Oregon Greater Sage-Grouse Proposed Resource Management Plan Amendment and Final Environmental Impact Statement

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The Bureau of Land Management's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

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Chapter 7
References

CHAPTER 7
REFERENCES

Changes Between the Draft EIS and Final EIS

Changes to this chapter between the Draft EIS and Final EIS are as follows:

- Reviewed updated or new literature
- Added approximately 155 references
- Updated, as appropriate, based on public comments received on the DEIS
- References and personal communications for **Section 5.3**, Greater Sage-Grouse Cumulative Effects Analysis: Oregon Sub-Region, are listed separately in **Section 7.2**.

7.1 REFERENCES

Alaska Department of Natural Resources, Division of Oil and Gas. 2009. Cook Inlet Area wide Oil and Gas Lease Sale. Final Finding of the Director. Appendix C. Directional and Extended-Reach Drilling. January 20, 2009.

Aldridge, C. L., and M. S. Boyce. 2007. Linking occurrence and fitness to persistence: a habitat-based approach for endangered greater sage-grouse. Ecological Applications 17:508-526.

Aldridge, C. L., and R. M. Brigham. 2002. Sage-grouse nesting and brood habitat use in southern Canada. *Journal of Wildlife Management* 66:433-444.

Aldridge, C. L., S. E. Nielsen, H. L. Beyer, M. S. Boyce, J. W. Connelly, S. T. Knick, and M. A. Schroeder. 2008. Range-wide patterns of Greater Sage-Grouse persistence. *Diversity and Distributions* 17:983-994.

Allen-Diaz, B. and J. W. Bartolome. 1998. Sagebrush-grass vegetation dynamics: comparing classical and state-transition models. Ecological Applications 8(3): 795-804.

AMEC. 2012. Clean Air Status and Trends Network (CASTNET). 2010 annual report. EP-W-09-028. AMEC Environment and Infrastructure, Inc. [97 p.] Internet website: http://epa.gov/castnet/javaweb/index.html.

Ambrose, S., and C. Florian. 2013. Sound Levels of Gas Field Activities at Greater Sage-Grouse Leks, Pinedale Anticline Project Area, Wyoming. Prepared for Wyoming Game and Fish Department Cheyenne, WY.

American Birding Association. 2003. American Birding Association Member Handbook. American Birding Association Principles of Birding Ethics. p. 24.

Anderson, E. W, M. M. Borman, and W. C. Krueger. 1998. The ecological provinces of Oregon - a treatise on the basic ecological geography of the State. SR 900. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Arthur Carhart National Wilderness Training Center. 2011. Minimum Requirements Decision Guide Overview. Internet website: http://www.wilderness.net/MRDG/documents/MRDG_overview.pdf. Accessed on September 24, 2013.

Armstrong, J. C. 2007. Improving sustainable seed yield in Wyoming big sagebrush. Brigham Young University, Provo, UT. 29 p. Thesis.

Atamian, M., J. Sedinger, and C. Frey. 2007. Dynamics of greater sage-grouse (Centrocercus urophasianus) populations in response to transmission lines in central Nevada. Progress Report Year 5. 39 pp.

Atamian, M. T., M. S. Sedinger, J. S. Heaton, and E. J. Blomberg. 2010. Landscape-level assessment of brood rearing habitat for greater sage-grouse in Nevada. Journal of Wildlife Management 74:1533-1543.

Azuma, D. L., B. A. Hiserote, and P. A. Dunham. 2005. The western juniper resource in eastern Oregon. Resour. Bull. PNW-RB-249. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Bailey, V. 1936. The Mammals and Life Zone of Oregon. North American Fauna 55:1- 416.

Baker County. 1991. Baker County: Comprehensive Plan (1991). Internet website: https://scholarsbank.uoregon.edu/xmlui/handle/1794/9356.

_____. 2012. Baker County Natural Resources Plan. Internet website: http://www.bakercounty.org/natural_resources/docs/NRPlan_FINAL_12222010.pdf.

Baker, W. L. 2011. Pre-EuroAmerican and recent fire in sagebrush ecosystems. Pp. 185-20 *in* S.T. Knick and J. W. Connelly (eds). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, CA.

Balch, J. K., B. A. Bradley, C. M. D'Antonio, and J. Gomez-Dans. 2012. Introduced annual grass increases regional fire activity across the arid western USA (1980–2009). Global Change Biology 19 (1): 173-183.

Barber, J. R., K. M. Fristrup, C. L. Brown, A. R. Hardy, L. M. Angeloni, and K. R. Crooks. 2009a. The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25 (3): 180-189.

_____. 2009b. Conserving the wild life therein – Protecting park fauna from anthropogenic noise. Park Science 26 (3), Winter 2009-2010.

Barnett, J. K. 1992. Diet and nutrition of female sage grouse during the pre-laying period [thesis]. Corvallis, OR, USA: Oregon State University.

Barnett, J. K., and J. A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. Journal of Range Management 47:114–118.

Barrett, S. C. H., and J. Kohn. 1991. The genetic and evolutionary consequences of small population size in plant: implications for conservation. *In*: Genetics and Conservation of Rare Plants (Eds. D. Falk & K.E. Holsinger), pp. 3–30. Oxford University Press.

Baruch-Mordo, S., J. S. Evans, J. P. Severson, D. E. Naugle, J. D. Maestas, J. M. Kiesecker, M. J. Falkowski, C. A. Hagen, and K. P. Reese. 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. Biological Conservation 167:233-241.

Batchelor, J. L., Ripple, W. J., et al. 2015. Restoration of Riparian Areas Following the Removal of Cattle in the Northwestern Great Basin, Environmental Management. DOI 10.1007/s00267-014-0436-2.

Bates J. D. and K. W. Davies. 2014. Wyoming big sagebrush Associations of Eastern Oregon; Vegetation Attributes. USDA-ARS, Burns, Oregon, ARS-Burns-Report-1-2015 (unpublished file data.

Bates, J. D., R. F. Miller, and T. J. Svejcar. 2000. Understory dynamics in cut and uncut western juniper woodlands. Journal of Rangeland Management 53:119–126.Beck, J. L., and D. L. Mitchell. 2000. Influences of livestock grazing on sage grouse habitat. Wildlife Society Bulletin 28:993-1002.

Beck J. and D. L. Mitchell. 2000. Influences of livestock grazing on sage grouse habitat. Wildlife Society Bulletin 28(4):993-1002.

Beck, J. L., J. W. Connelly, and K. P. Reese. 2009. Recovery of Greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Restoration Ecology 17 (3):393-403.

Beever, E. A. and C. L. Aldridge. 2011. Influences of free-roamingequids on sagebrush ecosystems, with focus on greater sage-grouse. Pp. 273-291 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Behnke, R. J. 1979. Monograph of the native trouts of the genus Salmo of western North America. United States Forest Service, United States. Fish and Wildlife Service and United States Bureau of Land Management.

Bell, Tom W., Olaf Menzer, Enrique Troyo-Diéquez, and Walter C. Oechel. 2012. Carbon dioxide exchange over multiple temporal scales in an arid shrub system near La Paz, Baja California Sur, Mexico. Global Change Biology 18: 2570-2582, doi: 10.1111/j.1365- 2486.2012.02720.x.

Bentz, B., D. Alston and T. Evans. 2008. Great Basin insect outbreaks. *In*: Chambers, J. C., N. Devoe, and A. Evans, eds. Collaborative management and research in the Great Basin – examining issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station: 43-48.

Bergquist, E., P. Evangelista, T. J. Stohlgren, and N. Alley. 2007. Invasive species and coal bed methane development in the Powder River Basin, Wyoming. Environmental Monitoring and Assessment 128:381-394.

Beschta, Robert L. 1997. Riparian Shade and Stream Temperature: An Alternative Perspective. Rangelands, Vol. 19, No. 2 (Apr., 1997), pp. 25-28. Published by: Allen Press and Society for Range Management Article Stable URL: http://www.jstor.org/stable/4001341.

Bills, F. T. 1977. Taxonomic status of the isolated populations of tui chub referred to Gila bicolor oregonensis (Snyder). M.S. Thesis. Oregon State Univ.

Blank, Robert R., Robert H. White, and Lewis H. Ziska. 2006. Combustion properties of *Bromus tectorum* L.: influence of ecotype and growth under four CO_2 concentrations. International Journal of Wildland Fire 15: 227-236.

BLM. 1984. North Warner Lakes Area Habitat Management Plan. USDI, BLM, Lakeview District, Lakeview, OR.

_____. 1986. South Warner Lakes Area Habitat Management Plan. USDI, BLM, Lakeview District, Lakeview, OR.

_____. 1988. Manual 1613–Areas of Critical Environmental Concern. Rel. 1-1541. BLM, Washington, DC. September 29, 1988.

_____. 1989a. Baker Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. July 1989.

_____. 1989b. Brothers/LaPine Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. July 1989.

_____. 1990a. Warner Wetlands Habitat Management Plan for Vegetation. USDI, BLM, Lakeview District. Lakeview, OR.

_____. 1990b. Handbook H-1624-1: Planning for Fluid Mineral Resources. Rel. No. 1-1583, May 7, 1990. BLM, Washington, DC.

_____. 1991. Vegetation Treatment on BLM Lands in Thirteen Western States. BLM, Washington, DC.

_____. 1992a. Three Rivers, Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. September 1992.

_____. 1992b. BLM Manual 9015, Integrated Weed Management. December 2, 1992.

_____. 1993. Rosebud/Edmunds Well Habitat Management Plan. USDI, BLM, Lakeview District, Lakeview, OR.

_____. 1995. Manual 8550–Interim Management Policy and Guidelines for Lands Under Wilderness Review. Rel. 8-66. BLM, Washington, DC. July 5, 1995.

_____. 1997. Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the Bureau of Land Management in the States of Oregon and Washington. Bureau of Land Management. August 1997. Internet website: http://www.blm.gov/or/resources/recreation/csnm/files/rangeland_standards.pdf.

_____. 1998. Riparian Area Management: Process for Assessing Proper Functioning Condition. Technical Reference 1737-9. Revised 1998.

_____. 2001. Proposed Southeastern Oregon Resource Management Plan and Final Environmental Statement.

_____. 2002. Southeastern Oregon Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. September 2002._____. 2003a.Lakeview Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. November 2003.

_____. 2003b. Riparian area management: Riparian-wetland soils. Technical Reference 1737-19. Bureau of Land Management, Denver, CO. BLM/ST/ST-03/001+1737.

_____. 2004a. National Sage-Grouse Habitat Conservation Strategy. November 2004.

_____. 2004b. Andrews Management Unit/Steens Mountain Cooperative Management and Protection Area Proposed Resource Management Plan and Final Environmental Impact Statement.

_____. 2004c. Proposed Upper Deschutes Resource Management Plan and Final Environmental Impact Statement.

_____. 2005a. Andrews Management Unit Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. August 2005.

_____. 2005b. Steens Mountain Cooperative Management and Protection Area (CMPA), Resource Management Plan (RMP), Record of Decision (ROD). Department of the Interior, Bureau of Land Management. August 2005.

_____. 2005c. Upper Deschutes Resource Management Plan (RMP) Record of Decision (ROD). Department of the Interior, Bureau of Land Management. October 2005.

_____. 2005d. Handbook H-1601-1: Land Use Planning Handbook. Rel. 1-1693, March 11, 2005. BLM, Washington, DC.

_____. 2005e. Record of Decision for Implementation of a Wind Energy Development Program and Associated Land Use Plan Amendments. BLM, Washington, DC. December 15, 2005.

_____. 2007a. Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement. BLM, Nevada State Office, Reno, NV. June 2007.

_____. 2007b. Burned Area Emergency Stabilization and Rehabilitation Handbook (H-1742-1). February 12, 2007.

_____. 2007c. Steens Mountain Travel Management Plan. BLM, Burns District Office. Hines, OR. November 2007.

_____. 2008a. Handbook H-1790-1: NEPA Handbook. Rel. 1-1710, January 30, 2008. BLM, Washington, DC.

_____. 2008b. Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States. BLM, Washington, DC. December 2008.

_____. 2008c. BLM Special Status Species Manual (6840).

_____. 2008d. BLM Manual 1740, Renewable Resource Improvements and Treatments. February 29, 2008.

_____. 2008e. BLM Integrated Vegetation Handbook H-1740-2. March 25, 2008.

_____. 2009a. Lime Wind Energy Project. Environmental Assessment, FONSI and Record of Decision. #OR-30-04-013. Internet website: http://www.blm.gov/or/plans/nepa-details.php?id=733.

_____. 2009b. Rapid ecological assessment of the Northern Basin and Range and Snake River Plain. BLM/OC/ST-10/002+1636. Denver, CO: US Department of the Interior, Bureau of Land Management, National Operations Center, Division of Resource Services.

_____. 2010a. Final environmental impact statement: Vegetation treatments using herbicides on BLM lands in Oregon, Volume 1. Portland, OR: US Department of the Interior, Bureau of Land Management, Oregon State Office.

_____. 2010b. BLM Instructional Memorandum 2011-004. Revised Recreation and Visitor Services Land Use Planning Guidance, Updated Checklist, and Three Land Use Planning Templates.

_____. 2011a. BLM Instructional Memorandum 2011-154, Requirement to Conduct and Maintain Inventory Information for Wilderness Characteristics and to Consider Lands with Wilderness Characteristics in Land Use Plans.

_____. 2011b. Baker Field Office Draft Resource Management Plan and Environmental Impact Statement.

_____. 2011c. BLM Instruction Memorandum 2012-044: BLM National Greater Sage-Grouse Land Use Planning Strategy. BLM, Washington, DC. December 27, 2011.

_____. 2011d. BLM Instruction Memorandum 2012-043: Greater Sage-Grouse Interim Management Policies and Procedures. BLM, Washington, DC. December 22, 2011.

_____. 2012c. Manual 6330–Management of Wilderness Study Areas. Rel. 6-134. BLM, Washington, DC. July 13, 2012.

_____. 2012d. Final Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States. BLM, Washington, DC.

_____. 2012e. BLM Oregon Instruction Memorandum, OR-2012-018 – Final State Director's Special Status Species List. Portland, Oregon.

_____. 2012f. Fires Burned in PGH and PPH as of August 15, 2012. BLM, NOC, and USGS, GeoMAC.

_____. 2012g. Visitor use Data Based on Visitor Use Days. Recreation Management Information System, BLM, Oregon State Office. April 4, 2013.

_____. 2012h. OHV Designation acreage tables. GIS Metadata. Oregon State Office Corporate Data. April 4, 2013.

_____. 2012i. Draft Resources Area Management Plan for Lakeview Field Office, Chapter 3: Affected Environment. BLM, Lakeview Field Office, Oregon. August 2012.

_____. 2012j. BLM Manual 6310—Conducting Wilderness Characteristics Inventory on BLM Lands. Rel. 6-129. BLM, Washington, DC. March 15, 2012.

_____. 2012k. BLM Manual 6320—Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process. Rel. 6-130. BLM, Washington, DC. March 15, 2012.

_____. 2012m. Summary of Oregon Sub-Region Economic Strategies Workshop: Bend, Oregon, June 28, 2012.

_____. 2012n. Recreation Management Information System.

_____. 2012o. John Day Basin Proposed Resource Management Plan and Final Environmental Impact Statement. Internet website: http://www.blm.gov/or/districts/prineville/plans/johndayrmp/jdbdocuments.php.

_____. 2012p. Manual 6340—Management of Designated Wilderness Areas. Rel. 6-135. BLM, Washington, DC. July 13, 2012.

_____. 2012q. Manual 6400—Wild and Scenic Rivers – Policy and Program Direction for Identification, Evaluation, Planning, and Management. Rel. 6-136. BLM, Washington, DC. July 13, 2012.

_____. 2012r. Renewable and Conventional Energy: Socioeconomic Contributions. Internet website: http://www.blm.gov/or/socioeconomic/energy.php.

_____. 2012s. Manual 6280—Management of National Scenic and Historic Trails and Trails under Study or Recommended as Suitable for Congressional Designation. Rel. 6-139. BLM, Washington, DC. September 14, 2012.

_____. 2012t. Manual 6220—National Monuments, National Conservation Areas, and Similar Designations. Rel. 6-132. BLM, Washington, DC. July 13, 2012.

_____. 2013a. Draft – Regional Mitigation Manual Section – 1794. Internet Website: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2013.Par.57631.File.dat/IM2013-142_att1.pdf. Accessed on July 16, 2013.

_____. 2013b. Invasive weeds data from corporate database Weeds_poly (Oregon Data Framework corporate dataset) and BLM National dataset National Invasive Species Information Management System (NISIMS).

_____. 2013c. LR2000 from 1996 to 2013. Internet website: www.blm.gov/lr2000. Accessed on February 2, 2013.

_____. 2013e. BLM Instructional Memorandum 2013-128, Sage-grouse Conservation Related to Wildland Fire and Fuels Management. Washington Office. May 23, 2013.

_____. 2013f. Personal communication with BLM Oregon Realty Specialist.

_____. 2014. Greater Sage-grouse Monitoring Framework. Bureau of Land Management, National Operations Center, Denver, CO.

_____. 2014a. Personal communication with BLM grazing specialist Michael Tietmeyer.

_____. 2014b. Fact Sheet on the BLM's Management of Livestock Grazing. Internet Website: http://www.blm.gov/wo/st/en/prog/grazing.html. Accessed in June 2014.

_____. 2015a. Research Natural Areas vegetation monitoring report summaries: 2014. Bureau of Land Management, Portland, OR.

_____. 2015b. Ecological Site Inventory data summary, Bureau of Land Management, Vale District, OR.

_____. 2015c. Oregon Sub-Region Greater Sage-Grouse Final Resource Management Plan Amendment and Environmental Impact Statement. Bureau of Land Management, Portland, OR.

_____. 2015d. Livestock Grazing Data. Data provided in personal communication with Robert Hopper. Rangeland Management Specialist, BLM, Oregon State Office. April 2015.

_____. Undated. Celatom Mine Expansion. Internet website: http://www.blm.gov/or/districts/burns/plans/celatom/index.php.

BLM (United States Department of the Interior, Bureau of Land Management) and Forest Service (United States Department of Agriculture, Forest Service). 2008. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, Volume 1, II, III: Programmatic Analysis, Publication No.-FES 08-44._____. 2012. National Greater Sage-Grouse Planning Strategy Land Use Plan Amendments and Environmental Impact Statements Scoping Summary Report. May 2012.

Blomberg, E., D. Noone, and J. Sedinger. 2010. Dynamics of greater sage-grouse (*Centrocercus urophasianus*) populations in response to transmission lines in central Nevada. Progress Report: Year 8. University of Nevada, Reno, Nevada.

Blomberg, E. J., S. Sedinger, M. T. Atamian, and D. V. Nonne. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3(6):55 http://dx.doi.org/10.1890/ES11-00304.1.

Blickley, J. L., and G. L Patricelli. 2010. Impacts of anthropagenic noise on wildlife: research priorities for thedevelopment of standards and mitigation. Journal of International Wildlife Law & Policy 13:274-292.

Blickley, J. L., and G. L. Patricelli. 2012. Potential acoustic masking of Greater Sage-Grouse (Centro cercus urophasianus) display components by chronic industrial noise. Ornithological Monographs. Volume (2012), No. 74, Pp. 23-35.

Blickley, J. L., Karen R. Word, Alan H. Krakauer, Jennifer L. Phillips, Sarah N. Sells, Conor C. Taff, John C. Wingfield, and Gail L. Patricelli. 2012a. Experimental Chronic Noise Is Related to Elevoted Fecal Corticosteroid Metabolites in Lekking Male Greater Sage-Grause (*Centrocercus urophosianus*). PLoS ONE 7(11): e50462.dOi:10.1371/journal.pone.0050462.

Blickley, J. L., D. Blackwood, and G. L. Patricelli. 2012b. Experimental evidence for the effects of chronic anthopogenic noise on abundance of greater sage-grouse leks. Conservation Biology 26:461-471.

Blickley, J. L, and G. L. Patricelli. 2013. Noise monitoring recommendations for Greater Sage-Grouse habitat in Wyoming. Prepared for the PAPA, Pinedale, WY.

BLS (Bureau of Labor Statistics). 2012a. CPI Inflation Calculator. Internet website: http://www.bls.gov/data/inflation_calculator.htm.

_____. 2012b. Local Area Unemployment Statistics. Internet website: http://www.bls.gov/lau/data.htm.

Boarman, W. I., and B. Heinrich. 1999. Common Raven (*Corvus corax*). In: The birds of North America, No. 476. A. Poole and F. Gill (eds). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, DC.

Bolshakova, V. L. J. 2013. Causes and consequences of local variability in *Aroga websteri* Clarke abundance over space and time. PhD Dissertation. Logan, UT: Utah State University.

Bossard, C. C., J. M. Randall, and M. C. Hoshovsky. 2000. Invasive plants of California's wildlands. University of California Press.

Bower, A., B. St Clair, V. Erickson. 2011. Provisional seed zones for native plants. Unpublished report, USDA US Forest Service, Pacific Northwest Research Station, Corvallis. Oregon.

Boyd C. S, J. L. Beck, and J. A. Tanaka. 2014. Livestock Grazing and Sage-Grouse Habitat: Impacts and Opportunities. Journal of Rangeland Applications: Vol. 1 (2014) pp 58-77.

Bradford, John B. and William K. Lauenroth. 2006. Controls over invasion of *Bromus tectorum*: the importance of climate, soil, disturbance and seed availability. Journal of Vegetation Science 17(6): 693-704.

Bradley, Bethany A. 2009. Regional analysis of the impacts of climate change on cheatgrass invasion shows potential risk and opportunity. Global Change Biology 15: 196–208, doi: 10.1111/j.1365-2486.2008.01709.x.

Bradley, Bethany A. 2010. Assessing ecosystem threats from global and regional change: hierarchical modeling of risk to sagebrush ecosystems from climate change, land use and invasive species in Nevada, USA. Ecography 33: 198-208, doi: 10.1111/j.1600-0587.2009.05684.x.

Bradley, B.A. and J.F. Mustard. 2006. Characterizing the landscape dynamics of an invasive plant and risk of invasion using remote sensing. Ecological Applications 16(3): 1132-1147.

Bradley, Bethany A., R. A. Houghton, John F. Mustard, and Steven P. Hamburg. 2006. Invasive grass reduces aboveground carbon stocks in shrublands of the western US. Global Change Biology 12: 1815–1822, doi: 10.1111/j.1365-2486.2006.01232.x.

