around 165,000 acres, and 6th level HUC watersheds are about 21,000 acres.

Hydrophytic vegetation: The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present.

Instream flow: Seasonal stream flows needed for maintaining aquatic and riparian ecosystems, wildlife, fisheries, and recreation opportunities at an acceptable level.

Invasive species: Are alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health; species that cause, or is likely to cause harm and that is exotic to the ecosystem it has infested. Invasive species infest both aquatic and terrestrial areas and can be identified within any of the following four taxonomic categories**:** plants, vertebrates, invertebrates, and pathogens.

LANDFIRE: (Landscape Fire and Resource Management Planning Tools Project) is an interagency Program producing consistent and comprehensive data describing landscape change, disturbance, vegetation, fuel, and fire regimes across the United States.

Leasable minerals: Leasable minerals include coal, oil, gas, oil shale, sodium, phosphate, potassium, and geothermal. Leasable minerals also include the hardrock minerals, if they are found on lands that have "acquired" status. Leases are obtained through the Bureau of Land Management to extract these mineral resources.

Litter: Litter consists of dead, unattached organic material on the soil surface that is effective in protecting the soil surface from raindrop splash, sheet, and rill erosion and is at least ½ inch thick. Litter is composed of leaves, needles, cones, and woody vegetative debris including twigs, branches, and trunks.

Livestock grazing: Foraging by permitted livestock (domestic foraging animals of any kind).

Locatable minerals: In general, the hardrock minerals mined and processed for metals (gold, silver, copper, uranium, and some types of nonmetallic minerals such as sandstone). They are called "locatable," meaning subject to mining claim location under the United States mining laws. Locatable minerals are limited to lands with "reserved public domain" status.

Low-income population: Any readily identifiable group of low-income persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who would be similarly affected by USDA programs or activities. Low-income populations may be identified using data collected, maintained and analyzed by an agency or from analytical tools such as the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.

Management practices (vegetation management practices): Silvicultural practices such as reforestation, prescribed fire, thinning to reduce stand density, and other practices designed to facilitate growth and development of trees.

Managing wildfires to meet resource objectives: A strategic choice to use unplanned wildfire starts to achieve resource management objectives and ecological purposes under specific environmental conditions. Such fires are monitored closely to ensure safe conditions for people, property, and other highly valued resources.

Mechanical treatment: For the purposes of this analysis, mechanical treatments include most vegetation treatments except fire. They may include mechanical thinning, hand thinning, and other silvicultural treatments.

Mechanized travel/transport: Movement using any contrivance over land, water, or air, having moving parts, that provides a mechanical advantage to the user and that is powered by a living or nonliving power source. This includes, but is not limited to, sailboats, hang gliders, parachutes, bicycles, game carriers, carts, and wagons. It does not include wheelchairs when used as necessary medical appliances. It does not include skis, snowshoes, rafts, canoes, sleds, travois, or similar primitive devices without moving parts.

Minority: A person who is a member of one or more the following population groups**:** American Indian or Alaskan Native, Asian or Pacific Islander, Black, or Hispanic.

Minority population: Any readily identifiable group of minority persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who would be similarly affected by USDA programs or activities.

Motorized travel: Movement using machines that use a motor, engine, or other nonliving power sources other than a vehicle operated on rails or a wheelchair or mobility device, including one that is battery powered, designed solely for the use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area.

National Forest System (NFS): Includes national forests, national grasslands, and the National Tallgrass Prairie.

National Forest System road: A road wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources. A forest road other than a road which has been authorized by a legally documented right-of-way held by a state, county, or other local public road authority. (36 CFR 212.1)

National Forest System trail: A trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a state, county, or other local public road authority. (36 CFR 212.1)

National Wild and Scenic Rivers System: It was created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.

Nonmotorized travel: Movement not relying on machines that use a motor, engine, or other nonliving power source (walking, canoeing, and horseback riding).