Bradley, B. A., D. M. Blumenthal, D. S. Wilcove and L. H. Ziska. 2010. Predicting plant invasions in an era of global change. Trends in Ecology and Evolution 25(5): 310-318.

Braun, C. E. 1998. Sage grouse declines in western North America: What are the problems? Proceedings of Western Association of Fish and Wildlife Agencies 78:139-156.

Briske, D. D., J. D. Derner, D. G. Milchunas, and K. W. Tate. 2011. "An evidence-based assessment of prescribed grazing practices." In: Conservation benefits of rangeland resources: assessment, recommendations, and knowledge gaps, D. D. Briske. Pp. 23-74 in. US Department of Agriculture, USDA Natural National Resources Conservation Service, Washington, DC.

Brooks, M. L., C. M. D'Antonio, D. M. Richardson, J. M. DiTomaso, J. B. Grace, R. J. Hobbs, J. E. Keeley, M. Pellant, D. Pyke. 2004. Effects of invasive alien plants on fire regimes. Bioscience 54:677-688.

Brown, G. W. 1969. Predicting Temperatures of Small Streams, Water Resour. Res., 5(1), 68–75, doi:10.1029/WR005i001p00068.

Brown, J. K. 1982. Fuel and fire behavior prediction in big sagebrush. US Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. Research Paper INT-290. Ogden, UT.

Brown, K. G. and K. M. Clayton. 2004. Ecology of the greater sage-grouse (*Centrocercus urophasianus*) in the coal mining landscape of Wyoming's Powder River Basin. Final Technical Report, Thunderbird Wildlife Consultants, Inc. Wright, WY.

Bruce, J. R., W. D. Robinson, S. L. Petersen, and R. F. Miller. 2011. Greater sage-grouse movements and habitat use during winter in central Oregon. Western North American Naturalist 71(3):418-424.

Bryant, L. D., and C. Maser. 1982. Classification and distribution, p. 1-59 In: J.W. Thomas and D.E. Toweill (eds.), Elk of North America: ecology and management. Stackpole Books, Harrisburg, PA.

Budeau, D. 2012. Upland Game Bird Coordinator. Oregon Departement of Wildlife. Personal communication with BLM Oregon Wildlife Biologist, BLM. May 16, 2012.

_____. 2014a. Upland Game Bird Coordinator. Oregon Departement of Wildlife. Personnal e-mail communication with BLM Oregon Wildlife Biologist, BLM. March 20, 2014.

_____. 2014b. Upland Game Bird Coordinator. Oregon Departement of Wildlife. Personal communication with BLM Oregon Wildlife Biologist, BLM. June 14, 2014.

Bui, T. D., J. M. Marzluff, and B. Bedrosian. 2010. Common raven activity in relation to land use in western Wyoming: Implications for grater sage-grouse reproductive success. Condor 112: 65-78.

Bunch, T. R. 1965. Forage production on range sites in east central Malheur County. Master's thesis. Oregon State University, Corvallis, OR.

Burcsu, T. 2014. Draft Mid- to Broad-Scale Baseline Habitat Conditions for the Greater Sage-grouse in the State of Oregon. Report prepared for the Sage Grouse Conservation Partnership. Institute for Natural Resources, Portland State University, Portland, OR.

Burkhardt, J. W., and E. W. Tisdale. 1976. Causes of juniper invasion in Southwestern Idaho. Ecology 57: 472-484.

Burns Paiute Tribe. 2012. Burns Paiute Tribe Website. Internet website: http://www.burnspaiute-nsn.gov/index.php?option=com_content&view=article&id=1:welcome-to-the-burns-paiute-tribe&catid=1:latest-news.

Cagney, J., E. Bainter, B. Budd, T. Christiansen, V. Herren, M. Holloran, B. Rashford, M.A. Smith, J. Williams. 2010. Grazing Influence, Objective Development, and Management in Wyoming's Greater Sage-Grouse Habitat. University of Wyoming Cooperative Extension Bulletin B-1203.

Calkin, David E., Jack D. Cohen, Mark A. Finney, Matthew P. Thompson. 2014. How risk management can prevent future wildfire disasters in the wildland-urban interface. PNAS. 111(2): 746-751.

Campbell, John L., Robert E. Kennedy, Warren B. Cohen, and Richard F. Miller. 2012. Assessing the carbon consequences of western juniper (*Juniperus occidentalis*) encroachment across Oregon, USA. Rangeland Ecology and Management 65: 223–231, doi: 10.2111/REM-D-11-00012.1.

Carpenter, J., C. Aldridge, and M. S. Boyce. 2010. Sage-grouse habitat selection during winter in Alberta. Journal of Wildlife Management 74:1806-1814.

Carr, H. D. 1967. Effects of sagebrush control on abundance, distribution, and movements of sage grouse. Job Completion Report. W-37-R-20.Job 8a. Colorado Game, Fish and Parks Department, Colorado, USA.

Casazza, M. L., P. S. Coates, C. T. Overton, 2011. Linking habitat selection and brood success in Greater Sage-Grouse. In: Sandercock, B.K., Martin, K., Segelbacher, G. (Eds.), Ecology, Conservation, and Management of Grouse. Studies in Avian Biology 39. University of California Press, Berkeley, California, USA, pp. 151–167.

Center for Invasive Plant Management. 2003. Invasive Plant Prevention Guidelines. Internet website: http://www.weedcenter.org/store/docs/CIPM_prevention.pdf. September 2003.

CEQ (Council on Environmental Quality). 1981. Forty Most Asked Questions Concerning CEQ's NEPA Regulations. March 23, 1981.

_____.1997. CEQ Environmental Justice: Guidance Under the National Environmental Policy Act. United States Council on Environmental Quality. Washington, DC. Internet website: http://www.epa.gov/compliance/ej/resources/policy/ej_guidance_nepa_ceq1297.pdf.

Chambers, J. C., Bruce A. Roundy, Robert R. Blank, Susan E. Meyer and A. Whittaker. 2007. What makes Great Basin sagebrush invasible by *Bromus tectorum*?. Ecological Monographs 77(1): 117-145.

Chambers, J. C., B. A. Bradley, C. S. Brown, C. D'Antonio, M. J. Germino, J. B. Grace, S. P. Hardegree, R. F. Miller, and D. A. Pyke. 2014a. Resilience to stress and disturbance and resistance to *Bromus tectorum* L. invasion in cold desert shrublands of western North America. Ecosystems 17: 360-375.

Chambers, J. C., R. F. Miller, D. I. Board, D. A. Pyke, B. A. Roundy, J. B. Grace, E. W. Schupp, and R. J. Tausch. 2014b. Resilience and resistance of sagebrush ecosystems: implications for state and transition models and management treatements. Rangeland Ecology and Management 67(5): 440-454.

Chambers, Jeanne C., David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S Boyd, Steven B. Campbell, Shawn Espinosa, et al. 2014c. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: A strategic multi-scale approach. Gen. Tech. Rep. RMRS-GTR-326. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Christiansen, T. 2009. Fence marking to reduce greater sage-grouse collisions and mortality near Farson, Wyoming – summary of interim results. Wyoming Game and Fish Department unpublished interim report.

Chi, R. Y. 2004. Greater sage-grouse reproductive ecology and tebuthiron manipulation of dense big sagebrush of Parker Mountain. Thesis. Logan, UT: Utah State University.

Clark, L., J. Hall, R. McLean, M. Dunbar, K. Klenk, R. Bowen C. A. Smeraski. 2006. Susceptibility of Greater Sage-Grouse to Experimental Infection with West Nile Virus. Journal of Wildlife Diseases 42: 14-22.

Clary, Warren P., Nancy L. Shaw, Jonathan G. Dudley, Victoria A. Saab, John W. Kinney, and Lynda C. Smithman. 1996. Response of a Depleted Sagebrush Steppe Riparian System to Grazing Control and Woody Plantings. United States Department of Agriculture, Forest Service, Intermountian Reasearch Station, INT-RP-492. December 1996.

Clutter, T. J. 2010. Neal Hot Springs Promises Oregon Commercial Geothermal Power. Renewable Energy World (online magazine). October 18. Internet website: http://www.renewableenergyworld.com/rea/news/article/2010/10/neal-hot-springs-promises-oregon-commercial-geothermal-power. Accessed in July 2013.

Coates, P. S. 2007. Greater Sage-Grouse (*Centrocercus urophasianus*) nest predation and incubation behavior. M.S. Thesis. Idaho State University, Boise, Idaho.

Coates, P. S., Casazza, M. L., Blomberg, E. J., Gardner, S. C., Espinosa, S. P., Yee, J. L., Wiechman, L. and Halstead, B. J. (2013), Evaluating greater sage-grouse seasonal space use relative to leks: Implications for surface use designations in sagebrush ecosystems. The Journal of Wildlife Management, 77: 1598–1609. doi: 10.1002/jwmg.618.

Coffey, G. 2004. Indian Paintbrush: The Sunset Shades of Castilleja. Bay Nature. June 2004.

Coggins, K. A. 1998. Relationship Betwen Habitat Changes and Productivity of Sage Grouse at Hart Mountain National Antelope Refuge, Oregon. M.S. thesis, Oregon State University, Corvallis, USA.

Commission for Environmental Cooperation (CEC). 2012. Invasive Species. The Northern American Mosaic: An Overview of Key Environmental Issues. Commission for Environmental Cooperation document. p. 1-4.

Connelly, J. W., and C. E. Braun. 1997. A review of long-term changes in sage-grouse Centrocercus urophasianus populations in western North America. Wildlife Biology. 3: 229-234.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000a. Guidelines to Manage Sage Grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Connelly, J. W., A. D. Apa, R. B. Smith, and K. P. Reese. 2000b. Effects of predation and hunting on adult sage-grouse *Centrocercus urophasianus* in Idaho. Wildlife Biology 6:227-32.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, WY.

Connelly J. W. and K. P. Reese 2009. Recovery of greater sage-grouse habitat features in Wyoming big sagebrush following prescribed fire. Restoration Ecology. 17:393-403.

Connelly, J. W., C. A. Hagen, and M. A. Schroeder. 2011a. Characteristics and dynamics of Greater Sage-Grouse populations. Pp. 53-67 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Connelly, J. W., E. T. Rinkes, and C. E. Braun. 2011b. Characteristics of Greater Sage-Grouse habitats: a landscape species at micro- and macroscales. Pp. 69-83 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Connelly, J. W., S. T. Knick, C. E. Braun, W. L. Baker, E. A. Beever, T. Christiansen, K. E. Doherty, E. O. Garton, C. A. Hagen, S. E. Hanser, D. H. Johnson, M. Leu, R. F. Miller, D. E. Naugle, S. J. Oyler-McCance, D. A. Pyke, K. P. Reese, M. A. Schroeder, S. J. Stiver, B. L. Walker, and M. J. Wisdom. 2011c. Conservation of greater sage-grouse: A synthesis of current trends and future management. Studies in Avian Biology.

Cooper. 2007. Post-fire Recover of Wyoming Big Sagebrush Shrub-steppe in Central and Southeast Montana.

Crawford, J. A., and L. A. Carter. 2000. Habitat use by sage grouse on the Beatys Butte allotment. Oregon State University. Final Report. Corvallis, USA.

Crawford, J. A., R. A. Olson, N. E. West, J. C. Mosley, M. A. Schroder, T. D. Whitson, R. F. Miller, M. A. Gregg, and C. S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. Journal of Range Management 57:2-19.

Cronk, Q. and J. Fuller. 1995. Plant Invaders: The threat to natural ecosystems. Chapman & Hall. New York.

Crook County Planning Department. 2003. Crook County Comprehensive Plan. Internet website: http://www.co.crook.or.us/LinkClick.aspx?fileticket=-Ft1XqVA6y0%3d&tabid=1747&mid=3733.

Crook County. 2012. Crook County Oregon. Internet website: http://co.crook.or.us/AbouttheCounty/tabid/56/Default.aspx

Crooks, K. R. and M. A. Sanjayan, editors. 2006. Connectivity Conservation. Cambridge University Press, New York.

Dahlgren, D. K., R. Chi, and T. A. Messmer. 2006. Greater sage-grouse response to sagebrush management in Utah. Wildlife Society Bulletin 34:975–985.

Dahlgren, D. 2007 Adult and Juvenile Greater Sage-grouse Seasonal Diet Selection; Utah State University; Unpublished paper. March 2007.

Dambacher, J. M., K. K. Jones, and H. W. Li. 2001. The distribution and abundance of Great Basin redband trout: an application of variable probability sampling in a 1999 status review. Oregon Department of Fish and Wildlife, Information Reports 2001-08.

Daubenmire, R. 1975. Ecology of Artemisia tridentata subsp. tridentata in the state of Washington. Northwest Science 49(1): 24-35.

Davies K. W., J. D. Bales, A. M. Nafus. 2012. Mowing Wyoming Big Sagebrush Communities With Degraded Herbaceous Understories: Has a Threshold Been Crossed? Rangeland Ecology and Management 65:498–505.

Davies, K. W., J. D. Bates, D. D. Johnson, and A. M. Nafus. 2009. Influence of mowing *Artemisia tridentata* spp. *wyomingensis* on winter habitat for wildlife. Environmental Management 44: 84-92.

Davies, K. W., J. D. Bates, T. J. Svejcar, and C. S. Boyd. 2010. Effects of long-term livestock grazing on fuel characteristics in rangelands: an example from the sagebrush steppe. Rangeland Ecology and Management 63(6): 662-669.

Davies, K. W., C. S. Boyd, J. L. Beck, J. D. Bates, T. J. Svejcar, and J. G. Gregg. 2011. Saving the sagebrush sea: an ecosystem conservation plan for big sagebrush. Biological Conservation 144:2573-2584.

Davies, K. W., C. S. Boyd, A. M. Nafus. 2013. Restoring the sagebrush component in crested wheatgrass-dominated communities. Rangeland Ecology and Management 66(4): 472-478.

Davies K. W., T. J. Svejcar, J. D. Bates. 2009. Interaction of historical and nonhistorical disturbances maintains native plant communities. Ecological Applications 19: 1536-1545.

Davies K. W., M. Vavra, B. Schultz, and N. Rimbey. 2014. Implications of Longer Term Rest from Grazing in the Sagebrush Steppe. Journal of Rangeland Applications 1: 14-34.

Dealy, J. E., D. A. Leckenby, and D. M. Concannon. 1981. Wildlife habitats in managed rangelands—the Great Basin of southeastern Oregon: plant communities and their importance to wildlife. General Technical Report PNW-120. Portland, OR. US Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

Dean Runyan Associates. 2014. Oregon Travel Impacts. 1991-2013p. Internet website: http://www.deanrunyan.com/doc_library/ORImp.pdf. Accessed on July 25, 2014.

Deines, L., R. Rosentreter, D. J. Eldridge, and M. D. Serpe. 2007. Germination and seeding establishment of two annual grasses on lichen-dominated biological soil crusts. Plant and Soil 295(1-2): 23-35.

Diamond, J. M., C. A. Call, and N. Devoe. 2009. Effects of targeted cattle grazing on fire behavior of cheatgrass-dominated rangeland in the northern Great Basin, USA. International Journal of Wildland Fire 18:944–950.

_____. 2012. Effects of targeted grazing and prescribed burning on community and seed dynamics of a downy brome (*Bromus tectorum*)-dominated landscape. Invasive Plant Management and Science 5(2): 259-269. Abstract.

Dobler, F. C. J. Eby, C. Perry, S. Richardson, and M. Vander Haegen. 1996. Status of Washington's shrubsteppe ecosystem: Extent, ownership and wildlife/vegetation relationships. Washington Department of Fish and Wildlife Technical Report.

DOE and BLM (United States Department of Energy and United States Department of the Interior, Bureau of Land Management). 2009. Approved Resource Management Plan Amendments/Record of Decision (ROD) for Designation of Energy Corridors on Bureau of Land Management-Administered Lands in the 11 Western States (BLM/WO-GI-09-005-1800). January 2009. United States Department of the Interior, Bureau of Land Management, Washington DC.

Doescher, P. S., R. F. Miller, S. R. Swanson, and A. H. Winward. 1986. Identification of the Artemisia tridentata ssp. wyomingensis/Festuca idahoensis habitat type in eastern Oregon. Northwest Science 60:55–60.

Doherty, M. K. 2007. Mosquito populations in the Powder River Basin, Wyoming: a comparison of natural, agricultural, and effluent coal-bed natural gas aquatic habitats. Thesis. Montana State University, Bozeman, MT.

Doherty, K. E., D. E. Naugle, B. L. Walker, and J. M. Graham. 2008. Greater sage-grouse winter habitat selection and energy development. Journal of Wildlife Management 72:187-195.

Doherty, K. E., D. E. Naugle, and B. L. Walker. 2010. Greater sage-grouse nesting habitat: The importance of managing at multiple scales. Journal of Wildlife Management 74:1544-1553.

Doherty, K. E., D. E. Naugle, H. E. Copeland, A. Pocewicz, and J. M. Kiesecker. 2011. Energy development and conservation tradeoffs: systematic planning for Greater Sage-Grouse in their eastern range. Pp. 505-516 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Doherty, K. E., J. L. Beck, and D. E. Naugle. 2011b. Comparing ecological site descriptions to habitat characteristics influencing greater sage-grouse nest site occurrence and success. Rangeland Ecology & Management 64: 344-351.

DOI (United States Department of the Interior). 1998. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Technical Reference 1737-15.

_____. 2003. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas. Technical Reference 1737-16.

_____. 2004. Department Manual 620 - Wildland Fire Management, Chapter 3, Burned Area Emergency Stabilization and Rehabilitation. Effective Date: May 20, 2004.

_____. 2012. Payments in Lieu of Taxes FY 2010. Internet website http://www.nbc.gov/pilt/search.cfm#search.

DOI and USDA. 1995. Federal Wildland Fire Management Policy.

DOI, USDA, DOE, DOD, DOC, EPA, FEMA, and NASF (United States Departments of the Interior, Agriculture, Energy, Defense, Commerce, United States Environmental Protection Agency, Federal Emergency Management Agency and National Association of State Foresters). 2001. Review and Update of the 1995 Federal Wildland Fire Management Policy, January 2001.

Drut, M. S. 1992. Habitat use and selection by sage grouse broods in southeastern Oregon. M.S. thesis, Oregon State University, Corvallis, USA, 44 pp.

Drut, M. S., W. H. Pyle, and J. A. Crawford. 1994a. Diets and Food Selection of Sage Grouse Chicks in Oregon Journal of Range Management, Vol. 47, No. 1: pp. 90-93.

Drut, M. S., J. A. Crawford, and M. A. Gregg. 1994b. Brood habitat use by Sage Grouse in Oregon Great Basin Naturalist 54(2), pp. 170-176.

Dukes, J. S., N. R. Chiariello, S. R. Loarie and C. B. Field. 2011. Strong response of an invasive plant species (*Centaurea solstitialis* L.) to global environmental changes. Ecological Applications 21(6): 1887-1894.

Dunn, P. O. and C. E. Braun. 1986. Summer Habitat Use by Adult Female and Juvenile Sage Grouse. The Journal of Wildlife Management, Vol. 50, No. 2 (Apr. 1986), pp. 228-235.

Durtsche, B., B. J. Christopher, and S. V. Stegman. 2010. A GIS-based habitat model for the Greater Sage-Grouse in the Western United States. Unpublished report. Bureau of Land Management, Portland, OR.

Dusek, R. J., C. A. Hagen, J. C. Franson, and D. A. Budeau. 2014. Utilizing Hunter Harvest Effort to Survey for Wildlife Disease: A Case Study of West Nile Virus in Greater Sage-Grouse. Wildlife Society Bulletin; DOI: 10.1002/wsb.472.

EIA (Energy Information Administration). 2012. Power Outages Often Spur Questions Around Burying Power Lines. July. Available: http://www.eia.gov/todayinenergy/detail.cfm?id=7250.

EIA (United States Energy Information Administration). 2013, United States Natural Gas Wellhead Price (Dollars per Thousand Cubic Feet). Internet website: http://www.eia.gov/dnav/ng/hist/n9190us3m.htm. Accessed on April 30, 2013.

Eiswerth, M. E. and J. S. Shonkwiler. 2006. Examining post-wildfire reseeding on arid rangeland: a multivariate tobit modeling approach. Ecological Modeling 192:286-298.

Ellis, K. L. 1984. Behavior of lekking sage-grouse in response to a perched golden eagle. Western Birds 15:37–38.

Ellstrand, N. C., and D. R. Elam. 1993. Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology & Systematics 24: 217-242.

Elmore, W. and R. L. Beschta. 1987. Riparian Areas: Perceptions in Management. Rangelands 9(6):260-265.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and monitoring plant populations. US Department of the Interior, Bureau of Land Management, Denver, CO.

Emmons, S. R. 1980. Lek attendance of male Sage Grouse in North Park, Colorado. M.S. thesis. Colorado State University, Fort Collins, Colorado.

Eng, R. L., and P. Schladweiler. 1972. Sage-grouse winter movements and habitat use in central Montana. Journal of Wildlife Management 36:141-146.

EPA (Environmental Protection Agency). 2012a. The Green Book Nonattainment Areas for Criteria Pollutants. Internet website http:// http://www.epa.gov/oaqps001/greenbk/.

_____. 2012b. Inventory of United States greenhouse gas emissions and sinks: 1990-2010. EPA 430-R-12-001. Washington, DC: United States Environmental Protection Agency. Internet website http://www.epa.gov/climatechange/emissions/.

Evers, Louisa B. 2010. "Modeling sage-grouse habitat using a state-and-transition model." Oregon State University, Corvallis. Doctoral dissertation.

Fansler, V. A. and J. M. Mangold. 2011. Restoring native plants to crested wheatgrass stands. Restoration Ecology 19: 16-23.

Federal Interagency Committee for Management of Noxious and Exotic Weeds (eds). 1998. Pulling Together: National Strategy for Invasive Plant Management. Second edition. US Government Printing Office.

FHA (US Department of Transportation Federal Highway Administration). 2011. Noise Effect on Wildlife. Internet website: http://www.fhwa.dot.gov/environment/noise/noise_effect_on_wildlife/effects/wild01.cfm#content. Accessed on May 29, 2013.

Fire and Invasive Assessment Team. 2014. Greater Sage-Grouse Wildfire, Invasive Annual Grasses and Conifer Expansion Assessment (Fire and Invasives Assessment Tool [FIAT]). June 2014.