Nonpoint source pollution: Refers to water pollution affecting water quality from diffuse sources, such as polluted runoff from agricultural areas draining into lakes, wetlands, rivers, and streams. Nonpoint source pollution can be contrasted with point source pollution, where discharges occur to a body of water at a single location, such as discharges from a chemical factory, urban runoff from a roadway or storm drain. Nonpoint source pollution may derive from many different sources with no specific solution to rectify the problem, making it difficult to regulate.

Objective: An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives are based on reasonable foreseeable budgets.

Old forest: Old forests are characterized by the presence of large and old trees for the given species and site productivity. Old forests vary widely based on forest type, soil condition, topography, and fire history. Tree size is not necessarily related to tree age. Old forests often contain large snags and logs in addition to large live trees. The density of these old forest components vary widely.

Outstandingly remarkable value: A value that a river or river segment possesses that reflects its unique, rare, or exemplary qualities. In the Wild and Scenic River Act, river values identified

include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Examples of other similar values include botanical, hydrological, paleontological, scientific, or heritage. A river must have at least one outstandingly remarkable value to be eligible for wild and scenic river designation.

Protected Activity Center: The areas that surround nest areas. They represent an area of habitat used for nesting and raising young until the time of leaving the nest.

Patch: Refers to a relatively homogeneous area that differs from its surroundings. Patches are the basic unit of the landscape that change and fluctuate. Patches have a definite shape and spatial configuration, and can be described compositionally by internal variables such as number of trees, number of tree species, age of trees, height of trees, or other similar measurements.

Planned ignition: A fire ignited by management actions under certain predetermined conditions to meet plan desired conditions. Prescribed fire is a synonymous term.

Planning period: The life of the plan, generally 10 to 15 years from plan approval. As a general rule, this analysis uses 10 years to define the planning period.

Primitive recreation: The reliance on personal, nonmotorized, or nonmechanized skills to travel and camp in an area, rather than reliance on facilities or outside help.

Recreation opportunity spectrum (ROS): Recreation settings allow a range of experiences to be achieved, from remote and challenging to easily navigated and supported by tourism services in surrounding communities. The recreation opportunity spectrum has six distinct classes in a continuum to describe settings that provide this range of experience, from highly modified and developed settings to primitive and undeveloped settings. The classes are**:**

> **Primitive (P):** Characterized by essentially unmodified natural environment. Interaction between users is very low and evidence of other users is minimal. Essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is generally not permitted. Very high probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.
>
> **Semiprimitive Nonmotorized (SPNM):** Characterized by a predominantly natural or natural-appearing environment. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present, but are subtle. Motorized use is generally not permitted. High probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.
>
> **Semiprimitive Motorized (SPM):** Characterized by a predominantly natural or natural-appearing environment. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on site controls and restrictions may be present, but are subtle. Motorized use is generally permitted. Moderate probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.
>
> **Roaded Natural (RN):** Characterized by a predominantly natural-appearing environment with moderate evidence of the sights and sounds of other humans. Such evidences usually harmonize with the natural environment. Interaction between users may be low to moderate but with evidence of other users prevalent. Resource modification and utilization practices are evident but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to affiliate with other users in developed sites but with some chance for privacy.

Roaded Modified (RM): Characterized by substantially modified natural environment except for campsites. Roads and management activities may be strongly dominant. There is moderate evidence of other users on roads. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to get away from others, but with easy access.

Rural (R): Characterized by substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available. Opportunity to observe and affiliate with other users is important, as is convenience of facilities.

Urban (U): Characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of people onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site. Opportunity to observe and affiliate with other users is very important, as is convenience of facilities.

Reforestation: The natural or artificial reestablishment of an area with forest tree cover.

Research natural area: A physical or biological unit in which current natural conditions is maintained and can be observed. These conditions are ordinarily achieved by allowing natural physical and biological processes to prevail without human intervention. Research natural areas are principally for non-manipulative research, observation, and study. They are designated to maintain a wide spectrum of high quality representative areas that represent the major forms of variability found in forest, shrublands, grassland, alpine, and natural situations that have scientific interest and importance that, in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity.

Resilience: The ability of an ecosystem and its component parts to absorb, or recover from, the effects of disturbance through preservation, restoration or improvement of its essential structures and functions, and redundancy of ecological patterns across the landscape.

Restoration: See ecological restoration.

Riparian area: Include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths.

Riparian Conservation Areas: An area of vegetation or forest litter located adjacent to stream courses and/or riparian areas for the purpose of filtering sediment, providing bank stability, and providing shade for fisheries habitat in tree/shrub ecosystems.

Road maintenance: The upkeep of the entire transportation facility including surface and shoulders, parking and side areas, structures, and such traffic control devices as are necessary for its safe and efficient utilization (36 CFR 212.1). This work includes brushing of roadside vegetation, falling danger trees, road blading, cleaning ditches, cleaning culvert inlets and outlets, etc.

Sacred sites: Defined in Executive Order 13007 as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

Scenic integrity objectives– In the context of the forest plan are equivalent to goals or desired conditions. Scenic integrity describes the state of naturalness or a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the landscape character valued by constituents for its aesthetic quality. Scenic integrity is the state of naturalness or, conversely, the state of disturbance created by human activities or alteration. Scenic integrity is measured in five levels**:**

Very high: landscapes where the valued landscape character "is" intact with only minute, if any deviations. The existing landscape character and sense of place is expressed at the highest possible level.

High: landscapes where the valued landscape character appears unaltered. Deviations may be present but must repeat the form, line, color, texture and pattern common to the landscape character so completely and at such scale that they are not evident.

Moderate: landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.

Low: landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect, pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed, but compatible or complimentary to the character within.

Very Low: landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect, pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain so that elements such as unnatural edges, roads, landings and structures do not dominate the composition.

Scenic character - is defined as the combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity.

Scenic stability - Scenic stability measures the degree to which the scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes. It recognizes the often subtle, incremental changes that can severely diminish or eliminate scenic character.

Scoping period: The time during which a proposed action has been provided to the public for review and comment so that the scope of issues related to the proposed action can be determined.

Seral stage: A particular plant and animal community developmental stage which is transitional between other stages along the continuum of succession or change. Changes in seral states can take place over time or very quickly and movement between states can be in either direction. Aspen is an example of a seral state that, without disturbance over time, will eventually be replaced by a subsequent seral state dominated by conifers.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands using species silvics to meet the diverse needs and values of landowners and society on a sustainable basis.

Slash: The residue (such as branches or bark) left on the ground after a management activity, such as logging, or natural ecological process such as a storm or fire.

Snags: Standing dead or partially dead trees (snag topped), often missing many or all limbs and/or bark. Snags (generally 12 inches or larger) provide essential wildlife habitat for many species and are important for forest ecosystem function.

Soil productivity: The inherent capacity of the soil to support appropriate site-specific biological resource management objectives, which includes the growth of specified plants, plant communities, or a sequence of plant communities to support multiple land uses.

Special use authorization: A permit, term permit, temporary permit, lease, easement, or other written instrument that grants rights or privileges of occupancy and use subject to specified terms and conditions on National Forest System land.

Stand: A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged and uneven-aged stands.

Standard: A standard is a mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Standard terra trails: Trails that have a surface consisting predominantly of the ground and are designed and managed to accommodate use on that surface. They do not include snow or water trails.

Structure: Structure includes both the vertical and horizontal dimensions of a vegetation type or plant community. The horizontal structure refers to spatial patterns of individual and groups of plants and openings, as well as plant size and species composition. The vertical component refers to the layers of vegetation between the forest floor and the top of the canopy. Each vegetation type has its own structure. For example, forests have greater vertical structure than a grassland or woodland based on the height of the dominant species.