Finch, Deborah M., ed. 2012. Climate change in grasslands, shrublands, and deserts of the interior American West: a review and needs assessment. Gen. Tech. Rep. RMRS-GTR-285. Fort Collins, CO: United States Department of Agriculture, Forest Service, Rocky Mountain Research Station. Chapter 6, Disturbance and Climate Change in the Interior West, pgs 80-96.

Flora of North America. 2013. Flora of North America. Internet website: http://www.efloras.org/flora_page.aspx?flora_id=1. Accessed on May 21, 2013.

Foden, W., G. Mace, J. C. Vié, A. Angulo, S. Butchart, L. DeVantier, H. Dublin, A. Gutsche, S. Stuart, and E. Turak. 2008. Species susceptibility to climate change impacts. In: J. C. Vié, C. Hilton-Taylor and S.N. Stuart (eds). The 2008 Review of The IUCN Red List of Threatened Species. IUCN Gland, Switzerland.

Forests and Rangelands. 2011. National Cohesive Wildland Fire Management Strategy: Western Regional Assessment and Strategy. September 30, 2011.

Forest Service 2012. Completed Motor Vehicle Use Maps. Internet website: http://www.fs.fed.us/recreation/programs/ohv/ohv_maps.shtml. Accessed on August 16, 2012.

France, K. A., D. C. Ganskopp, C. S. Boyd. 2008. Interspace/undercanopy foraging patterns of beef cattle in sagebrush habitats. Rangeland Ecol. Manage. 61(4): 389-393.

Frankham. 1999. Quantitative genetics in conservation biology. Genet. Res., Camb. (1999), 74, pp. 237 - 244.

Freese, M. T. 2009. Linking greater sage-grouse habitat use and suitability across spatiotemporal scales in central Oregon. Unpublished M.S. Thesis, Oregon State University, Corvallis, OR.

Frey, B. R., V. J. Lieffers, E.H. Hogg, and S. M. Landhäusser. 2004. Predicting landscape patterns of aspen dieback: mechanisms and knowledge gaps. Canadian Journal of Forest Research 34: 1379-1390.

Gamperl, A. K., K. J. Rodnick, H. A. Faust, E. C. Venn, M. T. Bennett, L. I. Crawshaw, E. R. Keeley, M. S. Powell, and H. W. Li. 2002. Metabolism, Swimming Performance, and Tissue Biochemistry of High Desert Redband Trout (Oncorhynchus mykiss ssp.): Evidence for Phenotypic Differences in Physiological Function. Physiological and Biochemical Zoology, 75 (5): 413-431.

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. A. Schroeder. 2011. Greater Sage-Grouse population dynamics and probability of persistence. Pp. 293-381 in S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Gates, D. H. 1964. Sagebrush infested by leaf defoliating moth. Journal of Range Management 17: 209-210.

Gedney, D. R., D. L. Azumz, C. L. Bolsinger, and N. Mckay. 1999. Western Juniper in Eastern Oregon. General Technical Report PNW-GTR-464. Portland, OR: United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Gelbard, J. L., and J. Belnap. 2003. "Roads as conduits for exotic plant invasions in a semiarid landscape." Conservation Biology 17:420-432.

George M., R. D. Jackson, C. S. Boyd, K. W. Tate. 2011. A scientific assessment of the effectiveness of riparian management practices. In: Briske DD (ed) Conservation benefits of rangeland practices: assessment, recommendations, and knowledge gaps. Allen, Lawrence, pp 213–252.

Grant County Chamber of Commerce. 2012. Grant County Chamber of Commerce. Internet website: http://www.gcoregonlive.com/history.php

Grant County Planning Department. 1996. Comprehensive Land Use Plan. Internet website: http://www.gcoregonlive2.com/pdf/GCComprehensive_Plan.pdf.

Grasty, S. 2012. Personal communication from Judge Steve Grasty, Harney County, to Josh Sidon, BLM. September 24.

Great Basin Environmental Program. 2014. Assessing Landscape Scale Cheatgrass Fuel Load Reduction for protection f Great Basin Ecosystems and Wildland-Urban Interaction Using Late Season Grazing. University of Nevada, Reno.

Gregg, M. A. 1991. Use and selection of nesting habitat by sage grouse in Oregon. M.S. thesis, Oregon State University, Corvallis, USA.

Gregg, M. A., J. K. Barnett, and J. A. Crawford. 2008. Temporal Variation in Diet and Nutrition of Preincubating Greater Sage-Grouse Rangeland Ecology & Management, 61(5):535-542.

Gregory, S. V., F. J. Swanson, A. McKee, and K. W. Cummins. 1991. An ecosystem perspecitive of riparian zones. BioScience 41(8): 540-551.

Gilmanov, Tagir G., Douglas A. Johnson, Nicanor Z. Saliendra, Tony J, Svejcar, Ray F. Angell and Kirk L. Clawson. 2004. Winter CO_2 fluxes above sagebrush-steppe ecosystems in Idaho and Oregon. Agricultural and Forest Meteorology 126: 73-88, doi:10.1016/j.agrformet.2004.05.007.

Gisler, S., and T. N. Kaye. 2004. Conservation Research in the Leslie Gulch ACEC. Population monitoring for Trifolium owyheense and seed bank dynamics in Senecio ertterae. Prepared by Institute for Applied Ecology for Vale BLM. Corvallis Oregon.

Gitzendanner, M. A., and P. S. Soltis. 2000. Patterns of genetic variation in rare and widespread plant congeners. American Journal of Botany 87:777-786.

Hagen, C. A. 2005. Greater sage-grouse conservation assessment and strategy for Oregon: a plan to maintain and enhance populations of habitat. Oregon Department of Fish and Wildlife, Salem, USA.

_____. 2011. Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitats. Oregon Department of Fish and Wildlife, Bend, Oregon. April 22, 2011.

Hagen, C. A., J. W. Connelly, and M. A. Schroeder. 2007. A meta-analysis for greater sage-grouse nesting and brood rearing habitats. Wildlife Biology 13 (Supplement 1): 42-50.

Hall, R. C. 1965. Sagebrush defoliator outbreak in northern California. Res. Note PSW-75. Berkeley CA: US Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station.

Hand, Jenny L., Scott A. Copeland, Derek E. Day, Ann M. Dillner, Hege Indres, William C. Malm, Chuck E. McDade, et al. 2011. Spatial and seasonal patterns and temporal variability of haze and its constituents in the United States: Report V. Fort Collins, CO: Colorado State University, Cooperative Institute for Research in the Atmosphere. Internet website: http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm.

Hanf, J. M., P. A. Schmidt, and E. B. Groshens. 1994. Sage grouse in the high desert of central Oregon: results of a study, 1988-1993. - Bureau of Land Management, Portland, Oregon, USA.

Hann, Wendel J., Ayn Shlisky, Doug Havlina, Kathy Schon, Stephen W. Barrett, Thomas E. DeMeo, Kelly Pohl, et al. 2008. Interagency Fire Regime Condition Class (FRCC) guidebook. Version 1.3.0. Homepage of the Interagency and The Nature Conservancy Fire Regime Condition Class website, USDA Forest Service, United States Department of the Interior, The Nature Conservancy, and Systems for Environmental Management. Internet website: www.frcc.gov.

Hann, W. J., and D. L. Bunnell. 2001. Fire and land management planning and implementation across multiple scales. Int. J. Wildland Fire. 10:389-403.

Hanna, P. and D. Kulakowski. 2012. The influences of climate on aspen dieback. Forest Ecology and Management 274: 91-98.

Hanus, Ann. 2011. Socio-Economic Profile and Analysis of Seven Oregon Counties Included in the Greater Sage-Grouse Conservation Strategy for Oregon. Association of Oregon Counties.

Harney County. 2012. Harney County Fair, Rodeo & Race Meet 2012. Internet website: http://www.co.harney.or.us/countyfair.html.

Harney County Community Response Team. 2002. Harney County Strategic Plan 2002. Internet website: http://www.harneycounty.org/PDF%20Files/HC%20Strategic%20Plan%202002.pdf.

Harney County Planning Department. 2009. Harney County Comprehensive Plan. Internet website: http://www.co.harney.or.us/PDF_Files/Planning/Comprehensive%20Plan/Harney%20County%20 Comprehensive%20Plan%202009.pdf.

Hawkins, B., Sharrock, S. and Havens, K., 2008. Plants and climate change: which future? Botanic Gardens Conservation International, Richmond, UK.

Headwaters Economics. 2012. Economic Profile System-Human Dimensions Toolkit (EPS-HDT). Internet website: http://headwaterseconomics.org/tools/eps-hdt.

_____. 2013. A Profile of Timber and Wood Products. County Region. Economic Profile System-human Dimensions Toolkit, EPS-HDT. August 2013.

_____. 2014. A Profile of Mining, Including Oil & Gas. County Region. Economic Profile System-human Dimensions Toolkit, EPS-HDT. July 2014.

Heady, H. F., ed. 1988. The Vale rangeland rehabilitation program: an evaluation. Res. Bull PNW-RB-157. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Hershler, R. and H. Liu. 2009. New species and records of Pyrgulopsis (Gastropoda: Hydrobiidae) from the Snake River basin, southeastern Oregon: further delineation of a highly imperiled fauna, Zootaxa, 2006: 1-22.

Holloran, M. J. 2005. Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming. PhD Dissertation. University of Wyoming. Laramie, Wyoming.

Hulet, A., B. A. Roundy, and B. Jessop. 2010. Crested wheatgrass control and native plant establishment in Utah. Rangeland Ecology and Management 63: 450-460.

Huwer, S. L. 2004. Evaluating Greater Sage Grouse Brood Habitat using Human imprinted chicks. Thesis. Department of Fishery and Wildlife Biology; Colorado State University.

Institute for Applied Ecology. 2012. Monitoring reports for select species. Online: http://appliedeco.org/reports.

Interagency Fire and Weather Data website. 2013. Internet website: http://fam.nwcg.gov/fam-web/weatherfirecd/state.data.htm.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor, and H. L. Miller, eds.]. New York, NY: Cambridge University Press. 996 p. Internet website: http://www.ipcc.ch/.

_____. 2013. Summary for policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. T. F. Stocker, D. Qin, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley (eds.). Cambridge University Press, New York, NY, USA.

Irwin, L. L., J. G. Cook, R. A. Riggs, and J. M. Skovlin. 1994. Effects of long-term grazing by big game and livestock in the Blue Mountains forest ecosystems. U. S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-325, Portland, Oregon.

Jenni, D. A., and J. E. Hartzler. 1978. Attendance at a sage grouse lek: implications for spring censuses. Journal of Wildlife Management 42:46-52.

Jeppesen, D. J. 1978. Competitive moisture consumption by western juniper (*Juniperus occidentalis*). *In* Martin, R. E., J. E. Dealy, and D. L. Caraher, eds. Proceedings: Western Juniper Ecology and Management Workshop. USDA Forest Service General Technical Report PNW-74. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station: 83-90.

Jessup, B. D. and V. J. Anderson. 2007. Cheatgrass invasion in salt desert shrublands: benefits of postfire reclamation. Rangeland Ecology and Management 60: 235-243.

Jobbágy, Esteban G., and Robert B. Jackson. 2000. The vertical distribution of soil organic carbon and its relationship to climate and vegetation. Ecological Applications 10(2): 423-436.

Johnson, R., L. Stritch, P. Olwell, S. Lambert, M. E. Horning, and R. Cronn. 2010. What are the best seed sources for ecosystem restoration on BLM and USFS lands? Native Plants Journal 11(2): 117–131.

Johnson, D. H., M. J. Holloran, J. W. Connelly, S. E. Hanser, C. L. Amundson, and S. T. Knick. 2011. Influences of environmental and anthropogenic features on Greater Sage-Grouse populations, 1997-2007. Pp. 407-450 in S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Jones, A. 2004. Graph-theoretic modeling of functional habitat connectivity for lynx on the Okanogan Highlands, northern Washington. Unpublished MS Thesis. Montana State University. Internet website: http://scholarworks.montana.edu/xmlui/handle/1/1578.

Jones, A. L. (ed). 2012. Best Management Practices for siting, developing, operating, and monitoring renewable energy in the intermountain West: a conservationist's guide. Special publication. Wild Utah Project. Salt Lake City, UT.

Jones, A., M. Schindel, and S. Scott. 2015. Mapping Habitat Connectivity for Greater Sage-Grousein Oregon's Sage-Grouse Conservation Partnership (SageCon) Assessment Area. Produced by The NatureConservancy (Portland OR) in partial fulfillment of BLM Cooperative Agreement L12AC20615.

Kagan, J., and S. Caicco. 1996. Manual of Oregon Actual Vegetation, Oregon Gap Analysis Program. US Fish and Wildlife Service, Portland, OR.

Karl, M. and J. Sadowski. 2005. Assessing big sagebrush at multiple scales: an example in southeast Oregon. Tech. Note 417. Denver, CO: US Department of the Interior, Bureau of Land Management.

Karl, Thomas R., Jerry M. Melillo, and Thomas C. Peterson. 2009. Global climate change impacts in the United States. New York, NY: Cambridge University Press.

Karron, J. D. 1987. A comparison of levels of genetic polymorphism and self-compatibility in geographically restricted and widespread plant congeners. Evolutionary Ecology 1: 47–58.

Kaye, T. N. 2002. Effects of Cattle Grazing, Insect Interactions and Population Ecology of Snake River Golden Weed (*Happlopappus radiatus*). Prepared by Institute for Applied Ecolgy for Vale District BLM. Corvallis, Oregon.

Kaye, T. N., R. J. Meinke, J. Kagan, S. Vrilakas, K. L. Chambers, P. F. Zika, and J. K. Nelson. 1997. Patterns of rarity in the Oregon flora: implications for conservation and management. In, Kaye, T.N., A. Liston, R.M. Love, D. Luoma, R.J. Meinke, and M.V. Wilson [editors]. Conservation and management of native plants and fungi. Native Plant Society of Oregon, Corvallis, Oregon.

Kestner, K. 2012. Personal communication from Ken Kestner, County Commissioner, Lake County, OR, to Josh Sidon, BLM. August 24.

Kirol, C. P. 2012. Quantifying habitat importance for greater sage-grouse (Centrocercus urophasianus) population persistence in an energy development landscape, M.S. Thesis, U. of Wyoming.

Klebenow, D. A. and G. M. Gray. 1968. Food Habits of Juvenile Sage Grouse Journal of Range Management, Vol. 21, No. 2. Pp. 80-83.

Knapp, P. A., P. T. Soulé, and H. D. Grissino-Mayer. 2001. Detecting potential regional effects of increased atmospheric CO_2 on growth rates of western juniper. Global Change Biology 7: 903-917.

Knick, S. T. and J. W. Connelly. 2011. Greater Sage-Grouse and sagebrush: an introduction to the landscape. Pp. 1-9 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Knick, S. T., S. E. Hanser, K. L. Preston. 2013. Modeling ecological minimum requirements for distribution of Greater Sage-Grouse leks: implications for population connectivity across their western range, U.S.A. Ecology and Evolution, pp.1-13.

Knick, S. T. and S. E. Hanser. 2011. Connecting pattern and process in Greater Sage-Grouse populations and sagebrush landscapes. Pp. 383-405 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Knick, S. T., S. E. Hanser, R. F. Miller, D. A. Pyke, M. J. Wisdom, S. P. Finn, E. T. Rinkes, and C. J.Henny. 2011. Ecological influence and pathways of land use in sagebrush. Pp. 203-251 *in* S. T. Knick and J. W. Connelly. Greater Sage-Grouse: ecology and conservation of a landscape species and its habitat. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, CA.

Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. A. Schroeder, W. M. Vander Haegen, and C. Van Riper III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105:611-634.

Kolada, E. J., M. L. Casazza, and J. S. Sedinger. 2009. Ecological factors influencing nest survival of greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1341-1347.

Kramer, A. T. and K. Havens. 2009. Plant conservation genetics in a changing world. Trends in Plant Science 14:599-607.

Kunkel, C. 1976. Biology and production of the red-band trout (Salmo sp.) in four southeastern Oregon streams Thesis (M.S.): Oregon State University, 1977. 73 leaves, bound pp.

Lake County. 2012. Lake County. Internet website: http://www.lakecountyor.org.

Lake County Board of Commissioners. 1982. Lake County Comprehensive Plan. Internet website: http://www.lakecountyor.org/government/docs/comp__plan.pdf.

Lake County Chamber of Commerce. 2012. Lake County Chamber. Internet website: http://www.lakecountychamber.org/history.html.

Landres, P., C. Barns, J.G. Dennis, T. Devine, P. Geissler, C. S. McCasland, L. Merigliano, J. Seastrand, and R. Swain. 2008. Keeping it wild: an interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. Gen. Tech. Rep. RMRS-GTR-212. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Internet website: http://www.wilderness.net/toolboxes/documents/WC/Keeping%20it%20Wild%20Interagency%20Strategy%20GTR-212.pdf. Accessed on September 24, 2013.

Launchbaugh, K., B. Brammer, M. L. Brooks, S. Bunting, P. Clark, J. Davison, M. Fleming, R. Kay, M. Pellant, D. A. Pyke, and B. Wylie. 2007. Interactions among livestock grazing, vegetation type, and fire behavior in the Murphy Wildland Fire Complex in Idaho and Nevada, July 2007. US Geological Survey Open-File Report 2008–1214. Internet website: http://pubs.usgs.gov/ofr/2008/1214.

Lavin, M.; T. J. Brummer; R. Quire; B. D. Maxwell; and L. J. Rew. Physical disturbance shapes vascular plant diversity more profoundly than fire in the sagebrush steppe of southeastern Idaho. Ecology and Evolution 3: 1626-1641.

LeBeau, C. W. 2012. Evaluation of greater sage-grouse reproductive habitat and response to wind energy development in south-central Wyoming. Thesis. University of Wyoming, Laramie, Wyoming.

Leu, M., and S. E. Hanser. 2011. Influences of the human footprint on sagebrush landscape patterns: implications for sage-grouse conservation. Pages 253-271 in S. T. Knick and J. W. Connelly (editors). Greater sage-grouse ecology and conservation of a landscape species and its habitat. Studies in Avian Biology (Vol 38). University of California Press, Berkeley, CA.

Leu, M., S. E. Hanser, and S. T. Knick. 2008. The human footprint in the west: a large-scale analysis of anthropogenic impacts. Ecological Applications 18:1119–1139.

Lockyer Z. B., P. S. Coates, M. L. Casazza, S. Espinosa, D. J. Delehanty. 2013. Greater sage grouse nest predators in the Virginia Mountains of northwestern Nevada. Journal of Fish and Wildlife Management 4(2):242–254; e1944-687X.

Lubow, B. C. and J. I. Ransom. 2009. Validating aerial photographic mark–recapture for naturally marked feral horses. Journal of Wildlife Management 73(8): 1420–1429.

Lyon, A. G. 2000. The potential effects of natural gas development on sage grouse (Centrocercus urophasianus) near Pinedale, Wyoming. M.S. Thesis, University of Wyoming, Laramie, WY.

Lyon, L. A., and S. H. Anderson. 2003. Potential gas development impacts on sage grouse nest initiation and movement. Wildlife Society Bulletin 31:486-491.

Lynn D. Steiger & Associates. 1979. Union County: Comprehensive Plan. Internet website: https://scholarsbank.uoregon.edu/xmlui/handle/1794/9086.

Mack, R. N., and J. N. Thompson. 1982. Evolution in Steppe with Few Large Hooved Mammals. American Naturalist 119:757-773.

Malheur County. 2012. Basic Annual Financial Report for the Fiscal Year Ended June 30, 2012.

Malheur County. 1982. Malheur County: Comprehensive Plan (1982). Internet website: https://scholarsbank.uoregon.edu/xmlui/handle/1794/9377.

_____. 2012. Malheur County. Internet website: http://www.malheurco.org/about.

Malheur County Economic Development. 2012. Malheur County Economic Development. Internet website: http://ecodev.malheurco.org/.

Mangla, S., R. L. Sheley and J. J. James. 2011. Field growth comparisons of invasive alien annual and native perennial grasses in monocultures. Journal of Arid Environments 75: 206-210, doi:10.1016/j.jaridenv.2010.09.015.

Manier, D. J., D. J. A. Wood, Z. H. Bowen, R. M. Donovan, M. J. Holloran, L. M. Juliusson, K. S. Mayne, et al. 2013. Summary of science, activities, programs, and policies that influence the rangewide conservation of Greater Sage-Grouse (*Centrocercus urophasianus*): US Geological Survey Open-File Report 2013–1098, 170 p., http://pubs.usgs.gov/of/2013/1098/.

Manier, D. J., Z. H. Bowen, M. L. Brooks, M. L. Casazza, P. S. Coates, P. A. Deibert, S. E. Hanser, and D. H. Johnson. 2014. Conservation buffer distance estimates for Greater Sage-Grouse—A review. US Geological Survey Open-File Report 2014–1239. Internet website: http://dx.doi.org/10.3133/ofr20141239. November 21, 2014.

Martin, N. S. 1970. Sagebrush Control Related to Habitat and Sage Grouse Occurrence The Journal of Wildlife Management, Vol. 34, No. 2. pp. 313-320.

Mayeux, H. S., H. B. Johnson, and H. W. Polley. 1994. Potential interactions between global change and intermountain annual grasslands. In: Monsen, Stephen B. and Stanley G. Kitchen, eds. Proceedings – ecology and management of annual rangelands. Gen. Tech. Rep. INT-313. Ogden, UT: US Department of Agriculture, Forest Service, Intermountain Research Station: 95-100.

McAdoo, J. K., B. W. Schultz, and S. R. Swanson. 2013. Aboriginal precedent for active management of sagebrush-grass communities in the Great Basin. Rangeland Ecology and Management 66(3): 241-253.

McArthur, E. D., B. L. Welch, and S. C. Sanderson. 1988. Natural and artificial hybridization between big sagebrush *(Artemisia tridentata)* subspecies. Journal of Heredity 79: 268-276.

McDowell, M. K. D. 2000. The Effects of Burning in Mountain Big Sagebrush on Key Sage Grouse Habitat Characteristics in Southeastern Oregon [Thesis].Corvallis, OR, USA: Oregon State University.