Suitable timberlands: Land to be managed for timber production on a regulated basis. Such lands are those which have been determined to meet the following criteria**:** (a) are available for timber production (not withdrawn for wilderness or other official designation by Congress, the Secretary of Agriculture, or Chief of the Forest Service); (b) are physically capable of producing crops of industrial wood without irreversible resource damage to soils productivity or watershed conditions; (c) adequate tree restocking within 5 years of final harvest is reasonably assured; (d) adequate information exists about responses to timber management activities; (e) timber management is cost efficient over the planning horizon in meeting forest objectives that include

timber production; (f) timber production is consistent with meeting the management requirements and multiple-use objectives specified in the forest plan or plan alternative; and (g) other management objectives do not limit timber production activities to the point where it is impossible to meet management requirements set forth in 36 CFR 129.27 (per Forest Service Handbook 2409.13, WO Amendment 2409.13-92-1, O Code and Chapter 20).

Suitability of Lands: The suitability of lands is determined for specific lands within the plan area. The lands are identified as suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. Every plan must identify those lands that are not suitable for timber production (§ 219.11).

Sustainability: The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of the land management planning regulation at 36 CFR part 219, ecological sustainability refers to the capability of ecosystems to maintain ecological integrity; economic sustainability refers to the capability of society to produce and consume or otherwise benefit from goods and services, including contributions to jobs and market and nonmarket benefits; and social sustainability refers to the capability of society to support the network of relationships, traditions, culture and activities that connect people to the land and to one another, and support vibrant communities.

Sustainable recreation - the set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations.

Thinning: An intermediate treatment made to reduce the stand density of trees primarily to improve growth, enhance forest health, to recover potential mortality, or to emphasize desired tree species. Includes crown thinning (thinning from above, high thinning), free thinning, low thinning (thinning from below), mechanical thinning (geometric thinning), and selection thinning (dominant thinning). Thinning can be used with both even and uneven-aged management systems.

Timber production: The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

Total maximum daily load (TMDL): A TMDL is a written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the "load"), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety.

Traditional cultural properties (TCP): Defined in National Register Bulletin 38 as properties associated "with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." TCPs can range from structures, mountains, and other landforms to plant gathering locations to communities. These areas are considered historic properties that may be eligible to the National Register of Historic Places

Travel Management Rule (November 29, 2005, 36 CFR 212.51)**:** requires that each national forest designate a system of roads, trails, and areas for motor vehicle use by vehicle class and, if appropriate, by time of year. Once the system is designated, the rule will prohibit motor vehicle use off the designated system.

Unauthorized road or trail: A road or trail that is not a forest road or trail or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212.1, Forest Service Manual 2353.05, and Forest Service Manual 7705).

Uncharacteristic wildfire: Refers to wildfire that exceeds the natural range of variation in fire severity (high severity proportion, high severity patch size) and other fire effects indicators for a specific vegetation type[50].

Undesirable wildfire: Wildfire that does not meet the desired conditions for a specific vegetation type.

Unplanned ignition: A wildfire, not including planned ignitions.

Vegetation Burn Severity: The degree of vegetation mortality caused by a fire and the fire severity from the ecological effect of the fire. As used in this Forest Plan, refers to the effect of the fire on the dominant vegetation, which are coniferous trees. Three levels of fire severity are recognized**:**

- High severity**:** greater than 75 percent of the dominant overstory vegetation (trees) are killed. Also referred to as stand-replacement fire.
- Moderate severity**:** 35 to 75% of the dominant overstory vegetation (trees) are killed.
- Low severity**:** less than 35% of dominant overstory vegetation (trees) are killed.

Wild and scenic river: A river designated by Congress as part of the National Wild and Scenic Rivers System that was established in the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271–1287).

Wild: Those rivers or sections of rivers free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

Scenic: Those rivers or sections of rivers free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Recreational: Those rivers or sections of rivers readily accessible by road or railroad that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Wildland-urban intermix (WUI): Includes those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, church camps, scout camps, research facilities, and other structures that if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved (Forest Service Manual 5140.5).

Xeric: Very dry region or climate; tolerating or adapted to dry conditions. Dry soil moisture regime. Some moisture is present but does not occur at optimum levels for plant growth. Irrigation or summer fallow is often necessary for crop production.

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Chapter 3

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Revision Topic 1: Fire Management

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Index

air quality, 21, 26, 32, 37, 116, 118
  class I airsheds (wilderness), 120, 124, 126, 128, 130
  Clean Air Act, 3, 118, 640
  smoke from prescribed fire, 119
  smoke from wildfires, 119
alternatives
  alternative A, the existing forest plans, 20
  alternative B, 24
  alternative B, the proposed forest plans, 13
  alternative C, 14, 31
  alternative D, 15, 36, 575
  comparison of, 45, 50, 51, 52, 54
  considered but eliminated from detailed study, 40
  development process, 13
aquatic and riparian ecosystems, 263, 272
  influence of climate change, 271
  lakes and ponds, 57, 174, 192, 195, 270, 289, 320, 351, 402, 410, 420, 423, 426, 437, 470, 514, 517, 518, 520, 521, 543, 584, 601, 608, 636, 720
  meadows, fens, and springs, 268, 403, 419, 420, 424, 426
  riparian vegetation, 265, 271, 274, 276, 278, 280
  streams and rivers, 267, 353, 357, 401, 410, 412, 413, 418, 420, 421, 423, 426, 444
aquatic species, 397, 407, 705
aquatic species diversity, 265, 274, 276, 278, 280
aspen, 220
assumptions, 56
at-risk species, 22, 27, 29, 34, 39, 219, 305, 306, 340, 409, 605
  federally listed, candidate or proposed, 306
  federally listed aquatic species, determinations, 427
  federally listed plant species, determinations, 458
  federally listed wildlife species, determinations, 396
  wildlife, 239, 259, 308, 321, 344, 688
bald eagle, 313, 334
bats, 17, 24, 320, 349, 351, 352, 696
  Pacific fringe-tailed bat, 327
best available science, 55
butterflies, 314, 320, 342, 381
California condor, 324, 703
carbon sequestration and stability, 205, 216, 225, 227, 231, 238, 241, 243, 247
civil rights, 599, 606
climate change, 20, 57
  influences on fire trends, 58
  resilience to, 22, 28, 34, 38, 265, 272, 274, 276, 278, 280
  trends, 58
complex early seral habitat, 16, 28, 33, 38, 250, 319, 435, 436
connectivity, 211, 216, 227, 232, 239, 241, 244, 247
conservation strategies and assessments, 308
critical aquatic refuges, 22, 28, 34, 38, 46, 47, 48, 266, 267
critical habitat, 313, 321, 323, 324, 396, 399, 427, 641
Death Valley National Park, 1, 634
derived under the Endangered Species Act,, 305
designated areas, 49
Devils Postpile National Monument, 1, 634, 712
drivers and stressors, 57
ecological indicators, 253
ecological integrity, 133
ecological resilience, 21, 27, 33, 37, 166
ecological sustainability, 210, 221, 229, 237, 240, 243, 246, 250
ecological vulnerability and adaptation, 251, 255, 389
economic conditions, 578, 580
  effects to local communities, 589, 590, 592, 594
  importance of water, 584
  national forest contributions, 582, 584
  recreation and tourism, 581, 583, 719
  revenues, 581
  timber sector jobs, 582
  unemployment, 580
ecosystem processes and functions, 204, 223
Endangered Species Act, 307
environmental justice, 599, 608