McKenney, Daniel W., John H. Pedlar, Kevin Lawrence, Kathy Campbell, and Michael F. Hutchinson. 2007. "Potential impacts of climate change on the distribution of North American trees." *BioScience* 57(11): 939-948.

McKenney, Daniel W., John H. Pedlar, Richard B. Rood, and David Price. 2011. "Revisiting projected range shifts in the climate envelopes of North American trees using updated general circulation models.: *Global Change Biology* 17: 2720-2730.

McRae, B. H. and D. M. Kavanagh. 2011. Linkage Mapper Connectivity Analysis Software. The Nature Conservancy, Seattle, WA. Internet website: http://www.circuitscape.org/linkagemapper.

McRae, B. H. and V. B. Shah. 2009. Circuitscape user's guide. The University of California, Santa Barbara. Internet website: http://www.circuitscape.org.

Meehan, W. R. (ed.). 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Meinke, C. W., S. T. Knick, and D. A. Pyke. 2009. A spatial model to prioritize sagebrush landscapes in the intermountain west (USA) for restoration. Restoration Ecology 17:652-659.

Meinke, R. 2012. Oregon Department of Agriculture. Personal Communication on ODA rare plant monitoring.

Menard, C., P. Duncan, G. Fleurance, J. Georges, and M. Lila. 2002. Comparative foraging and nutrition of horses and cattle in European wetlands. Journal of Applied Ecology 39: 120-133.

METI Corp / Economic Insights of Colorado. 2012. USDA Forest Service Protocols for Delineation of Economic Impact Analysis Areas.

Meyer, S. E., S. C. Garvin and J. Beckstead. 2001. Factors mediating cheatgrass invasion of intact salt desert shrubland. In: McArthur, E. D., D. J. Fairbanks, comps. Shrubland ecosystem genetics and biodiversity: proceedings; 2000 June 13–15; Provo, UT. Proc. RMRS-P-21. Ogden, UT: US Department of Agriculture, Forest Service, Rocky Mountain Research Station: 224-232.

Miller, R. F., and J. A. Rose. 1995. Historic expansion of *Juniperus occidentalis* (western juniper) in southeastern Oregon. Great Basin Naturalist 55: 37-45.

_____. 1999. Fire history and western juniper encroachment in sagebrush steppe. Journal of Range Management 52: 550-559.

Miller, R. F. and R. J. Tausch. 2001. The role of fire in juniper and pinyon woodlands: a descriptive analysis. *In*: Galley, K.E.M and T.P. Wilson (eds). Proceedings of the Invasive Species Workshop: the role of fire in the control and Spread of Invasive Species. Fire Conference 2000: the First National congress of Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11. Tallahassee, FL; Tall Timbers Research Station: 15-30.

Miller, R. F. and L. L. Eddleman 2001. Spatial and Temporal Changes of Sage Grouse Habitat in the Sagebrush Biome. Oregon State University Agricultural Experiment Station Technical Bulletin 151.

Miller, R., C. Baisan, J. Rose, and D. Pacioretty. 2001. Pre- and Post-Settlement Fire Regimes in Mountain Big Sagebrush Steppe and Aspen: The Northwestern Great Basin. Final Report 2001 to the National Interagency Fire Center.

Miller, R. F., J. C. Chambers, D. A. Pyke, F. B. Pierson, and C. J. Williams. 2013. A review of fire effects on vegetation and soils in the Great Basin region: response and ecological site characteristics. General Technical Report RMRS-GTR-308. Fort Collins, CO. US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, R. F., R. J. Svejcar, and J. A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management 53: 574-585.

Miller, R. F. and P. E. Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands. Bioscience 44(7): 465-474.

Miller, R. F., S. T. Knick, D. A. Pyke, C. W. Meinke, S. E. Hanser, M. J. Wisdom, and A. L. Hild. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. Pp. 145-184 in S. T. Knick and J. W. Connelly (editors). Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. University of California Press, Berkeley, CA.

Miller, R. F., J. D. Bates, F. B. Pierson, and L. E. Eddleman. 2005. Biology, ecology and management of western juniper. Technical Bulletin 152. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Miller, Richard F., Jon D. Bates, Tony J. Svejcar, Fred B. Pierson and Lee E. Eddleman. 2005. Biology, ecology and management of western juniper (*Juniperus occidentalis*). Tech. Bull. 152. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Miller, R. F., R. J. Tausch, D. Macarthur, D. D. Johnson, and S. C. Sanderson. 2008. Age Structure and Expansion of Piñon-Juniper Woodlands: A Regional Perspective in the Intermountain West. USDA Forest Service Research Paper Report RMRS-RP-69.

Miller, R. F., S. T. Knick, D. A. Pyke, C. W. Meinke, S. E. Hanser, M. J. Wisdom and A. L. Hild. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. In: Knick, Steven T. and John W. Connelly, eds. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology Vol. 38. Berekely, CA: University of California Press: 145-184.

Miller, S. A. A. Bartow, M. Gisler, K. Ward, A. S. Young, and T. N. Kaye. 2011. Can an Ecoregion Serve as a Seed Transfer Zone? Evidence from a Common Garden Study with Five Native Species. Restoration Ecology: Vol 19, No. 201. pp. 268-276.

Minerals Management Service, press release Dec. 4, 2007. Available: http://www.gomr.mms.gov/ and http://www.gomr.mms.gov/homepg/whatsnew/newsreal/2007/071204.pdf.

Mote, Phillip W. and Eric P. Salathé, Jr. 2010. Future climate in the Pacific Northwest. Climatic Change 102: 29-50.

Mote, Phillip, Amy K. Snover, Susan Capalbo, Sanford D. Eigenbrode, Patricia Glick, Jeremy Littell, Richard Raymondi and Spencer Reeder. 2013. Chapter 21 – Northwest. In Draft National Climate Assessment. Internet website http://ncadac.globalchange.gov/. Accessed on February 8, 2013.

National Research Council. 2002. Riparian areas: functions and strategies for management. National Academy of Science. Washington, DC.

NRCS (Natural Resources Conservation Service). 2012. Natural Resources Conservation Service Introduction to NRCS' New Sage-Grouse Initiative: Wildlife Conservation through Sustainable Ranching. Department of Agriculture, Washington DC.

_____. 2015. Field Office Technical Guides. Internet website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Columbia Spotted Frog, Rana luteiventris. Last updated: October 2012. Internet website: http://www.natureserve.org/explorer. Accessed on February 14, 2013.

Naugle, D. E., C. L. Aldridge, B. L. Walker, T. E. Cornish, B. J. Moynahan, M. J. Holloran, K. Brown, et al. 2004. West Nile virus: Pending crisis for greater sage-grouse. Ecology Letters 7:704-713.Nelson, E. W. 1925. Status of the pronghorned antelope, 1922-24. USDA Bull. No. 1346. Washington DC.

NCSL (National Conference of State Legislatures). 2008. North Dakota- Assessing the Costs of Climate Change. Climate Change and the Economy. Internet website: http://www.ncsl.org/print/environ/ClimateChangeND.pdf. Accessed on August 31, 2012.

NCSL (National Conference of State Legislatures). 2013. Federal and State Recognized Tribes. Internet Website: http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#or

Nelle, P. J., K. P. Reese, and J. W. Connelly. 2000. Long-Term Effects of Fire on Sage Grouse Habitat Journal of Range Management, Vol. 53, No. 6, pp. 586-591.

Nelson, Z. P., P. J. Weisberg, and S. G. Kitchen. 2013. Influence of climate and environment on post-fire recovery of mountain big sagebrush. International Journal of Wildland Fire 23(1): 131-142.

Newton, R.E., R.T. Massatti and A.S. Thorpe. 2010. Astragalus mulfordiae: population dynamics and the effect of cattle grazing in the Vale District, BLM. Final Report. Prepared by Institute for Applied Ecology, Corvallis Oregon.

NIFTT (National Interagency Fuels, Fire & Vegetation Technology Transfer). 2010. Interagency fire regime condition class (FRCC) guidebook: version 3.0. 126 p. Internet website: http://www.frames.gov/portal/server.pt/community/frcc/309.

Nonne, J. S., E. Blomberg, and J. Sedinger. 2013. Unpublished data. University of Nevada, Reno, Nevada.

NRCS (Natural Resources Conservation Service). 2011. Introduction to NRCS' New Sage-Grouse Initiative: Wildlife Conservation through 15 Sustainable Ranching. Department of Agriculture, Washington DC.

_____. 2012. National soil survey handbook, title 430-VI. Internet website: http://soils.usda.gov/technical/handbook/. Accessed on August 28, 2012.

NREL (National Renewable Energy Laboratory). 2009a. Oregon – Annual Average Wind Speed at 80m. Internet website: http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=id. Accessed in July 2013.

_____. 2009b. Geothermal Resource of the United States. Internet website: http://www.nrel.gov/gis/images/geothermal_resource2009-final.jpg. Accessed in September 2013.

NTT (Sage-Grouse National Technical Team). 2011. A Report on National Greater Sage-Grouse Conservation Measures. December 2011.

ODEQ (Oregon Department of Environmental Quality). 2010a. 2009 Oregon Air Quality Data Summaries. June 2010. Internet website: http://www.deq.state.or.us/aq/forms/2009AnnualReport.pdf. Accessed on August 23, 2012.

_____. 2010b. WPCF Underground Injection Control Disposal Permit Evaluation and Fact Sheet. Portland, Oregon. WPCF Permit Number 119576; Permittee: USG Oregon LLC (for Neal Hot Springs Geothermal Power Plant). Internet website: http://www.deq.state.or.us/nwr/permits/NealHotSpringsPER.pdf. Accessed in July 2013.

_____. 2011. 2010 Oregon Air Quality Data Summaries. June 2011. Internet website: http://www.deq.state.or.us/aq/forms/2010annualReport.pdf. Accessed on August 23, 2012.

_____. 2012a. Klamath Falls $PM_{2.5}$ Attainment Plan Fact Sheet. Internet website: http://www.deq.state.or.us/aq/rulemaking/KFallsPM25FactSheet.pdf.

_____. 2012b. 2011 Oregon Air Quality Data Summaries. June 2012. Internet website: http://www.deq.state.or.us/aq/forms/2011AirQualityAnnualReport.pdf. Accessed on August 23, 2012.

ODEQ. 2010. Polley, H. Wayne, William Emmerich, James A. Bradford, Phillip L. Sims, Douglas A. Johnson, Nicanor Z. Saliendra, Tony Svejcar, Raymond Angell, Albert B. Frank, Rebecca L. Phillips, Keirith A. Snyder, Jack A. Morgan, Joaquin Sanabria, Patricia C. Mielnick and William A. Dugas. Precipitation regulates response of net ecosystem CO_2 exchange to environmental variation on United States rangelands. Rangeland Ecology and Management 63: 176–186, doi: 10.2111/REM-D-09-00015.1.

ODA (Oregon Department of Agriculture). 2012. Oregon agricultural water quality report. Salem, OR. Internet website: http://apps.oregon.gov/Applications/PDFDownload/ODA/water_qual_rpt2012.pdf.

_____. 2014. Noxious weed policy and classification system 2014. Salem, OR. 12 p. Internet website: http://www.oregon.gov/ODA/PLANT/WEEDS/docs/pdf/2014ClassPolicy.040914.pdf.

ODFW (Oregon Department of Fish and Wildlife). 2005. Oregon Native Fish Status Report Volume I Species Management Unit Summaries. Oregon Department of Fish and Wildlife.

_____. 2006. The Oregon Conservation Strategy. February 2006.

_____. 2009. Recommendations for Greater Sage-Grouse Habitat Classification Under Oregon Department of Fish and Wildlife's Fish and Wildlife Habitat Mitigation Strategy (OAR 635-415-0000). July 2009.

_____. 2010. WPCF Underground Injection Control Disposal Permit Evaluation and Fact Sheet. Portland, Oregon. WPCF Permit Number 119576; Permittee: USG Oregon LLC (for Neal Hot Springs Geothermal Power Plant). Internet website: http://www.deq.state.or.us/nwr/permits/NealHotSpringsPER.pdf. Accessed in July 2013.

_____. 2011. Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitat. April 22, 2011.

_____. 2012a. What is the Fish and Wildlife Habitat Mitigation Policy? Internet website: http://www.dfw.state.or.us/lands/mitigation_policy.asp. Accessed on August 27, 2012.

_____. 2012b. Mitigation Framework for Sage-Grouse Habitats. March 20, 2012.

ODOE (Oregon Department of Energy). 2011. Oregon greenhouse gas inventory through 2008. Internet website: http://www.oregon.gov/energy/GBLWRM/pages/portal.aspx. Accessed on May 22, 2012.

_____. 2012. Growing Oregon's Biomass Industry. Oregon's Forest Biomass Strategy. November 01. Available: http://www.oregon.gov/energy/RENEW/Biomass/Pages/forest_biomass_working_group.aspx#2012_Strategy_Development.

Oles, L. 2007. Effectiveness of raptor perch-deterrent devices on power poles for reducing secondary effects on prey species. Bureau of Land Management Resources Note No. 84.

Olson, R. A., and T. D. Whitson. 2002. Restoring structure in late-successional sagebrush communities by thinning with tebuthiron. Restoration Ecology 10: 146-155.

OLMIS. 2010a. Harney County Nonfarm Employment 2010. Internet website: http://www.qualityinfo.org/olmisj/OlmisPortal?zineid=2b. Accessed on June 27, 2014.

_____. 2010b. 2010 Oregon Agricultural Employment Estimates. Internet website: http://www.qualityinfo.org/olmisj/PubReader?itemid=00003093. Accessed on July 27, 2014.

DOE (United States Department of Energy, Division of Geothermal Energy). 2003. Oregon Geothermal Resources, Publication no. INEEL/MIS-2002-1621 Rev. 1, 1 sheet, scale 1:500,000.

ONRR (Office of Natural Resources Revenue). 2012. Personal email communication from Nathan Brannberg, ONRR, to Josh Sidon, BLM, July 26.

Oregon Department of Administrative Services. 2011. Oregon's Demographic Trends. Internet website: http://cms.oregon.egov.com/DAS/OEA/docs/demographic/OR_pop_trend2011.pdf.

Oregon Department of Revenue. 2010. A Summary of Oregon Taxes. Internet website: http://cms.oregon.gov/dor/STATS/docs/oregon-taxes-summary-150-800-401.pdf. Accessed in July 2012.

_____. 2012a. Oregon Property Tax Statistics, Fiscal Year 2011-2012. Internet website: http://cms.oregon.gov/dor/STATS/docs/303-405-12/property-tax-stats_303-405_2011-12.pdf. Accessed in July 2012.

_____. 2012b. Oregon's State Transient Lodging Tax: Program Description, Revenue, and Characteristics of Taxpayers Oregon Property Tax Statistics. Internet website: http://cms.oregon.gov/dor/STATS/docs/state-lodging-report_604-005-12.pdf. Accessed in July 2012.

_____. 2014. Oregon Property Tax Statistics. Fiscal Year 2013-14. Internet website: http://www.oregon.gov/DOR/STATS/Pages/statistics.aspx#property. Accessed on July 28, 2014.

_____. Undated. How Property Taxes Work in Oregon. Internet website: http://www.oregon.gov/DOR/ptd/Pages/property.aspx. Accessed on July 28, 2014.

Oregon Secretary of State. 2012. Oregon's Counties: 2012 Financial Condition Review. Secretary of State Audit Report. Report number 2012-17. Internet website: http://www.sos.state.or.us/audits/pages/state_audits/full/2012/2012-17.pdf.

Oregon State Government. 2012. Western Juniper Utilization Group. Project Designation Letter, Governor John A. Kitzhaber. August 6. Internet webiste: http://orsolutions.org/osproject/juniper.

Oregon State Historic Preservation Office. 2011. Federally Recognized Tribes in Oregon - Cultural Resource Contacts. Internet website: http://www.oregon.gov/OPRD/HCD/ARCH/docs/oregon_federally_recognized_tribes.pdf?ga=t.

Oregon/Washington BLM. 2013. Oregon/Washington BLM Corporate GIS Database. Oregon State Office. Portland, Oregon.

_____. 2014. Oregon/Washington BLM Corporate GIS Database. Oregon State Office. Portland, Oregon.

_____. 2015. Oregon/Washington BLM Corporate GIS Database. Oregon State Office. Portland, Oregon.

ORBIC (Oregon Biodiversity Information Center). 2012. Oregon Biodiversity Information Center – Portland State University. Spatial and Rare Species Data layer available to BLM.

Oregon Department of Agriculture. 2013. Noxious Weed Policy and Classification System.

Oregon Employment Department. 2012. Employment Projections by Industry & Occupation 2010 – 2020. Internet website: http://www.qualityinfo.org/pubs/projections/projections.pdf. Accessed in July 2013.

Oregon Natural Heritage Advisory Council. 2010. Oregon Natural Areas Plan. Oregon Biodiversity Information Center, Institute for Natural Resources—Portland. Portland, Portland State University, Portland, OR. 198pp. Internet website: http://orbic.pdx.edu/documents/2010NAP.pdf. Accessed on September 24, 2013.

Oregon Office of Economic Analysis. 2013. Personal Income: 1990 – 2023. Internet website: http://www.oregon.gov/DAS/OEA/Pages/economic.aspx. Accessed in July 2013.

Oregon Plant Atlas, 2012. Oregon Flora Project, Oregon State University. On Line: http://www.oregonflora.org/atlas.php

Oregon Watershed Enhancement Board. 2004. Oregon Riparian Assessment Framework, Oregon Plan for Salmon and Watersheds, Salem, OR. Internet website: http://www.oregon.gov/OWEB/docs/pubs/or_riparianassessframework.pdf. Accessed on June 9, 2014.

Oregon Water Resourcs Department, OWRD. 2011. Oregon's Intergrated Water Resources Strategy, Oregon Water Resources Department. Discussion Draft, December 22, 2011.

Orr, E. L., W. N. Orr, and E. M. Baldwin. 1992. Geology of Oregon, 4th Edition. Kendall/Hunt Publishing Company.

Ouborg N. J., P. Vergeer, and C. Mix. 2006. The rough edges of the conservation genetics paradigm, Journal of Ecology (2006) 94, 1233–1248.

Paige, C., and S. A. Ritter. 1999. Birds in a sagebrush sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, ID.

Passey, H. B. and V. K. Hugie. 1962. Sagebrush on relic ranges in the Snake River Plains and northern Great Basin. Journal of Range Management 15(5): 273-278.

Patricelli, G. L., J. L. Blickley, and S. L. Hooper. 2013. Recommended management strategies to limit anthropogenic noise impacts on greater sage-grouse in Wyoming. Human–Wildlife Interactions 7(2):230–249, Fall 2013.

Patterson, R. L. 1952. The Sage Grouse in Wyoming. Sage Books, Inc., Denver, CO.

Pellant, M. and C. R. Lysne. 2005. Stratgies to enhance plant structure and diversity in crested wheatgrass seedings. *In*: N. L. Shaw, M. Pellant, and S. B. Monsen, comps. Sage-grouse habitat restoration symposium proceedings. Proceedings RMRS-P-28. Fort Collins CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station: 81-92.

Petersen, C. A. 2012. Cattle Browsing Sagebrush Steppe During Fall: Effects on Plant Community Structure and Influence of Experience on Cattle Foraging Behavior and Body Weights. Masters thesis, Utah State University, Logan.

Peterson, J. G. 1970. The Food Habits and Summer Distribution of Juvenile Sage Grouse in Central Montana The Journal of Wildlife Management, Vol. 34, No. 1, (Jan. 1970), pp. 147-155.

Ponzetti, J. M., B. McCune, and D. A. Pyke. 2007. Biotic soil crusts in relation to topography, cheatgrass and fire in the Columbia Basin, Washington. Bryologist 110:706-722.

Polley, H. W., D. D. Briske, J. A. Morgan, K. Wolter, D. W. Bailey, and J. R. Brown. 2013. Climate change and North American rangelands: trends, projections, and implications. Rangeland Ecology & Management 66:493-511.

Prater, Margaret R., Daniel Obrist, John A. Arnone, III and Evan H. DeLucia. 2006. Net carbon exchange and evapotranspiration in postfire and intact sagebrush communities in the Great Basin. Oecologia 146: 595-607, doi: 10.1007/s00442-005-0231-0.

Prather, Phoebe R. and Terry A. Messmer. 2010. Raptor and Corvid Response to Power Distribution Line Perch Deterrents in Utah. The Journal of Wildlife Management Volume 74, Issue 4, pages 796–800, May 2010.

Prichard, D., H. Barrett, J. Cagney, R. Clark, J. Fogg, Gebhardt, P. L. Hansen, B. Mitchell, and D. Tippy. 1998. Riparian area management: Process for assessing proper functioning condition. Technical Reference 1737-9. Denver, CO: US Department of the Interior, Bureau of Land Management. 58 p. Internet website http://www.blm.gov/nstc/library/techref.htm.

PSC (Public Service Commission of Wisconsin). 2011. Undergound Electric Transmission Lines. Internet website: https://psc.wi.gov/thelibrary/publications/electric/electric11.pdf.

Pyke, D. A. 2011. Restoring and rehabilitating sagebrush habitats. Pp. 531-548 in S. T. Knick and J. W. Connelly (editors). Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. University of California Press. Berkeley, CA.

Pyrah, D. B. 1987. American pronghorn antelope in the Yellow Water Triangle, Montana. Montana Department of Fish, Wildlife and Parks and Bureau of Land Management. 121pp.

Quigley, T. M. and S. J. Arbelbide, eds. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: Volume III. General Technical Report PNW- GTR-405. United States Department of Agriculture, Forest Service, and United States Department of the Interior, Bureau of Land Management.

Radle, A. L. 2007. The effect of noise on wildlife: a literature review. Internet website: http://interact.uoregon.edu/MediaLit/wfae/library/articles/radle_effect_noise_wildlife.pdf.

Rau, B. N., D. W. Johnson, R. R. Blank, R. J. Tausch, B. A. Roundy, R. F. Miller, T. G. Caldwell and A. Lucchesi. 2009. Woodland expansion's influence on belowground carbon and nitrogen in the Great Basin United States Journal of Arid Environments 75: 827-835, doi:10.1016/j.jaridenv.2011.04.005.

Reeves, M. C., A. L. Moreno, K. E. Bagne, and S. W. Running. 2014. Estimating climate change effects on net primary production of rangelands in the United States. Climatic Change 126:29-42.

Reiley, D. K., D. D. Breshears, P. H. Zedler, M. H. Ebinger and C. W. Meyer. 2010. Soil carbon heterogeneity in piñon-juniper woodland patches: effects of woody plant variation on neighboring intercanopies is not detectable. Journal of Arid Environments 74: 239-246, doi:10.1016/j.jaridenv.2009.08.015.

Reisner, M. D., Grace, J. B., Pyke, D. A., Doescher, P. S. 2013, Conditions favouring Bromus tectorum dominance of endangered sagebrush steppe ecosystems. Journal of Applied Ecology. doi: 10.1111/1365-2664.

Remington, T. E., and C. E. Braun. 1985. Sage Grouse Food Selection in Winter, North Park, Colorado, The Journal of Wildlife Management, Vol. 49, No. 4, pp. 1055-1061.

Remington, T. E., and C. E. Braun. 1991. How surface coal mining affects sage grouse, North Park, Colorado. Thorne Ecological Institute. Proceedings, Issues and Technology in the Management of Impacted Western Wildlife 5: 128-132 (not seen; as cited by Manier et al. 2013).

Richards, R. T., J. C. Chambers, and C. Ross. 1998. Use of native plants on federal lands: policy and practice. Journal of Range Management 51:625-632.

Rieman, B. E., and J. D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. US Forest Service, Intermountain Research Station. General Technical Report INT-302.

Rieman, B. E., D. C. Lee and R. F. Thurow. 1997. Distribution, status and likely future trends of bull trout within the Columbia River and Klamath Basins. North American Journal of Fisheries Management 17(4): 1111-1125.

Richardson, B. A., N. L. Shaw, and R. L. Pendleton. 2012. Chapter 4, Plant Vulnerabilities and Genetic Adaptation. In: Climate Change in Grasslands, Shrublands, and Deserts of the Interior American West. USDA / Forest Service. Rocky Mountain Research Station General Technical Report 285. August 2012.

Rishel G. B., J. A. Lynch, E. S. Corbett. 1982. Seasonal stream temperature changes following forest harvesting. J. Environ. Qual. 11:112–116.

Ritchie, M. E., M. L. Wolfe, and R. Danvir. 1994. Predation of artificial sage grouse nests in treated and untreated sagebrush. Great Basin Naturalist 54:122-129.

Romme, William H., Craig D. Allen, John D. Bailey, William L. Baker, Brandon T. Bestelmeyer, Peter M. Brown, Karen S, Eisenhart, M. Lisa Floyd, David W. Huffman, Brian E. Jacobs, Richard F. Miller, Esteban H. Muldavin, Thomas W. Swetnam, Robin J. Tausch and Peter J. Weisberg. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in piñon-juniper vegetation of the western United States. Rangeland Ecology and Management 62: 203-222.

Rosgen, D. 1996. Applied river morphology. Wildlife Hydrology, Pagosa Springs, CO. J. B. Runyon, J. L. Butler, M. M. Friggens, S. E. Meyer, and S. E. Sing. 2012. Chapter 7, Invasive Species and Climate Change, In: Climate Change in Grasslands, Shrublands, and Deserts of the Interior American West. USDA / Forest Service. Rocky Mountain Research Station General Technical Report 285. August 2012.

Rothenmaier, D. 1979. Sage grouse reproductive ecology: breeding season movements, strutting ground attendance and site characteristics and nesting. M.S. thesis. University of Wyoming.

Sada, D. W. and G. L. Vinyard. 2002. Anthropogenic changes in biogeography of Great Basin aquatic biota. Pages 277-293 in R. Hershler, D.B. Madsen, and D.R. Currey (eds.). Great Basin Aquatic Systems History. Smithsonian Contributions to the Earth Sciences, Number 33.

Schemske, D.W., B.C. Husband, M.H. Ruckelshaus, C. Goodwillie, I.M. Parker and J.G. Bishop, 1994. Evaulating approaches to the conservation pf rare and endangered plants. Ecology, 75(3), Ecological Society of America.

Scheinost, P., M. Stannard and T. Prather. 2008. Plant Guide: Ventenata. US Department of Agriculture, Natural Resources Conservation Service. 2 p. Internet website http://plants.usda.gov/core/profile?symbol=VEDU.

Schlaepfer, D. R., W. K. Lauenroth, and J. B. Bradford. 2012. Effects of ecohydrological variables on current and future ranges, local suitability patterns, and model accuracy in big sagebrush. Ecography 35:374-384.

Schlaepfer, D. R., K. A. Taylor, V. E. Pennington, K. N. Nelson, T. E. Martyn, C. M. Rottler, W. K. Lauenroth, and J. B. Bradford. 2015. Simulated big sagebrush regeneration supports predicted changes at the trailing and leading edges of distribution shifts. Ecosphere 6:art3.

Schmelzer, L. 2009. Reducing fuel load of key cheatgrass (Bromus tectorum L.) dominated range sites by the use of fall cattle grazing. Master's Thesis, University of Nevada, Reno.

Schoenberg, T. J. 1982. Sage grouse movements and habitat selection in North Park, Colorado. M.S. thesis. Colorado State University, Fort Collins, Colorado.

Schlaepfer, D. R., W. K. Lauenroth, and J. B. Bradbord. In Press. Natural regeneration processes in big sagebrush (*Artemisia tridentata*). Rangeland Ecology and Management.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage Grouse (*Centrocercus urophasianus*). The birds of North America. No. 425. The Academy of Natural Sciences, Philadelphia, P.A., and The American Ornithologists' Union, Washington, DC.

Schroeder, M. A. and R. K. Baydack. 2001. Predation and the management of prairie grouse. Wildlife Society Bulletin 29:24-32.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. Diebert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North American. Condor 106:363-376.

Seton, E. T. 1927. Lives of Game Animals. Vol. III. Doubleday, Doran & Co., Inc. New York, New York.

Sheley, R. L., J. J. James, M. J. Rinella, D. Blumenthal and J. M. DiTomaso. 2011. Invasive plant management on anticipated conservation benefits: a scientific assessment. *In*: Briske, David D., ed. Conservation benefits of rangeland practices: assessment, recommendations, and knowledge gaps. US Department of Agriculture, Natural Resources Conservation Service: 291-336.

Shepherd, III, J. F. 2006. Landscape-scale habitat use by Greater Sage-Grouse (*Centrocercus urophasianus*) in southern Idaho. Ph.D. dissertation. University of Idaho, Moscow, ID.

Shlisky, A., J. Waugh, P. Gonzalez, M. Gonzalez, M. Manta, H. Santoso, E. Alvarado, A. Ainuddin Nuruddin, D. Arturo Rodríguez-Trejo, R. Swaty, D. Schmidt, M. Kaufmann, R. Myers, A. Alencar, F. Kearns, D. Johnson, J. Smith, and D. Zollner. 2007. Fire, ecosystems and people: Threats and strategies for global biodiversity conservation. The Nature Conservancy Global Fire Initiative Technical Report 2007-2.

Sigler, W. F. and J. W. Sigler. 1987. Fishes of the Great Basin. University of Nevada Press, Reno, pp. 161–162.

Sitz, Angela. 2014. Fish and Wildlife Biologist. US Fish and Wildlife Service, Bend Field Office, Bend, Oregon. Personal communication with Robert Hopper, BLM. November 17, 2014.

Slabbekoorn, H., and E. A. P. Ripmeester. 2008. Birdsong and anthropogenic noise: implications and applications for conservation. Molecular Ecology 17:72-83. doi: 10.1111/j.1365-294X.2007.03487.x.

Slater, S. J., and J. P. Smith. 2010. Effectiveness of raptor perch deterrents on an electrical transmission line in southwestern Wyoming. Journal of Wildlife Management 74:1080-1088.

Soil Survey Staff. 2012. Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for Oregon, Statewide. Internet website: http://soildatamart.nrcs.usda.gov. Accessed on August 14, 2012.

Soulé, P. T., and P. A. Knapp. 1999. Western juniper expansion on adjacent disturbed and near relict sites. Journal of Range Management 52: 525-533.

Soulé, P. T., P. A. Knapp and H. D. Grissino-Mayer. 2004. Human agency, environmental drivers, and western juniper establishment during the late Holocene. Ecological Applications 14(1): 96-112.

State Department (United States Department of State). 2010. Fifth United States climate action report. Washington, DC: Global Publishing Services. 180 p. Internet website: http://www.state.gov/e/oes/rls/rpts/car/index.htm.

State of Oregon EOP. 2002. http://seca.unl.edu/web_archive/StateDroughtPlans/DroughtPlans/OR_2002.pdf

Steenhof, K., M. N. Kochert, and J. A. Roppe. 1993. Nesting by raptors and common ravens on electrical transmission line towers. Journal of Wildlife Management 57:271-281.

Stevens, B. S. 2011. "Impacts of Fences on Greater Sage-Grouse in Idaho: Collision, Mitigation, and Spatial Ecology." Master's thesis, University of Idaho, Moscow, ID.

Still, S. M., and B. A. Richardson. 2015. Projections of contemporary and future climate niche for Wyoming big sagebrush (Artemisia tridentata subsp. wyomingensis): a guide for restoration. Natural Areas Journal 35:30-43.

Stevens, B. S., K. P. Reese, J. W. Connelly, and D. D. Musil. 2012. Greater sage-grouse and fences: Does marking reduce collisions? Wildlife Society Bulletin. 36:297-303.

Stiver, S. J., A. D. Apa, J. R. Bohne, S. D. Bunnell, P. A. Diebert, S. C. Gardner, M. A. Hilliard, C.W. McCarthy, and M. A. Schroeder. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Western Association of Fish and Wildlife Agencies. Unpublished Report, Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming.

Stiver S. J., E. T. Rinkes, and D. E. Naugle. 2010. Sage-grouse Habitat Assessment Framework. United States Bureau of Land Management. Unpublished Report. United States Bureau of Land Management, Idaho State Office, Boise, ID.

_____. 2008b. Conservation Research in the Leslie Gulch ACEC: Population monitoring and seed bank dynamics in Senecio ertterae. Final Report. Prepared by Institute for Applied Ecolgy for Vale District BLM. Corvallis, Oregon.

Strand E. K. and K. L. Launchbaugh. 2013. Livestock Grazing Effects on Fuel Loads for Wildland Fire in Sagebrush Dominated Ecosystems. Great Basin Fire Science Delivery Report– April 2013.

Strand, E. K., K. L. Launchbaugh, R. Limb, and L. A. Torell. 2014. Livestock grazing effects on fuel loads for wildland fire in sagebrush dominated ecosystems. Journal of Rangeland Applications 1: 35-57.

Suring, L. H., M. J. Wisdom, R. J. Tausch, R. F. Miller, M. M. Rowland, L. Schueck, and C. W. Meinke. 2005. Modeling threats to sagebrush and other shrubland communities. Chapter 4 in Part II: Regional assessment of habitats for species of conservation concern in the Great Basin. *In* Wisdom, M.J., M.M. Rowland, and L.H. Suring, editors. Habitat threats in the sagebrush ecosystem: Methods of regional assessment and applications in the Great Basin. Alliance Communications Group, Lawrence, KS, USA: 114-149.

Tait, C. K., J. L. Li, G. A. Lambert, T. N. Pearsons, and H. W. Li. 1994. Relationships between riparian cover and the community structure of high desert streams. The North American Benthological Society 13(1): 45-56.

Taylor, R. T., D. E. Naugle, and L. S. Mills. 2012. Viability analysis for the conservation of sage-grouse populations: Buffalot Field Office, Wyoming. Final Report. 27 February 2012. Prepared for BLM.

Thorpe, A. S., and T. N. Kaye, 2008a. Conservation Research in the Leslie Gulch ACEC: Population monitoring and seed bank dynamics in Senecio ertterae. Final Report. Prepared by Institute for Applied Ecolgy for Vale District BLM. Corvallis, Oregon.

_____. 2008b. Astragalus tyghensis: Actual vs predicted population sizes. 2008 Final Report. Prepared by Institute for Applied Ecolgy for Prineville District BLM. Corvallis, Oregon.

Thorson, T. D., S. A. Bruce, D. A. Lammers, A. J. Woods, J. M. Omerink, J. Kagan, D. E. Pater and J. A. Comstock. 2003. Ecoregions of Oregon. Internet website: http: //www/epa.gov/wed/pages/ecoregions/or_eco.htm.

Thurow, T. L., and C. A. Taylor, Jr. 1999. Viewpoint: the role of drought in range management. Journal of Range Management 52:413-419.

Tisdale, E. W., and M. Hironaka. 1981. The sagebrush-grass ecoregion: a review of the ecological literature. Forest, Wildlife and Range Experiment Station Contribution No. 209. Moscow, ID: University of Idaho.

Toevs, G .R., J. J. Taylor, C. S. Spurrier, W. C. MacKinnon, and M. R. Bobo. 2011. Bureau of Land Management Assessment, Inventory, and Monitoring Strategy: For integrated renewable resources management. Bureau of Land Management, National Operations Center, Denver, CO.

Torell, L. A., J. A. Tanaka, N. Rimbey, T. Darden, L. Van Tassell and A. Harp. 2002. Ranch- level impacts of changing grazing policies on BLM land to protect the Greater Sage-Grouse: Evidence from Idaho, Nevada and Oregon. Policy Analysis Center for Western Public Lands, policy paper SG-01-02, Caldwell, Idaho. BLM 1997.

Torell, L. A, N. Rimbey, J. Tanaka, D. Taylor, J. Ritten, and T. Foulke. 2014. Ranch-Level Economic Impacts of Altering Grazing Policies on Federal Land to Protect the Greater Sage-Grouse.

Union County Commissioners. 2012. Forest Patrol. Internet website: http://www.union-county.org/website.nsf/MasterFrameset?OpenFrameSet&Frame=mainPane&Src=%2Fwebsite.nsf%2FForestPatrol%3FOpenPage%26AutoFramed.

US Census Bureau. 1990 Census of Population. Internet website http://www.census.gov/popest/data/intercensal/st-co/index.html.

_____. 2000 Census of Population. Internet website http://www.census.gov/popest/data/intercensal/st-co/index.html.

_____. 2010a. 2010 Census of Population. Internet website http://2010.census.gov/2010census/data/.

_____. 2010b. Profile of General Population and Housing Characteristics: 2010.

_____. 2010c. American Community Survey, 5-Year Estimates, 2006-2010.

_____. 2010d. State Government Tax Collections Summary Report: 2010. Internet website: http://www.census.gov/prod/2011pubs/g10-stc.pdf.

_____. 2011. 2007-2011 5-year American Community Survey. Internet website: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Accessed on July 27, 2014.

_____. 2012. How the Census Bureau Measures Poverty. Internet website: http://www.census.gov/hhes/www/poverty/about/overview/measure.html.

_____. 2014. County Business Patterns 2012. Internet website: https://www.census.gov/econ/cbp/. Accessed on July 23, 2014.

USDA (United States Department of Agriculture). 2010. USDA Animal and Plant Health Inspection Service, Federal noxious weed list, updated December 10, 2010. http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf.

USDA and DOI (United States Department of Agriculture and Department of the Interior). 2009. Guidance for Implementation of Federal Wildland Fire Management Policy.

USDA ERS (United States Department of Agriculture, Economic Research Service). 2012. Commodity Costs and Returns. Internet website: http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx. Accessed in August 2012.

US Department of Commerce. 2012a. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income & Employment. Internet website: http://www.bea.gov/regional/index.htm.

_____. 2012b. Local Area Personal Income and Employment Methodology. Internet website: http://www.bea.gov/regional/pdf/lapi2010.pdf.

USDI (US Department of the Interior). 1997. Riparian Area Management - Grazing Management for Riparian-Wetland Areas. TR 1737-14. USDI, BLM P. 3.

_____. 1999. National Park Service. Comprehensive Management and Use Plan and Final Environmental Impact Statement, California National Historic Trail, Pony Express National Historic Trail and Management and Use Plan Update-Final Environmental Impact Statement, Oregon National Historic Trail, Mormon Pioneer National Historic Trail.

_____. 2001. Biological Soil Crusts: Ecology and Management. Technical Reference 1730-2. United States Department of the Interior, p. 59.

USFWS (United States Fish and Wildlife Service). 1997. Catlow Redband Trout and Catlow Tui Chub Conservation Agreement and Strategy. US Fish and Wildlife Service. Oregon State Office, Portland OR.

_____. 1998. Recovery plan for the native fishes of the Warner Basin and Alkali Subbasin: Warner sucker (threatened) Catostomus warnerensis, Hutton tui chub (threatened) Gila bicolor ssp. Foskett speckled dace (threatened) Rhinichthys osculus ssp. US Fish and Wildlife Service. Oregon State Office, Portland, OR.

_____. 1999. Final Rule: Endangered and threatened wildlife and plants; ; Determination of Threatened Status for Bull Trout in the Coterminous United States. *Federal Register* 64: 210.

_____. 2004. Species assessment and listing priority assignment form. Columbia spotted frog (Great Basin DPS). US Fish and Wildlife Service. Region 8, Sacramento, CA.

_____. 2009a. Species Fact Sheet, Great Basin Redband Trout, Oncorhynchus mykiss gibbsi. Last updated: August 12, 2009. Internet website: http://www.fws.gov/oregonfwo/Species/Data/GreatBasinRedbandTrout/. Accessed on February 13, 2013.

_____. 2009b. Species Assessment and Listing Priority Form for the Columbia spotted frog (Great Basin DPS).

_____. 2010a. 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered: Notice of 12-month petition findings. Federal Register 75 pp 13910. March 23, 2010.

_____. 2010b. Bull Trout Final Critical Habitat Justification. Chapter 24, Upper Snake Recovery Unit—Malheur River Basin Critical Habitat Unit.

_____. 2010c. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for Bull Trout in the Coterminous United States Fish and Wildlife Service. October 18, 2010. *Federal Register* Vol. 70:63898.

_____. 2012a. Species Fact Sheet, Bull Trout, Salvelinus confluentus. Last updated: July 10, 2012. Internet website: http://www.fws.gov/oregonfwo/Species/Data/BullTrout/. Accessed on September 8, 2012.

_____. 2012b. Developing an Invasive Common Carp Management Plan at Malheur National Wildlife Refuge – A Unique High Desert Ecosystem and Key Stop for Waterfowl on the Pacific Flyway. AFS 2012 Poster Presentation. Internet website: http://www.fws.gov/malheur/pdf/2012_AFS_poster.pdf.

_____. 2013a. Greater Sage-grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. US Fish and Wildlife Service, Denver, CO. February 2013.

_____. 2013b. Species Fact Sheet, Lahontan Cuttroat Trout, Oncorhynchus clarki henshawi. Last updated: February 07, 2013. Internet website: http://www.fws.gov/oregonfwo/Species/Data/LahontanCutthroatTrout/. Accessed on February 13, 2013.

_____. 2013c. Species Fact Sheet, Borax Lake Chub, Gila boraxobius. Last updated: Tuesday, February 05, 2013. Internet website: https://www.fws.gov/oregonfwo/Species/Data/BoraxLakeChub/. Accessed on February 13, 2013.

_____. 2013d. Species Fact Sheet, Warner sucker, Catostomus warnerensis. Last updated: February 05, 2013. Internet website: http://www.fws.gov/oregonfwo/Species/Data/WarnerSucker/. Accessed on February 14, 2013.

_____. 2013e. Species Fact Sheet, Foskett speckled dace, Rhinichthys osculus ssp. Last updated: Tuesday, February 05, 2013.

_____. 2014a. Memorandum: Greater Sage-Grouse: Additional Recommendations to Refine Land Use Allocations in Highly Important Landscapes. October 27, 2014.

_____. 2014b. Greater Sage-Grouse Programmatic Candidate Conservation Agreement with Assurances for Private Rangelands in Harney County, Oregon. US Fish and Wildlife Service Ecological Services Office, Portland, OR. Website (last checked March 13, 2015): http://www.fws.gov/oregonfwo/ToolsForLandowners/HabitatConservationPlans/#Candidate.

US Geological Survey (USGS). 2006. Effects of Fire in the Northern Great Plains; Effects of Fire on Some Undesirable Species. Internet website: http://www.npwrc.usgs.gov/resource/habitat/fire/undesire.htm. Accessed on January 29, 2013.

Vaitkus, M. and L. E. Eddleman. 1987. Composition and productivity of a western juniper understory and its response to canopy removal. Pages 456–460 in R. L. Everett, ed. Proceedings: Pinyon–Juniper Conference. Ogden, UT: USDA Forest Service, General Technical report INT-215.

Vogel, K. P., M. R. Schmer, and R. B. Mitchell. 2005. Plant Adaptation Regions: Ecological and Climatic Classification of Plant Materials. Rangeland Ecology & Management, 58(3): 315-319.

Wachocki, B. A., M. Sondossi, S. C. Sanderson, B. L. Webb, and E. D. McArthur. 2001. Impact of tebuthiron on biodiversity of high elevation mountain big sagebrush communities. In McArthur, E.D. and D.J. Fairbanks, comps. Shrubland ecosystem genetics and biodiversity: proceedings. RMRS-P-21. Ogden, UT: US Department of Agriculture, Forest Service, Rocky Mountain Research Station: 216-223.

WAFWA (Western Association of Fish and Wildlife Agencies). 2008. Greater sage-grouse population trends: An analysis of lek count databases 1965-2007. Sage- and Columbian Sharp-tailed grouse Technical Committee, unpublished report. 126pp.

Walker, B. L., and D. E. Naugle. 2011. West Nile virus ecology in sagebrush habitat and impacts on greater sage-grouse populations. Pages 127-144 in S. T. Knick and J. W. Connelly (editors). Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. University of California Press, Berkeley, CA.

Walker, B. L., D. E. Naugle, and K. E. Doherty. 2007. "Greater sage-grouse population response to energy development and habitat loss." Journal of Wildlife Management 71(8):2644-2654.

Wallstead, R. O. 1971. Summer Movements and Habitat Use by Sage Grouse Broods in Central Montana The Journal of Wildlife Management, Vol. 35, No. 1: pp 129-136.

Wallestad, R., and P. Schladweiler. 1974. Breeding season movements and habitat selection of male Sage Grouse. Journal of Wildlife Management 38:634-637.

Washington Deptartment of Fish and Wildlife (WDFW). 2013. Aquatic Invasive Species: Cyprinus carpio carpio (Common carp). Web site: http://wdfw.wa.gov/ais/cyprinus_carpio_carpio/

WECC (Western Electricity Coordinating Council). 2012. Capital Costs for Transmission and Substations. Recommendations for WECC Transmission Expansion Planning. Internet website: http://www.wecc.biz/committees/BOD/TEPPC/External/BV_WECC_TransCostReport_Final.pdf. Accessed on June 04, 2014.