fire
ecological role, 89, 204, 210, 211, 223, 225, 246
fire regime, 204, 210, 215, 223, 229, 237, 241, 243, 246
fire return interval, 211
fire management, 87, 96
fire management zones, 21, 25, 32, 37, 96, 98, 99
managing wildfire to meet resource objectives, 21, 26, 32, 37, 93, 119
National Cohesive Wildland Fire Management Strategy, 88, 655, 664
fire trends, 66
fire history, 61
fire size, 63
intensity and severity, 65
forest products, 564
fuelwood, 569
special forest products, 569
fuel reduction treatments, 95
Giant Sequoia National Monument, 15
great gray owl, 17, 23, 334
greater sage-grouse, 23, 30, 35, 39, 333
habitats
aquatic habitat for wildlife, 381, 387
caves and cliffs, 385
eastside vegetation, 366
for aquatic wildlife, 319
for cavity excavators, 220
for terrestrial wildlife, 316
montane forests, 368
special habitats, 219
upper montane, subalpine, and alpine vegetation, 381
heritage resources, 503, 512
impacts to, 557
prehistoric sites, 505, 506
sites surveyed, 507, 510
Hispanic visitors, 600, 604, 608, 609, 618, 635, 636, 648
human health and safety, 606, 615
Indian tribes
Tule River Indian Reservation, 1, 2, 608
insects and pathogens, 74, 77, 81
bark beetles, 78, 658
defoliators, 80
dwarf mistletoes and root diseases, 80
non-native insects and diseases, 80
trends, 81
interdisciplinary team members, 625
invasive species, 20, 272, 453
Inyo National Forest
description, 1
issues, 10, 12, 676
ecological resilience, wildlife habitats, and wildfire, 10
forest products, 12
forest resilience and forest density, 11
fuels treatments and fire management, 11
protecting aquatic diversity, 11
recommended wilderness, 12
smoke, 12
watershed restoration, 11
John Muir Trail, 538, 539
Kern red-winged blackbird, 332
Kern River drainage, 69, 156, 259
Kings River Special Management Area, 2, 15
least Bell's vireo, 323
management areas, 45, 548
migratory birds, 343, 344
minority and low-income populations, 600, 609, 610, 619
national parks
Sequoia and Kings Canyon National Parks, 245, 538, 539
Yosemite National Park, 1, 73, 83, 164, 244, 282, 315, 325, 332, 337, 514, 527, 538, 568, 596, 634, 670, 673, 683, 696, 700, 704, 706
National Register of Historic Places, 504, 508, 510
natural range of variation, 133, 659, 660, 661, 672, 676, 696, 699, 706
need for change, 6, 308
Nevada Enhancement Act, 4, 7, 18, 19, 468, 479, 485
notice of intent, 9
old forests, 21, 216, 232, 235
Pacific Crest Trail, 532, 536
competitive events, 540, 547, 550
economic effects, 543
management, 536
nearby renewable energy projects, 542, 549
permits, 538
scenery management of, 540
vegetation management and wildfire effects, 541, 542
visitor use, 537, 547