Westbrooks, R. 1998. Invasive plants, changing the landscape of America: Fact book. Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW). Washington, DC.

WGA (Western Governors' Association). 2006. Clean and Diversified Energy Initiative, Geothermal Task Force Report. January. Internet website: http://www.westgov.org/wga/initiatives/cdeac/Geothermal-full.pdf. Accessed in January 2009.

White, E., D. Goodding and D. Stynes. 2013. Estimation of National Forest Visitor Spending Averages From National Visitor use Monitoring: Round 2. USDA Forest Service, General Technical Report PNW-GTR-883. May.

Wyoming Game and Fish Department (WGFD). 2011. Wyoming Game and Fish Department Protocols for Treating Sagebrush to Benefit Sage-Grouse. Unpublished report.

The White House. 2013. The President's Climate Action Plan.

White, Eric M., and Darren Gooding. 2012. Estimation of National Forest Visitor Spending Averages from National Visitor Use Monitoring Round 2. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR: United States Department of Agriculture, Forest Service. Pacific Northwest Research Station. 98 pages.

Wiken, E., F. J. Nava, and G. Griffith. 2011. North American Terrestrial Ecoregions-Level III. US Department of the Interior, Bureau of Land Management. 2010.

Wilcove, D.S., D. Rothstein, and J. Dubow. 1998. Quantifying threats to imperiled species in the United States. Bioscience, Vol. 78 (8). Pp. 607-615. University California Press.

Williams, J. E., and C. D. Williams. 1981. Distribution and status of fishes of the genus Gila (Cyprinidae) in the northwestern Great Basin. Cal-Neva Wild. Trans., pp. 19-24.

Williams, J. E., J. E. Johnson, D. A. Hendrickson, S. Contreras-Balderas, J. D. Williams, M. Navarro-Mendoza, D. E. McAllister, and J. E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. Fisheries 14 (6):2-20.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive management: the US Department of the Interior Technical Guide. US Department of the Interior, Adaptive Management Working Group, Washington, DC. Internet website: http://www.doi.gov/ppa/Adaptive-Management.cfm.

Williams, M. I., G. B. Paige, T. L. Thurow, A. L. Hild, and K. G. Gerow. 2011. Songbird relationships to shrubsteppe ecological site characteristics. Rangeland Ecology & Management 64:109-118.

Winward A.H. 2004. Sagebrush of Colorado. Taxonomy, distribution, ecology and management. Colorado Division of Wildlife. Department of Natural Resources. Denver, CO.

Wisdom, M. J., C. W. Meinke, S. T. Knick, and M. A. Schroeder. 2011. Factors associated with extirpation of Sage-Grouse. Pp. 451-472 in S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Wissmar, Robert C.; Smith, Jeanette E.; McIntosh, Bruce A.; Li, Hiram W.; Reeves, Gordon H.; Sedell, James R. 1994. Ecological health of river basins in forested regions of eastern Washington and Oregon. Gen. Tech. Rep. PNW-GTR-326. Portland, OR: United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Workman, J. P. 1986. Range Economics. New York: Macmillan.

Wulfhorst, J. D., N. Rimbey, and T. Darden. 2006. Sharing the Rangelands, Competing for Sense of Place. American Behavioral Scientist, V. 50, N. 2. October.

Yoakum, J. 1968. A review of the distribution and abundance of American pronghorn antelope. Antelope States Workshop 1968 Proceedings 3:4-14.

Yoakum, J. D. 2004. Foraging ecology, diet studies, and nutrient values. Pages 447-502 in Pronghorn: ecology and management. O'Gara, B. W. and J. D. Yoakum, (eds.). University Press of Colorado. Boulder, Colorado. 903 pp.

Ziska, L. H., J. B. Reeves, III, B. Blank. 2005. The impact of recent increases in atmospheric CO_2 on biomass production and vegetative retention of cheatgrass (*Bromus tectorum*): implications for fire disturbance. Global Change Biology 11(8): 1325-1332.

7.2 References and Personal Communications for Section 5.3, Greater Sage-Grouse Cumulative Effects Analysis: Oregon Sub-Region

References

Arkle R. S., D. S. Pilliod, S. E. Hanser, M. L. Brooks, J. C. Chambers, J. B. Grace, K. C. Knutson, et al. 2014. "Quantifying restoration effectiveness using multi-scale habitat models: implications for sage-grouse in the Great Basin." *Ecosphere* 5 (3): pp. 1-32.

Baker, W. L., 2011. Pre- Euro-American and recent fire in sagebrush ecosystems, *in* Knick, S. T. and Connelly, J. W., eds., Greater sage-grouse: ecology and conservation of a landscape species: Berkeley, Calif., University of California Press, p. 185–202.

Balch, J. K., B. A. Bradley, C. M. D'Antonio and J. Gómez-Dans. 2012. Introduced annual grass increases regional fire activity across the arid western USA (1980-2009). Global Change Biology 19: 173-183.

Bartmann, R. M., G. C. White, L. H. Carpenter, and R. A. Garrott. 1987. Aerial mark-recapture estimates of confines mule deer in pinyon-juniper woodland: Journal of Wildlife Management, v. 51, p. 41–46.

Baruch-Mordo, S., J. S. Evans, J. P. Severson, D. E. Naugle, J. D. Maestas J. M. Kiesecker, M. J. Falkowski , C. A. Hagen, K. P. Reese. 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. Biological Conservation 167: 233-241.

Beck, J. L., and D. L. Mitchell. 2000. "Influences of livestock grazing on sage grouse habitat." *Wildlife Society Bulletin* 28:993-1002.

Beever, E. A. 1999. Species- and community-level responses to disturbance imposed fy feral horse grazing and other management practices. Dissertation, University of Nevada, Reno.

_____. 2003. Commentary: Management implications of the ecology of free-roaming horses in semi-arid ecosystems of the western United States. Wildlife Society Bulletin 31(3):887-895.

Beever, E. A., and C. L. Aldridge. 2011. Influences of free-roaming equids on sagebrush ecosystems, with focus on greater sage-grouse, *in* Knick, S.T., and Connelly, J.W,. eds., Studies in avian biology, no.38: University of California Press, Berkeley, Cooper Ornithological Union, p. 273–291.

Beever, E. A. and P. F. Brussard. 2000. Examining Ecological Consequences of Feral Horse Grazing using Exclosures. Western North American Naturalist: 60(3) pp. 236-254.

Beever, E. A., R. J. Tausch, and P. F. Brussard. 2003. Characterizing disturbance in semiarid ecosystems across broad spatial scales using multiple indices. Ecological Applications 13:113-136.

Bend Bulletin. 2015. Online news article: Two solar arrays proposed east of Bend. Published April 14, 2015.

Blank, R.R., R.H. White, and L.H. Ziska. 2006. Combustion properties of Bromus tectorum L.: influence of ecotype and growth under four CO2 concentrations. International Journal of Wildland Fire 15: 227-236.

BLM (US Department of the Interior, Bureau of Land Management). 1991. Record of Decision Environmental Impact Statement for Vegetation Treatment on BLM Lands in Thirteen Western States. BLM, Wyoming State Office. Cheyenne, Wyoming.

____. 1997. Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the Bureau of Land Management in the States of Oregon and Washington. Bureau of Land Management. August 1997. Internet website: http://www.blm.gov/or/resources/recreation/csnm/files/rangeland_standards.pdf_____.____2002. Management Considerations for Sagebrush (Artemisia) in the Western United States: a selective summary of current information about the ecology and biology of woody North American sagebrush taxa. Washington, D.C.

_____. 2002. Management Considerations for Sagebrush (Artemisia) in the Western United States: a selective summary of current information about the ecology and biology of woody North American sagebrush taxa. Washington, DC.

_____. 2007. Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report. June 2007, FES 07-21. BLM. Reno, Nevada and Washington, DC. Internet website: www.blm.gov/wo/st/en/prog/more/veg_eis.html.

_____. 2008. Record of Decision for the Sage Steppe Ecosystem Restoration Strategy. BLM Eagle Lake Field Office. BLM/CA/ES-2009-005+1973. December 15, 2008.

_____. 2010. Final Environmental Impact Statement for Vegetation Treatments Using Herbicides on BLM Lands in Oregon. USDI, Bureau of Land Management, Portland, Oregon. Internet website: www.blm.gov/or/plans/vegtreatmentseis/

_____. 2013a. Interagency Standards for Fire and Fire Aviation Operations. US Department of the Interior, Bureau of Land Management. Washington, DC.

_____. 2013b. BLM Burns District Greater Sage-Grouse Fence Collision Analysis. Produced by The Nature Conservancy of Oregon. BLM Cooperative Areement No. L12AC20615, 2012. August 26, 2013.

_____. 2013c. Long Draw/Miller Homestead Fire Review. Vale and Burns Districts. April 2013.

_____. 2015. Geographic Information Systems (GIS) Data. National Operations Center, Denver, Colorado.

BLM (United States Department of the Interior, Bureau of Land Management) and Forest Service (United States Department of Agriculture, Forest Service). 2008. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States, Volume 1, II, III: Programmatic Analysis, Publication no.-FES 08-44.

Bradley, B. A. 2010. Assessing ecosystem threats from global and regional change: hierarchical modeling of risk to sagebrush ecosystems from climate change, land use and invasive species in Nevada, USA. Ecography 33: 198-208, doi: 10.1111/j.1600-0587.2009.05684.x

Braun, C. E. 1998. Sage Grouse declines in western North America: what are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies 78: 139-156.

Chambers, J. C., D. A. Pyke, J. D. Maestas, M. Pellant, C. S. Boyd, S. B. Campbell, S. Espinosa, D. W. Havlina, K. E. Mayer, and A. Wuenschel. 2014. Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach. USDA Forest Service Rocky Mountain Research Station. General Technical Report RMRS-GTR-326. September 2014.

Clark, L., J. Hall, R. McLean, M. Dunbar, K. Klenk, R. Bowen, and C. A. Smeraski. 2006. Susceptibility of Greater Sage-Grouse to experimental infection with West Nile virus: Journal of Wildlife Diseases, v. 42, p. 14–22.

Coates, P. S. 2007. "Greater sage-grouse (*Centrocercus urophasianus*) nest predation and incubation behavior." Doctoral dissertation, Idaho State University, Pocatello.

Coates, P. S., K. B. Howe, M. L. Casazza, and D. J. Delehanty. 2014. Common raven occurrence in relation to energy transmission line corridors transiting human-altered sagebrush steppe. Journal of Arid Environments 111:68–78.

Connelly, J. W., and L. A. Doughty, eds. 1989. Sage grouse use of wildlife water developments in southeastern Idaho: Boise, Idaho.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies.

Copeland, H. E., A. Pocewicz, D. E. Naugle, T. Griffiths, D. Keinath, J. Evans, J. Platt. 2013. "Measuring the effectiveness of conservation: A novel framework to quantify the benefits of sage-grouse conservation policy and easements in Wyoming. *PLoS ONE* 8(6): e67261. Doi:10.1371/journal.pone.0067261.

Council on Environmental Quality. 1997. Considering Cumulative Impacts under the National Environmental Policy Act. January 1997.

County of Elko. 2012. Elko County, Nevada Greater Sage Grouse Management and Conservation Strategy Plan. Division of Natural Resource Management. September 19, 2012. 179 pp.

County of Lake. 2015. Solar. Internet website: http://www.lakecountyor.org/government/solar_projects/index.php. Accessed on April 15, 2015.

Davies K. W., C. S. Boyd, J. L. Beck, J. D. Bates, T. J. Svejcar, M. A. Gregg. 2011. "Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities." *Biological Conservation* 144:2573-2584.

Davies, K. W., Bates, J. D., Svejcar, T. J., and Boyd, C. S. 2010. Effects of long-term livestock grazing on fuel characteristics in rangelands: An example from the sagebrush steppe. *Rangeland Ecology & Management, 63*(6), 662-669. doi:10.2111/REM-D-10-00006.1

Dobkin, D. S., A. C. Rich, and W. H. Pyle. 1998. Habitat and avifaunal recovery from livestock grazing in a riparian meadow system of the northwestern Great Basin: Conservation Biology, v. 12, p. 209–221.

Doherty, K. E., J. L. Beck, and D. E. Naugle. 2011. Comparing Ecological Site Descriptions to Habitat Characteristics Influencing Greater Sage-Grouse Nest Site Occurrence and Success. Rangeland Ecol Manage. 64:344-351. July 2011.

FICMNEW (Federal Interagency Committee for the Management of Noxious and Exotic Weeds). 2003. A National Early Detection and Rapid Response System for Invasive Plants of the United States. Washington, DC. September 2003.

Fischer, R. A., K. P. Reese, and J. W. Connelly. 1996. Influence of vegetal moisture content and nest fate on timing of female sage grouse migration. *The Condor*, Vol. 98:868-872.

Finch, W. I. 1996. Uranium provinces of North America—Their definition, distribution and models: Department of Energy, 24 p.

Fire and Invasive Assessment Team. 2014. Greater Sage-Grouse Wildfire, Invasive Annual Grasses and Conifer Expansion Assessment (Fire and Invasives Assessment Tool [FIAT]). June 2014.

Forman, R. T. T. and L. E. Alexander. 1998. "Roads and their major ecological effects." *Annual Review of Ecology and Systematics*. 29:207–31.

Garton, E. O., J. W. Connelly, J. S. Horne, C. A. Hagen, A. Moser, and M. Schroeder. 2011. "Greater sage-grouse population dynamics and probability of persistence." Pp. 293-381. *In:* S. T. Knick and J. W. Connelly (eds.), Greater Sage-Grouse: Ecology of a Landscape Species and Its Habitats. Cooper Ornithological Union, University of California Press, Berkeley.

Garton, E. O., A. G. Wells, J. A. Baumgardt and J. W. Connelly. 2015. Greater Sage-Grouse Population Dynamics and Probability of Persistence. Final Report to Pew Charitable Trusts. March 18, 2015.

George, M. R., R. D. Jackson, C. S. Boyd, K. W. Tate. 2011. "A scientific assessment of the effectiveness of riparian management practices. *In:* D. D. Briske (ed.), Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps. Washington, DC: USDA-NRCS. Pp. 213-252.

Gillen, R. L., W. C. Krueger, and R. F. Miller. 1984. "Cattle distribution on mountain rangeland in northeastern Oregon." *Journal of Range Management* 37:549-553.

Gregg, M. A., J. A. Crawford, M. S. Drut, and A. K. DeLong. 1994. "Vegetation cover and predation of sage grouse nests in Oregon." *Journal of Wildlife Management* 58(1):162-166.

Greater Sage-Grouse Habitat Conservation Advisory Council. 2014. Montana's Greater Sage-Grouse Habitat Conservation Strategy.

Hagen, C. 2011. *Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitat.* Oregon Department of Fish and Wildlife, Bend, OR. April 22, 2011. 207 pp.

Hall, F. C., and L. Bryant. 1995. Herbaceous stubble height as a warning of impending cattle grazing damage to riparian areas: Portland, Oreg., USDA Forest Service, Pacific Northwest Research Station, PNW-GTR-362.

Hanley, T. A. and K. A. Hanley. 1982. Food resource partitioning by sympatric ungulates on Great Basin rangeland. Journal of Range Management 35:152–158.

Hockett, G. A. 2002. Livestock Impacts on the Herbaceous Components of Sage Grouse Habitat: A Review. Intermountain Journal of Sciences. 8(2) 105-114.

Holloran, M. J. 2005. "Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming." Thesis. University of Wyoming Department of Zoology and Physiology, Laramie.

Homer, C. G., Xian, G., Aldridge, C. L., Meyer, D. K., Loveland, T. R., and O'Donnell, M. S. 2015. Forecasting sagebrush ecosystem components and greater sage-grouse habitat for 2050: Learning from past climate patterns and Landsat imagery to predict the future. Ecological Indicators 55:131–145.

Howe, K. B., P. S. Coates, and D. J. Delehanty. 2014. Selection of anthropogenic features and vegetation characteristics by nesting Common Ravens in the sagebrush ecosystem. The Condor, 116(1):35-49.

Hull, S. D., R. J. Robel, and K. E. Kemp. 1996. Summer avian abundance, invertebrate biomass, and forbs in Kansas CRP: Prairie Naturalist, v. 28, p. 1–12.

IDL (Idaho Department of Lands). 2015. Proposed Greater Sage-Grouse Conservation Plan. Draft. February 11, 2015. 33 pp.

Idaho Sage-Grouse Advisory Committee. 2006. Conservation plan for the Greater Sage-Grouse in Idaho.

Jamison, B. E., R. J. Robel, J. S. Pontius, and R. D. Applegate. 2002. Invertebrate biomass: associations with lesser prairie-chicken habitat use and sand sagebrush density in southwestern Kansas: Wildlife Society Bulletin, v. 30, p. 517–526.

Knapp, P.A., P.T. Soulé, H.D. Grissino-Mayer. 2001. Detecting potential regional effects of increased atmospheric CO2 on growth rates of western juniper. Global Change Biology 7: 903-917.

Knick, S. T. 2011. "Historical development, principal federal legislation and current management of sagebrush habitats: Implications for conservation." Pp. 13-32. *In:* S. T. Knick and J.W. Connelly (eds.), Greater Sage-Grouse: Ecology of a Landscape Species and Its Habitats. Cooper Ornithological Union, University of California Press, Berkeley.

Knick, S. T., and S. E. Hanser. 2011. "Connecting pattern and process in greater sage-grouse populations and sagebrush landscapes." Pp. 383-406. *In:* S. T. Knick and J.W. Connelly (eds.), Greater Sage-Grouse: Ecology of a Landscape Species and Its Habitats. Cooper Ornithological Union, University of California Press, Berkeley.

Knick, S. T., S. E. Hanser, R. F. Miller, D. A. Pyke, M. J. Wisdom, S. P. Finn, E. T. Rinkes, and C. J. Henny. 2011. "Ecological influence and pathways of land use in sagebrush." *In:* S. T. Knick and J. W. Connelly (eds.), Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and its Habitats. *Studies in Avian Biology* Vol. 38:203-251. University of California Press, Berkeley.

Laycock, W. A. 1978. Factors affecting choice of management strategies within the sagebrush ecosystem United States, *Artemisia tridentata*, *in* The sagebrush ecosystem: a symposium: Logan, Utah State University, College of Natural Resources, p. 230–236.

Leu, M., S. E. Hanser, and S. T. Knick. 2008. The human footprint in the West: a large-scale analysis of anthropogenic impacts. Ecological Applications 18:1119-1139.

Manier, D. J., D. J. A. Wood, Z. H. Bowen, R. M. Donovan, M. J. Holloran, L. M. Juliusson, K. S. Mayne, et al. 2013. Summary of Science, Activities, Programs and Policies that Influence the Range-Wide Conservation of Greater Sage-Grouse (*Centrocercus urophasianus*). US Geological Survey Open-File Report 2013-1098, Fort Collins, Colorado.

Manly, B. F., J. L. McDonald, D. L. Thomas, T. L. McDonald, and W. P. Erickson. 2002. Resource selection by animals: statistical design and analysis for field studies. Chapman and Hall, London, UK.

McLean, R. G. 2006. West Nile virus in North American birds: Ornithological Monographs, v. 60, p. 44–64.

Menard, C., P. Duncan, G. Fleurance, J. Georges, and M. Lila. 2002. Comparative foraging and nutrition of horses and cattle in European wetlands. Journal of Applied Ecology 39:120-133.

Miller, R. F., R. J. Tausch, E. D. McArthur, D. D. Johnson, and S. C. Sanderson. 2008. Age Structure and Expansion of Pinon-Juniper Woodlands: A Regional Perspective in the Intermountain West. USDA Forest Service. RMRS-RP-69.

Montana Sage Grouse Working Group. 2005. Management Plan and Conservation Strategies for Sage Grouse in Montana-Final. Revised February 1, 2005.

Mountain Home Air Force Base. 2012. Integrated Natural Resources Management Plan for Mountain Home Air Force Base, Small Arms Range, Saylor Creek Air Force Range, Juniper Butte Range, and other Mountain Home Range Complex Sites. June 2012. Internet website: http://www.mountainhome.af.mil/shared/media/document/AFD-120824-035.pdf. Accessed on September 25, 2012.

Mueggler, W. F. 1950. Effects of spring and fall grazing by sheep on vegetation of the upper snake river plains: Journal of Range Management, v. 3, p. 308–315.

Naugle, D.E., Aldridge, C.L., Walker, B.L., Cornish, T.E., Moynahan, B.J., Holloran, M.J., Brown, K., Johnson, G.D., Schmidtmann, E.T., Mayer, R.T., Kato, C.Y., Matchett, M.R., Christiansen, T.J., Cook, W.E., Creekmore, T., Falise, R.D., Rinkes, E.T., and Boyce, M.S. 2004. West Nile virus—Pending crisis for Greater Sage-Grouse: Ecology Letters, v. 7, p. 704–713.

Naugle, D.E., Aldridge, C.L., Walker, B.L., Doherty, K.E., Matchett, M.R., McIntosh, J., Cornish, T.E., and Boyce, M.S. 2005. West Nile virus and sage-grouse—What more have we learned?: Wildlife Society Bulletin, v. 33, p. 616–623.

Naugle, D. E., K. E. Doherty, B. L. Walker, M. J. Holloran, and H. E. Copeland. 2011. "Energy development and greater sage-grouse." Pp. 489-504. *In:* S. T. Knick and J. W. Connelly (eds.), Greater Sage-Grouse: Ecology of a Landscape Species and Its Habitats. Cooper Ornithological Union, University of California Press, Berkeley.

NDA (Nevada Department of Agriculture). 2013. Letter from Director Jim Barbee. RE: Justification for increase of Pesticide Registration Fee NAC 586.011. February 19, 2013.

Neilson, R. P., J. M Lenihan, D. Bachelet, and R. J. Drapek. 2005. Climate change implications for sagebrush ecosystems. Transactions of the North American Wildlife and Natural Resources Conference 70:145-159.

Nelle, P. J., K. P. Reese, and J. W. Connelly. 2000. "Long-term effects of fire on sage grouse habitat." *Journal of Range Management* 53(6):586-591.

NRCS. 2012. Applying the Sage-Grouse Fence Collision Risk Tool to Reduce Bird Strikes. NRCS/CEAP Conservation Insight Publication. November 2012. Internet website: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1049415.pdf.

_____. 2015. Outcomes in Conservation: Sage Grouse Initiative. February 2015. http://www.sagegrouseinitiative.com/wp-content/uploads/2015/02/ NRCS_SGI_Report.pdf

NREL (National Renewable Energy Laboratory). 2015. Solar Maps. Updated February 2, 2015. Internet website: http://www.nrel.gov/gis/solar.html. Accessed on April 14, 2015.

NTT (National Technical Team). 2011. *A Report on National Greater Sage-Grouse Conservation Measures*. Produced by the Sage-Grouse National Technical Team. December 21, 2011.

OCCRI (Oregon Climate Change Research Institute). 2010. Oregon Climate Assessment Report, K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR.

Owens, M. K., and B. E. Norton. 1990. Survival of juvenile basin sagebrush under different grazing regimes: Journal of Range Management, v. 43, p. 132–135.

Owyhee County. 2013. Sage-Grouse Management Plan, Owyhee County, Idaho. April 8, 2013.

Pyke, D. A. 2011. Restoring and rehabilitating sagebrush habitats. Pp. 531-548 *in* S. T. Knick and J. W. Connelly (eds). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, CA.

Pyle, W. J., and J. A. Crawford. 1996. "Availability of foods of sage grouse chicks following prescribed fire in sagebrush-bitterbrush." *Journal of Range Management* 49(4):320-324.

Renewable Northewest Project. 2015. Renewable Energy Projects Database and Map. Internet website: http://www.rnp.org/project_map?field_project_state_value%5B%5D=OR&tid%5B%5D=9&field_project_opstatus_value%5B%5D=Approved&field_project_opstatus_value%5B%5D=Proposed&field_project_opstatus_value%5B%5D=Operating&field_project_opstatus_value%5B%5D=In+Permitting+Process&field_project_opstatus_value%5B%5D=Under+Construction. Accessed on April 15, 2015.

Reisner, M. D., J. B. Grace, D. A. Pyke, and P. S. Doescher. 2013. "Conditions favoring *Bromus tectorum* dominance of endangered sagebrush steppe ecosystems." *Journal of Applied Ecology* 50:1039-1049.

Rickard, W. H. 1970. Ground-dwelling beetles in burned and unburned vegetation. Journal of Range Management. 23:293-294.

SETT (Sagebrush Ecosystem Technical Team). 2014. 2014 Nevada Greater Sage-Grouse Conservation Plan. October 1, 2014. 213 pp.

Sage-Grouse Conservation Team. 2004. Greater Sage-Grouse Conservation Plan for Nevada and Eastern California, First Edition. June 30, 2004.

State of Montana. 2014. Executive Order (No. 10-2014) Creating the Montana Sage Grouse Oversight Team and the Montana Sage Grouse Habitat Conservation Program. Office of the Governor. September 9. Internet website: governor.mt.gov/Portals/16/docs/2014EOs/EO_10_2014_SageGrouse.pdf.

Stevens, B. 2011. *Impacts of fences on Greater Sage-Grouse in Idaho: Collision, Mitigation, and spatial ecology*. Masters Thesis, University of Idaho.

Stevens, B. S., K. P. Reese, and J. W. Connelly. 2011. "Survival and detectability bias of avian fence collision surveys in sagebrush steppe." *Journal of Wildlife Management* 75(2):437-449.

Stiver, S. J. 2011. "The legal status of greater sage-grouse: Organizational structure of planning efforts." Pp. 33-49. *In:* S. T. Knick and J. W. Connelly (eds.) Greater Sage-Grouse: Ecology of a Landscape Species and Its Habitats. Cooper Ornithological Union, University of California Press, Berkeley.

Stiver, S. J., A. D. Apa, J. R. Bohne, S. D. Bunnell, P. A. Diebert, S. C. Gardner, M. A. Hilliard, et al. 2006. Greater Sage-Grouse Comprehensive Conservation Strategy. Western Association of Fish and Wildlife Agencies. Cheyenne, Wyoming.

Strand E. K., and K. L. Launchbaugh. 2013. Livestock Grazing Effects on Fuel Loads for Wildland Fire in Sagebrush Dominated Ecosystems. Great Basin Fire Science Delivery Report. April 2013.

Strand, E. Launchbaugh, K.L., Limb, R., and Torell, L.A. 2014. Livestock grazing effects on fuel loads for wildland fire in sagebrush dominated ecosystems. Journal of Rangeland Management (1):35-57.

Strawberry Valley Adaptive Resource Management Local Working Group (SVARM). 2006. Strawberry Valley Greater Sage-grouse *(Centrocercus urophasianus)* Local Conservation Plan. Utah State University Extension and Jack H. Berryman Institute and Utah Division of Wildlife Resources. Salt Lake City, Utah. Unpublished report.

Torregrosa, A., and N. Devoe. 2008. Urbanization and Changing Land Use in the Great Basin. USDA Forest Service General Technical Report RMRS-GTR-204. 13 pp.

USFWS. 2010. Endangered and Threatened Wildlife and Plants; 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered. P. 107. *In:* Fish and Wildlife Service, Department of the Interior (ed.), FWS R6-ES-2010-0018. *Federal Register*, Washington, DC.

_____. 2013a. Greater Sage-Grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. US Fish and Wildlife Service, Denver, Colorado. February 2013.

_____. 2013b. Greater Sage-Grouse Programmatic Candidate Conservation Agreement for Rangeland Management Practices on Bureau of Land Management Lands in Oregon. Agreement Number BLM-OR932-1235. Developed Cooperatively by the: Oregon Cattlemen's Association, BLM, and USFWS. May 30, 2013.

_____. 2013c. Draft Environmental Assessment for A Greater Sage-Grouse Programmatic Candidate Conservation Agreement with Assurances for Private Rangelands in Harney County, Oregon. December 13, 2013.

USGS (US Geological Service). 2014. Sage-grouse Local Working Group Locator. Internet website: http://greatbasin.wr.usgs.gov/LWG/. Accessed on May 15, 2015.

UDWR (Utah Department of Natural Resources, Division of Wildlife Resources). 2009. Utah Greater Sage-grouse Management Plan. Utah Department of Natural Resources, Division of Wildlife Resources, Publication 09-17, Salt Lake City, Utah, USA.

Utah Greater Sage-Grouse Working Group. 2013. Conservation Plan for Greater Sage-Grouse in Utah. February 14, 2013. 68 pp. + figures.

Vance, L. K., and D. Stagliano. 2007. Watershed Assessment of Portions of the Lower Musselshell and Fort Peck Reservoir Sub-Basins. Report to the Bureau of Land Management, Billings, Montana. Montana Natural Heritage Program, Helena.

Van Poolen, H. W., and J. R. Lacey. 1979. Herbage response to grazing systems and stocking intensities: Journal of Range Management, v. 32, p. 250–253.

Walker, B. L., and D. E. Naugle. 2011. "West Nile virus ecology in sagebrush habitat and impacts on greater sage-grouse populations." *In:* S. T. Knick and J. W. Connelly (eds.), Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and its Habitats. *Studies in Avian Biology* Vol. 38:127-144. University of California Press, Berkeley.

Western Area Power Administration (WAPA). 2013. Upper Great Plains Wind Energy programmatic Environmental impact Statement (Draft). DOE/EIS-0408. March 2013.

West, N. E., and T. P. Yorks. 2002. Vegetation responses following wildfire on grazed and ungrazed sagebrush semi-desert: Journal of Range Management, v. 55, p. 171–181.

West, N. E., and J. A. Young. 2000. Intermountain valleys and lower mountain slopes, *in* Barbour, M.G., and Billings, eds., North American terrestrial vegetation (2nd ed.): New York, Cambridge University Press, p. 256–284.

Wisdom, M. J., C. W. Meinke, S. T. Knick and M. A. Schroeder. 2011. Factors associated with extirpation of sage-grouse. Pp. 451-474 *in* S. T. Knick and J. W. Connelly (eds). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, CA.

Young, J. A., and R. A. Evans. 1978. Population dynamics after wildfires in sagebrush grasslands: Journal of Range Management, v. 31, p. 283–289.

Ziska, L.H., J.B. Reeves, III, and B. Blank. 2005. The impact of recent increases in atmospheric CO2 on biomass production and vegetative retention of cheatgrass (Bromus tectorum): implications for fire disturbance. Global Change Biology 11: 1325-1332.

Personal Communications

Barnes, Timothy. BLM Oregon/Washington Office. Phone call with author, March 25, 2015.

_____. BLM Oregon/Washington Office. Email with author, March 26, 2015.

Budeau, D. Oregon Department of Fish and Wildlife. Phone conversation with author, March 26, 2015.

_____. Oregon Department of Fish and Wildlife. Email with author, March 26, 2015.

Everett, Jeff. Wildlife Biologist, USFWS Oregon Fish & Wildlife Office, Portland Oregon. Phone conversation with author. April 16, 2015.

Everett, Jeff. Wildlife Biologist, USFWS Oregon Fish & Wildlife Office, Portland Oregon. Email with author. April 16, 2015.

Hopper, Bob. BLM Oregon/Washington Office. Phone conversation with author, April 13, 2015.

Appendix H

Fire and Invasives Assessment Tool

APPENDIX H
FIRE AND INVASIVES ASSESSMENT TOOL

In the Great Basin Region (WAFWA Management Zones III, IV, and V), the US Fish and Wildlife Service (2013a) identified wildfire as a primary threat to Greater Sage-Grouse (GRSG) and its habitat. In particular, it identified wildfire in response to invasive annual grasses and conifer expansion. The Fire and Invasives Assessment Tool (FIAT) (Fire and Invasive Assessment Team 2014) provides the BLM and other land management agencies with a framework for prioritizing wildfire management and GRSG habitat conservation.

Supported by US Forest Service General Technical Report 326 (Chambers et. al. 2014c; see **Attachment 1**), FIAT provides the BLM and other agencies with a mechanism to collaboratively identify and prioritize areas within GRSG habitat for potential treatment based on their resistance and resilience characteristics. In the cold desert ecosystem typical throughout the Great Basin, soil moisture and temperature fundamentally influence a landscape's ability to resist environmental change. These factors also influence the landscape's ability to be resilient after long-term ecosystem shifts following a disturbance event, such as wildfire. Low resistance and resilience landscapes are typically characterized by low elevations, south-facing slopes, and porous soils. These areas will likely respond differently to fuels management, wildfire, and subsequent rehabilitation compared to more resistant and resilient landscapes, such as those at higher elevations or on north-facing slopes.

At the resource management planning level, FIAT consists of the following parts:

- The identification of areas at the landscape level, based on national datasets and scientific literature, where the threat to GRSG and its habitat from conifer expansion and wildfire/invasive annual grass is highest.
- The identification of regional and local areas where focused wildfire and habitat management is critical to GRSG conservation efforts.

- The identification of overarching management strategies for conifer expansion and invasive annual grasses in the areas of habitat recovery/restoration, fuels management, fire operations, and post-fire emergency stabilization and rehabilitation (ESR).

Attachment 2 outlines the FIAT landscape-level framework and describes the anticipated process for implementing the resource management strategies in the BLM District Office and National Forest Unit. Ultimately, the outcomes of the FIAT process will provide land managers with spatially defined priorities and management protocols for the following:

- Preparedness and operational decision-making prior to and during wildfires.
- Implementation of NEPA projects for fuels management, habitat restoration and ESR efforts in key GRSG habitat.

Attachment 1—Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

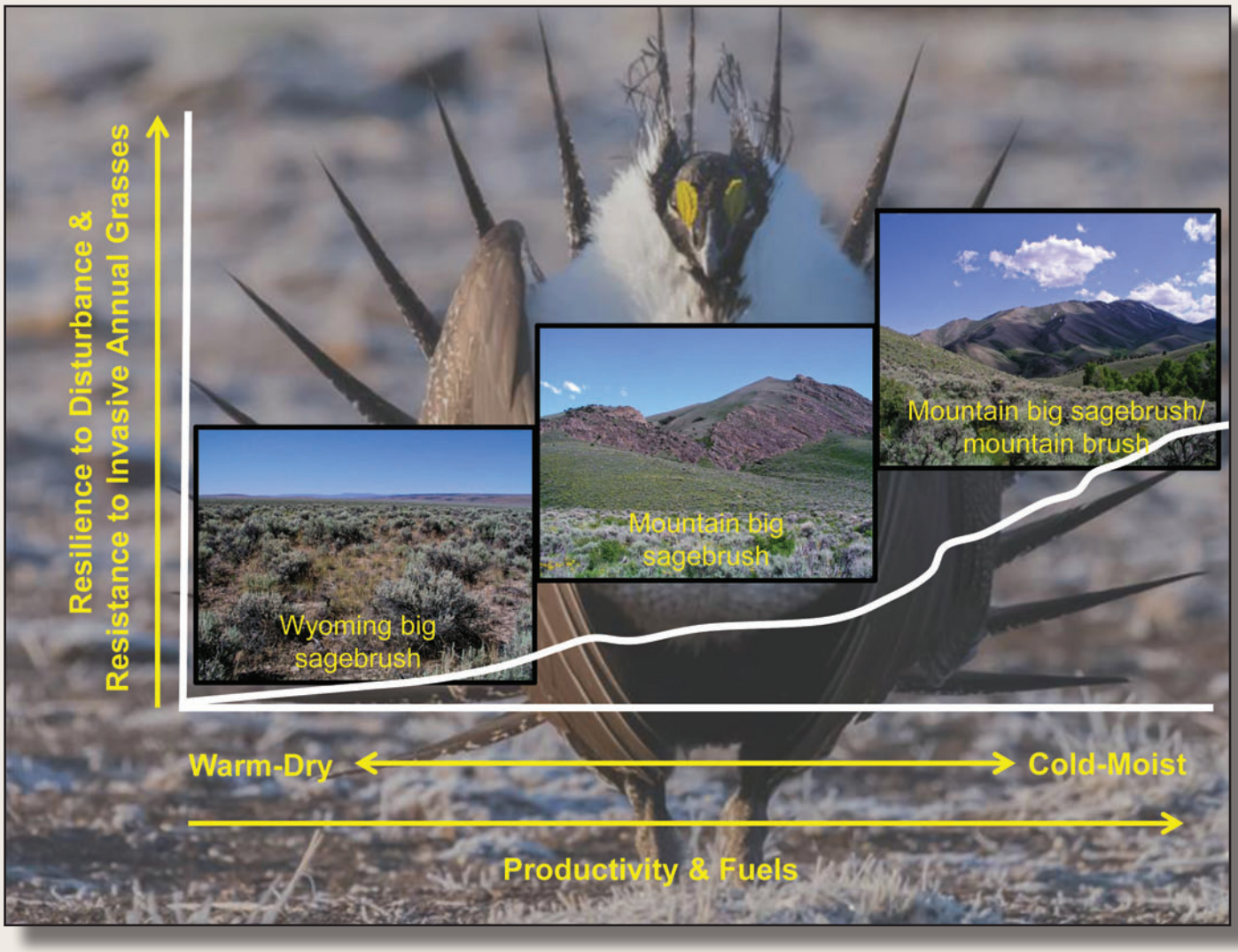
Attachment 2—Greater Sage-Grouse Wildfire, Invasive Annual Grasses, and Conifer Expansion Assessment

Appendix H – Attachment 1

United States Department of Agriculture

Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

Jeanne C. Chambers, David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S. Boyd, Steven B. Campbell, Shawn Espinosa, Douglas W. Havlina, Kenneth E. Mayer, and Amarina Wuenschel



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Abstract

This Report provides a strategic approach for conservation of sagebrush ecosystems and Greater Sage-Grouse (sage-grouse) that focuses specifically on habitat threats caused by invasive annual grasses and altered fire regimes. It uses information on factors that influence (1) sagebrush ecosystem resilience to disturbance and resistance to invasive annual grasses and (2) distribution, relative abundance, and persistence of sage-grouse populations to develop management strategies at both landscape and site scales. A sage-grouse habitat matrix links relative resilience and resistance of sagebrush ecosystems with sage-grouse habitat requirements for landscape cover of sagebrush to help decision makers assess risks and determine appropriate management strategies at landscape scales. Focal areas for management are assessed by overlaying matrix components with sage-grouse Priority Areas for Conservation (PACs), breeding bird densities, and specific habitat threats. Decision tools are discussed for determining the suitability of focal areas for treatment and the most appropriate management treatments.

Keywords: sagebrush habitat, Greater Sage-Grouse, fire effects, invasive annual grasses, management prioritization, conservation, prevention, restoration

Cover photos: *Greater Sage-grouse photo by Rick McEwan; sagebrush habitat photos by Jeanne Chambers.*

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Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

Jeanne C. Chambers, David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S. Boyd, Steven B. Campbell, Shawn Espinosa, Douglas W. Havlina, Kenneth E. Mayer, and Amarina Wuenschel

Introduction

An unprecedented conservation effort is underway across 11 States in the western United States to reduce threats to Greater Sage-Grouse (*Centrocercus urophasianus*; hereafter, sage-grouse) and the sagebrush ecosystems on which they depend (fig. 1). Recent efforts were accelerated by the March 2010 determination that sage-grouse warrant protection under the Federal Endangered Species Act, and by increased emphasis on broad collaboration among state and Federal partners to proactively identify and implement actions to reverse current trends (USFWS 2010, 2013). Conservation success hinges on being able to achieve "the long-term conservation of sage-grouse and healthy sagebrush shrub and native perennial grass and forb communities by maintaining viable, connected, and well-distributed populations and habitats across their range, through threat amelioration, conservation of key habitats, and restoration activities" (USFWS 2013). While strides are being made to curtail a host of threats across the range, habitat loss and fragmentation due to wildfire and invasive plants remain persistent challenges to

Figure 1. Greater Sage-Grouse (*Centrocercus urophasianus*) (photo by Charlotte Ganskopp).

achieving desired outcomes – particularly in the western portion of the range (Miller et al. 2011; USFWS 2010; 2013). Management responses to date have not been able to match the scale of this problem. Natural resource managers are seeking coordinated approaches that focus appropriate management actions in the right places to maximize conservation effectiveness (Wisdom and Chambers 2009; Murphy et al. 2013).

Improving our ability to manage for resilience to disturbance and resistance to invasive species is fundamental to achieving long-term sage-grouse conservation objectives. Resilient ecosystems have the capacity to ***regain*** their fundamental structure, processes, and functioning when altered by stressors like drought and disturbances like inappropriate livestock grazing and altered fire regimes (Holling 1973; Allen et al. 2005). Species resilience refers to the ability of a species to recover from stressors and disturbances (USFWS 2013), and is closely linked to ecosystem resilience. Resistant ecosystems have the capacity to ***retain*** their fundamental structure, processes, and functioning when exposed to stresses, disturbances, or invasive species (Folke et al. 2004). Resistance to invasion by nonnative plants is increasingly important in sagebrush ecosystems; it is a function of the abiotic and biotic attributes and ecological processes of an ecosystem that limit the population growth of an invading species (D'Antonio and Thomsen 2004**)**. A detailed explanation of the factors that influence resilience and resistance in sagebrush ecosystems is found in Chambers et al. 2014.

In general, species are likely to be more resilient if large populations exist in large blocks of high quality habitat across the full breadth of environmental variability to which the species is adapted (Redford et al. 2011). Because sage-grouse are a broadly distributed and often wide-ranging species that may move long-distances between seasonal habitats (Connelly et al. 2011a,b), a strategic approach that integrates both landscape prioritization and site-scale decision tools is needed. This document develops such an approach for the conservation of sagebrush habitats across the range of sage-grouse with an emphasis on the western portion of the range. In recent years, information and tools have been developed that significantly increase our understanding of factors that influence the resilience of sagebrush ecosystems and the distribution of sage-grouse populations, and that allow us to strategically prioritize management activities where they are most likely to be effective and to benefit the species. Although the emphasis of this Report is on the western portion of the sage-grouse range, the approach has management applicability to other sagebrush ecosystems.

In this report, we briefly review causes and effects of invasive annual grasses and altered fire regimes, and then discuss factors that determine resilience to disturbances like wildfire and resistance to invasive annual grasses in sagebrush ecosystems. We illustrate how an understanding of resilience and resistance, sagebrush habitat requirements for sage-grouse, and consequences that invasive annual grasses and wildfire have on sage-grouse populations can be used to develop management strategies at both landscape and site scales. A sage-grouse habitat matrix is provided that links relative resilience and resistance with habitat requirements for landscape cover of sagebrush to both identify priority areas for management and determine effective management strategies at landscape scales. An approach for assessing focal areas for sage-grouse habitat management is described that overlays Priority Areas for Conservation (PACs) and breeding bird densities with resilience and resistance and habitat suitability to spatially link sage-grouse populations with habitat conditions and risks. The use of this approach is illustrated for the western portion of the range and for a diverse area in the northeast corner of Nevada. It concludes with a discussion of the tools available for determining the suitability of focal areas for treatment and the most appropriate management treatments. Throughout the document, the emphasis is on using this approach to guide and assist fire operations, fuels management, post-fire rehabilitation, and habitat restoration activities to maintain or enhance sage-grouse habitat.

Threats of Invasive Annual Grasses and Altered Fire Regimes to Sagebrush Ecosystems and Sage-Grouse

Effects on Sagebrush Ecosystems

Sage-grouse habitat loss and fragmentation due to wildfire and invasive plants are widely recognized as two of the most significant challenges to conservation of the species, particularly in the western portion of the range (Miller et al. 2011; USFWS 2010, 2013). During pre-settlement times, sagebrush-dominated ecosystems had highly variable fire return intervals that ranged from decades to centuries (Frost 1998; Brown and Smith 2000; Miller et al. 2011). At coarse regional scales, fire return intervals in sagebrush ecological types were determined largely by climate and its effects on fuel abundance and continuity. Consequently, fire frequency was higher in sagebrush types with greater productivity at higher elevations and following periods of increased precipitation than in lower elevation and less productive ecosystems (West 1983b; Mensing et al. 2006). At local scales within sagebrush types, fire return intervals likely were determined by topographic and soil effects on productivity and fuels and exhibited high spatial and temporal variability (Miller and Heyerdahl 2008).