Pacific fisher, 23, 30, 39, 179, 185, 232, 328
Southern Sierra Nevada Fisher Conservation Strategy, 14, 16, 28, 30, 31, 35, 309, 311, 364, 378
partnerships, 18
peregrine falcon, 334
plants, 428, 432, 446, 613, 708
federally listed plant species, 433, 447, 454, 455, 456, 458
floristic biogeographic subdivisions, 430, 431, 432, 446, 450
pollinators, 208, 220
pseudoscorpion, 343
public engagement sessions, 8, 9
public participation, 8
Ramshaw Meadows abronia, 432, 434, 444, 453, 454, 455, 709
range management, 345, 627
recreation, 24, 461
access, 464
facilities, 462
partnerships and volunteers, 465
recreation opportunity spectrum, 463, 468, 472, 475, 479, 486, 493
use and activities, 464, 469, 473, 476
responsible official, 3, ii, 8, 625
revision topics, 6
ecological integrity, 7, 21, 27, 33, 37, 133, 666
fire management, 7, 21, 25, 32, 37, 86, 663
sustainable recreation and designated areas, 7, 24, 31, 36, 39, 460, 709
salamanders, 339, 347
scenery, 465, 471, 474, 477, 478, 483, 490, 496
scenic character, 466
scenic integrity, 20, 465, 466, 484, 485, 492, 498, 535
scenic stability, 467, 483, 490, 497
the Scenery Management System, 20
the Visual Management System, 24, 465, 547, 548
Sequoia National Forest
description, 2
Sierra marten, 17, 24, 330
Sierra National Forest
description, 2
Sierra Nevada bighorn sheep, 326, 703
Sierra Nevada red fox, 309, 325
snails, 314, 341, 342
social and economic benefits, 564
social conditions, 598
values, 598, 604
species of conservation concern, 16, 308
aquatic species, 399
aquatic species outcomes, 427
birds, 313
butterflies and moths, 314
mammals, 313
plant species, 434, 448, 454, 455, 456, 457, 458
snails, 314
terrestrial amphibians, 314
wildlife species outcomes, 397
spotted owl, 16, 23, 29, 34, 39, 335, 373, 694, 718
Interim Recommendations for the Management of California Spotted Owl Habitat, 14, 16, 23, 28, 29, 31, 34, 311, 364, 378, 656, 702
State Historic Preservation Office, 508, 511, 623
timber production, 564, 570
suitability, 566, 567
tribes, 506, 619, 633
access to areas, 554, 558, 559, 560, 561, 562
consultation with, 10, 623
effects of wilderness designation on, 560
traditional areas, 557
traditional uses, 17, 210, 220, 225, 228, 237, 240, 243, 245, 249, 554, 555, 556, 605, 613
tribal relations, 552, 554, 558, 610
tribal uses, 505
use of fire, 553, 555
Tricolored blackbird, 309, 332, 701
valley elderberry longhorn beetle, 321
vegetation
composition and structure, 161, 168
vegetation types, 133, 134, 142, 146, 162, 163, 205, 207, 210, 222, 252, 253
eastside vegetation, 156
montane forests, 150, 163, 164, 171, 182, 193, 198
subalpine and alpine vegetation, 154, 161, 172, 174, 188, 194, 196, 200, 202, 224, 226, 231, 238, 318
upper montane forests, 152, 164, 171, 174, 187, 191, 194, 195, 200, 202, 224, 226, 231, 238, 317, 381
westside foothill vegetation, 148, 316, 361

water, 266, 272, 282, 305
water quality, 266, 272, 282, 284, 285, 287, 288, 292, 294, 296, 298, 300, 302, 303, 305, 634
water quantity, 284, 286, 290, 292, 294, 296, 298, 300, 303, 304
watershed condition, 266, 272, 282, 286, 290, 295, 297, 299, 301, 303, 351, 402, 407, 453, 686
western yellow-billed cuckoo, 323
whitebark pine, 447
wild and scenic rivers, ii, vii, 18, 525, 526, 527, 528, 531, 532, 712
classification, 526
determining eligibility, 526
existing designated rivers, 527
existing recommended rivers, 18, 528
inventory of rivers, 525
suitability, 526
Wild and Scenic Rivers Act, 525, 643, 654
wilderness, 18, 346
coordination with other agencies, 524
existing designated wilderness areas, 514
National Wilderness Preservation System, 12, 446, 512, 516, 520, 521, 524, 613, 614
preliminary wilderness recommendation, 519
proposed recommended wilderness, 515
recommended wilderness, 15, 24, 31, 36, 40, 44, 46, 47, 48, 515, 516, 517, 518, 519, 554, 558, 559, 560, 561, 562
the Wilderness Act, 513
wilderness character, 513
wildlife
related plan components, 348
willow flycatcher, 17, 23, 309, 322, 331, 689, 701
yellow-eared pocket mouse, 327
Yosemite toad, 23, 30, 36, 39, 411, 706, 708