Euro-American arrival in sagebrush ecosystems began in the mid-1800s and initiated a series of changes in vegetation composition and structure that altered fire regimes and resulted in major changes in sagebrush habitats. The first major change in fire regimes occurred when inappropriate grazing by livestock led to a decrease in native perennial grasses and forbs and effectively reduced the abundance of fine fuels (Knapp 1996; Miller and Eddleman 2001; Miller et al. 2011). Decreased competition from perennial herbaceous species, in combination with ongoing climate change and favorable conditions for woody species establishment at the turn of the twentieth century, resulted in increased abundance of shrubs (primarily *Artemisia* species) and trees, including juniper (*Juniperus occidentalis*, *J. osteosperma*) and piñon pine (*Pinus monophylla*), at mid to high elevations (Miller and Eddleman 2001; Miller et al. 2011). The initial effect of these changes in fuel structure was a reduction in fire frequency and size. The second major change in fire regimes occurred when non-native annual grasses (e.g., *Bromus tectorum, Taeniatherum caput-medusa*) were introduced from Eurasia in the late 1800s and spread rapidly into low to mid-elevation ecosystems with depleted understories (Knapp 1996). The invasive annual grasses increased the amount and continuity of fine fuels in many lower elevation sagebrush habitats and initiated annual grass/fire cycles characterized by shortened fire return intervals and larger, more contiguous fires (fig. 2; D'Antonio and Vitousek 1992; Brooks et al. 2004). Since settlement of the region, cheatgrass came to dominate as much as 4 million hectares (9.9 million acres) in the states of Nevada and Utah alone (fig. 3; Bradley and Mustard 2005). The final change in fire regimes occurred as a result of expansion of juniper and piñon pine trees into sagebrush types at mid to high elevations and a reduction of the grass, forb, and shrub species associated with these types. Ongoing infilling of trees is increasing woody fuels, but reducing fine fuels and resulting in less frequent fires (fig. 4; Miller et al. 2013). Extreme burning conditions (high winds, high temperatures, and low relative humidity) in high density (Phase III) stands are resulting in large and severe fires that result in significant losses of above- and below-ground organic matter (sensu Keeley 2009) and have detrimental ecosystem effects (Miller et al. 2013). Based on tree-ring analyses at several Great Basin sites, it is estimated that the extent of piñon and/or juniper woodland increased two to six fold since settlement, and most of that area will exhibit canopy closure within the next 50 years (Miller et al. 2008).

Figure 2. A wildfire that burned through a Wyoming big sagebrush ecosystem with an invasive annual grass understory in southern Idaho (top) (photo by Douglas J. Shinneman), and a close-up of a fire in a Wyoming big sagebrush ecosystem (bottom) (photo by Scott Schaff).

Figure 3. A wildfire that started in invasive annual grass adjacent to a railroad track and burned upslope into a mountain big sagebrush and Jeffrey pine ecosystem in northeast Nevada (top). A big sagebrush ecosystem that has been converted to invasive annual grass in north central Nevada (bottom) (photos by Nolan E. Preece).

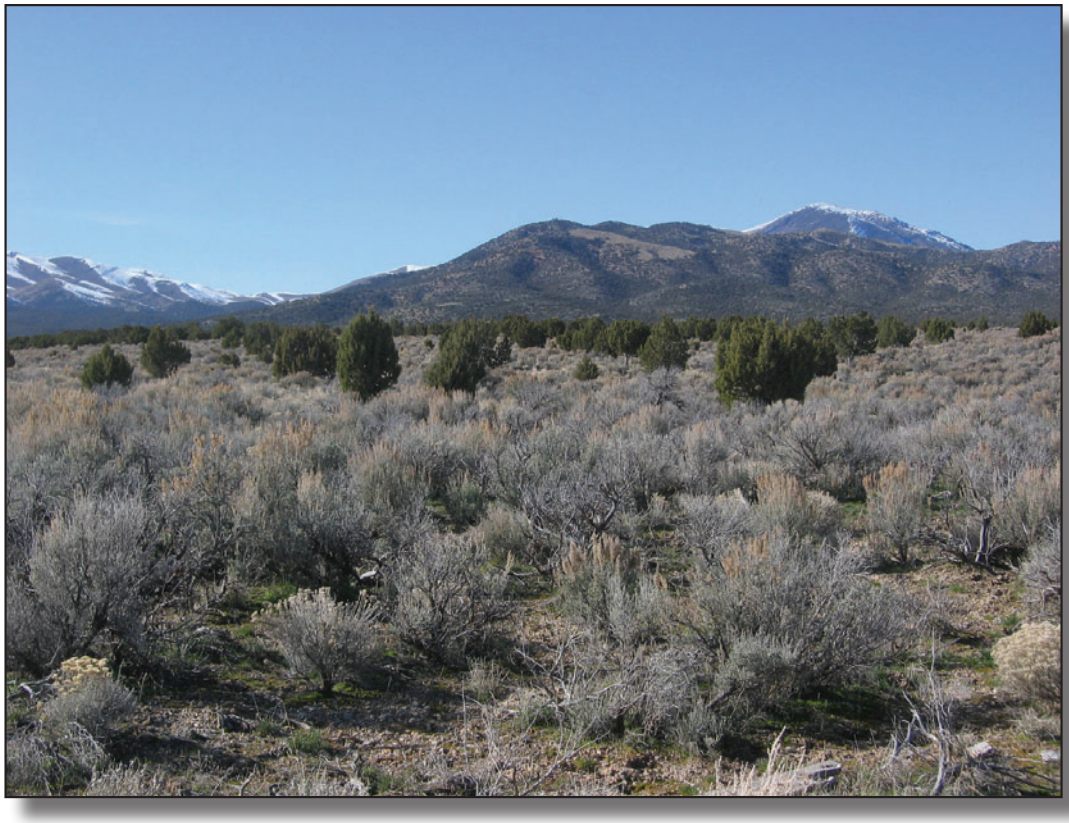


Figure 4. Expansion of Utah juniper trees into a mountain big sagebrush ecosystem in east central Utah (top) that is resulting in progressive infilling of the trees and exclusion of native understory species (bottom) (photos by Bruce A. Roundy).

Effects on Sage-Grouse Habitat Selection and Population Dynamics

Understanding the effects of landscape changes on sage-grouse habitat selection and population dynamics can help managers apply more strategic and targeted conservation actions to reduce risks. Two key land cover shifts resulting from invasive annual grasses and altered fire regimes are affecting the ability to achieve the range-wide goal of stable-to-increasing population trends − large-scale reduction of sagebrush cover and conversion of sagebrush ecosystems to annual grasslands.

Sage-grouse are true sagebrush obligates that require large and intact sagebrush landscapes. Consequently, wildfires occurring at the extremes of the natural range of variability that remove sagebrush, even temporarily, over large areas and over short time periods often have negative consequences for sage-grouse. Several range-wide studies have identified the proportion of sagebrush-dominated land cover as a key indicator of sage-grouse population persistence and, importantly, have revealed critical levels of sagebrush landscape cover required by sage-grouse (see Appendix 2 for a description of landscape cover and how it is derived). Knick et al. (2013) found that 90% of active leks in the western portion of the range had more than 40% landscape cover of sagebrush within a 5-km (3.1-mi) radius of leks. Another range-wide analysis documented a high risk of extirpation with <27% sagebrush landscape cover and high probability of persistence with >50% sagebrush landscape cover within 18-km (11.2-mi) of leks (Wisdom et al. 2011). Similarly, Aldridge et al. (2008) found long-term sage-grouse persistence required a minimum of 25%, and preferably at least 65%, sagebrush landscape cover at the 30-km (18.6-mi) scale. Considered collectively, cumulative disturbances that reduce the cover of sagebrush to less than a quarter of the landscape have a high likelihood of resulting in local population extirpation, while the probability of maintaining persistent populations goes up considerably as the proportion of sagebrush cover exceeds two-thirds or more of the landscape. Reduction of sagebrush cover is most critical in low to mid elevations where natural recovery of sagebrush can be very limited within timeframes important to sage-grouse population dynamics (Davies et al. 2011).

Nonnative annual grasses and forbs have invaded vast portions of the sage-grouse range, reducing both habitat quantity and quality (Beck and Mitchell 2000; Rowland et al. 2006; Miller et al. 2011; Balch et al. 2013). Due to repeated fires, some low- to mid-elevation native sagebrush communities are shifting to novel annual grassland states resulting in habitat loss that may be irreversible with current technologies (Davies et al. 2011; Miller et al. 2011; Chambers et al. 2014). At the broadest scales, the presence of non-native annual grasslands on the landscape may be influencing both sage-grouse distribution and abundance. In their analysis of active leks, Knick et al. (2013) found that most leks had very little annual grassland cover (2.2%) within a 5-km (3.1-mi) radius of the leks; leks that were no longer used had almost five times as much annual grassland cover as active leks. Johnson et al. (2011) found that lek use became progressively less as the cover of invasive annual species increased at both the 5-km (3.1-mi) and 18-km (11.2-mi) scales. Also, few leks had >8% invasive annual vegetation cover within both buffer distances.

Patterns of nest site selection also suggest local impacts of invasive annual grasses on birds. In western Nevada, Lockyer (2012) found that sage-grouse selected large expanses of sagebrush-dominated areas and, within those areas, sage-grouse selected microsites with higher shrub canopy cover and lower cheatgrass cover. Average cheatgrass cover at selected locations was 7.1% compared to 13.3% at available locations. Sage-grouse hens essentially avoided nesting in areas with higher cheatgrass cover. Kirol et al. (2012) also found nest-site selection was negatively correlated with the presence of cheatgrass in south-central Wyoming.

Sage-grouse population demographic studies in northern Nevada show that recruitment and annual survival also are affected by presence of annual grasslands at larger scales. Blomberg et al. (2012) analyzed land cover within a 5-km (3.1-mi) radius of leks and found that leks impacted by annual grasslands experienced lower recruitment than non-impacted leks, even following years of high precipitation. Leks that were not affected by invasive annual grasslands exhibited recruitment rates nearly twice as high as the population average and nearly six times greater than affected leks during years of high precipitation.

Piñon and juniper expansion at mid to upper elevations into sagebrush ecosystems also has altered fire regimes and reduced sage-grouse habitat availability and suitability over large areas with population-level consequences (Miller et al. 2011; Baruch-Mordo et al. 2013; Knick et al. 2013). Conifer expansion results in non-linear declines in sagebrush cover and reductions in perennial native grasses and forbs as conifer canopy cover increases (Miller et al. 2000) and this has direct effects on the amount of available habitat for sagebrush-obligate species. Sites in the late stage of piñon and juniper expansion and infilling (Phase III from Miller et al. 2005) have reduced fire frequency (due to decreased fine fuels), but are prone to higher severity fires (due to increased woody fuels) which significantly reduces the likelihood of sagebrush habitat recovery (fig. 5) (Bates et al. 2013). Even before direct habitat loss occurs, sage-grouse avoid or are negatively associated with conifer cover during all life stages (i.e., nesting, brood-rearing, and wintering; Doherty et al. 2008, 2010a; Atamian et al. 2010; Casazza et al. 2011). Also, sage-grouse incur population-level impacts at a very low level of conifer encroachment. The ability to maintain active leks is severely compromised when conifer canopy exceeds 4% in the immediate vicinity of the lek (Baruch-Mordo et al. 2013), and most active leks average less than 1% conifer cover at landscape scales (Knick et al. 2013).

Figure 5. A post-burn, Phase III, singleleaf piñon and Utah juniper dominated sagebrush ecosystem in which soils are highly erosive and few understory plants remain (photo by Jeanne C. Chambers).

Resilience to Disturbance and Resistance to Invasive Annual Grasses in Sagebrush Ecosystems

Our ability to address the changes occurring in sagebrush habitats can be greatly enhanced by understanding the effects of environmental conditions on resilience to stress and disturbance, and resistance to invasion (Wisdom and Chambers 2009; Brooks and Chambers 2011; Chambers et al. 2014). In cold desert ecosystems, resilience of native ecosystems to stress and disturbance changes along climatic and topographic gradients. In these ecosystems, Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), mountain big sagebrush (*A. t.* spp. *vaseyana*), and mountain brush types (e.g., mountain big sagebrush, snowberry [*Symphorocarpus* spp.], bitterbrush [*Purshia tridentata*]) occur at progressively higher elevations and are associated with decreasing temperatures and increasing amounts of precipitation, productivity, and fuels (fig. 6; West and Young 2000). Piñon pine and juniper woodlands are typically associated with mountain big sagebrush types, but can occur with relatively cool and moist Wyoming big sagebrush types and warm and moist mountain brush types (Miller et al. 2013). Resilience to disturbance, including wildfire, has been shown to increase along these elevation gradients (fig. 7A) (Condon et al. 2011; Davies et al. 2012; Chambers et al. 2014; Chambers et al. *in press*). Higher precipitation and cooler temperatures, coupled with greater soil development and plant productivity at mid to high elevations, can result in greater resources and more favorable environmental conditions for plant growth and reproduction (Alexander et al. 1993; Dahlgren et al. 1997). In contrast, minimal precipitation and high temperatures at low elevations result in lower resource availability for plant growth (West 1983a,b;

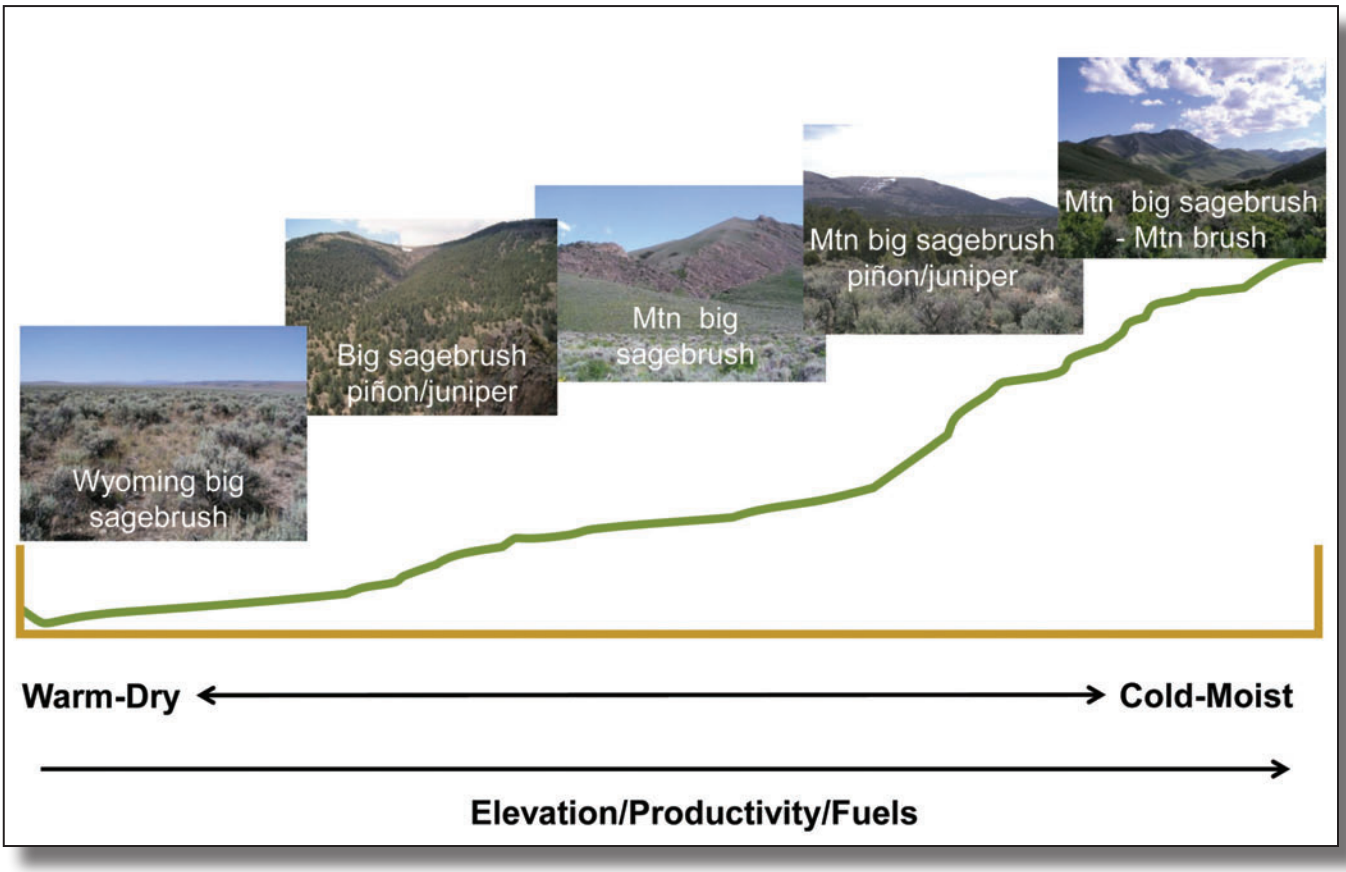


Figure 6. The dominant sagebrush ecological types that occur along environmental gradients in the western United States. As elevation increases, soil temperature and moisture regimes transition from warm and dry to cold and moist and vegetation productivity and fuels become higher.

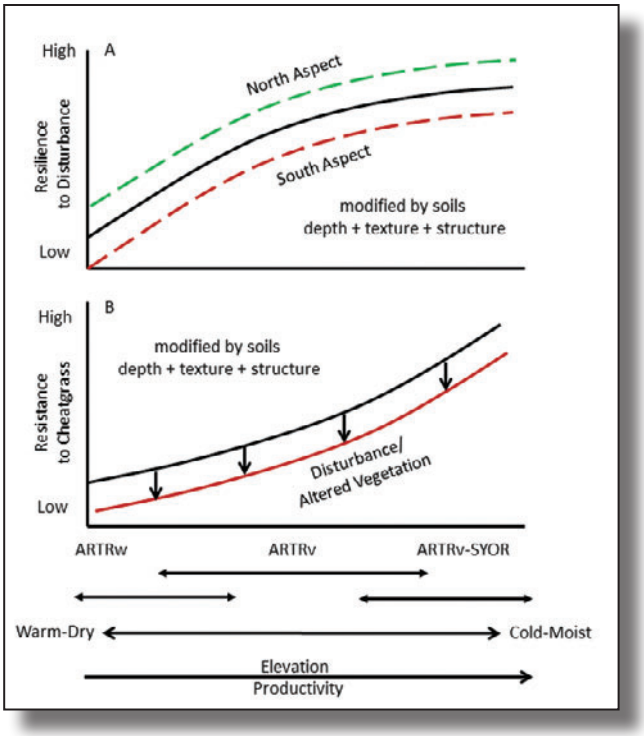


Figure 7. (**A**) Resilience to disturbance and (**B**) resistance to cheatgrass over a typical temperature/precipitation gradient in the cold desert. Dominant ecological sites occur along a continuum that includes Wyoming big sagebrush on warm and dry sites, to mountain big sagebrush on cool and moist sites, to mountain big sagebrush and root-sprouting shrubs on cold and moist sites. Resilience increases along the temperature/precipitation gradient and is influenced by site characteristics like aspect. Resistance also increases along the temperature/precipitation gradient and is affected by disturbances and management treatments that alter vegetation structure and composition and increase resource availability (modified from Chambers et al. 2014; Chambers et al. *in press*).

Smith and Nowak 1990). These relationships also are observed at local plant community scales where aspect, slope, and topographic position affect solar radiation, erosion processes, effective precipitation, soil development and vegetation composition and structure (Condon et al. 2011; Johnson and Miller 2006).

Resistance to invasive annual grasses depends on environmental factors and ecosystem attributes and is a function of (1) the invasive species' physiological and life history requirements for establishment, growth, and reproduction, and (2) interactions with the native perennial plant community including interspecific competition and response to herbivory and pathogens. In cold desert ecosystems, resistance is strongly influenced by soil temperature and moisture regimes (Chambers et al. 2007; Meyer et al. 2001). Germination, growth, and/or reproduction of cheatgrass is physiologically limited at low elevations by frequent, low precipitation years, constrained at high elevations by low soil temperatures, and optimal at mid elevations under relatively moderate temperature and water availability (fig. 7B; Meyer et al. 2001; Chambers et al. 2007). Slope, aspect, and soil characteristics modify soil temperature and moisture and influence resistance to cheatgrass at landscape to plant community scales (Chambers et al. 2007; Condon et al. 2011; Reisner et al. 2013). Genetic variation in cheatgrass results in phenotypic traits that increase survival and persistence in populations from a range of environments, and is likely contributing to the recent range expansion of this highly inbreeding species into marginal habitats (Ramakrishnan et al. 2006; Merrill et al. 2012).

The occurrence and persistence of invasive annual grasses in sagebrush habitats is strongly influenced by interactions with the native perennial plant community (fig. 7B). Cheatgrass, a facultative winter annual that can germinate from early fall through early spring, exhibits root elongation at low soil temperatures, and has higher nutrient uptake and growth rates than most native species (Mack and Pyke 1983; Arredondo et al. 1998; James et al. 2011). Seedlings of native, perennial plant species are generally poor competitors with cheatgrass, but adults of native, perennial grasses and forbs, especially those with similar growth forms and phenology, can be highly effective competitors with the invasive annual (Booth et al. 2003; Chambers et al. 2007; Blank and Morgan 2012).

Also, biological soil crusts, which are an important component of plant communities in warmer and drier sagebrush ecosystems, can reduce germination or establishment of cheatgrass (Eckert et al. 1986; Kaltenecker et al. 1999). Disturbances or management treatments that reduce abundance of native perennial plants and biological soil crusts and increase the distances between perennial plants often are associated with higher resource availability and increased competitive ability of cheatgrass (Chambers et al. 2007; Reisner et al. 2013; Roundy et al. *in press*).

The type, characteristics, and natural range of variability of stress and disturbance strongly influence both resilience and resistance (Jackson 2006). Disturbances like overgrazing of perennial plants by livestock, wild horses, and burros and more frequent or more severe fires are typically outside of the natural range of conditions and can reduce the resilience of sagebrush ecosystems. Reduced resilience is triggered by changes in environmental factors like temperature regimes, abiotic attributes like water and nutrient availability, and biotic attributes such as vegetation structure, composition, and productivity (Chambers et al. 2014) and cover of biological soil crusts (Reisner et al. 2013). Resistance to an invasive species can change when changes in abiotic and biotic attributes result in increased resource availability or altered habitat suitability that influences an invasive species' ability to establish and persist and/or compete with native species. Progressive losses of resilience and resistance can result in the crossing of abiotic and/or biotic thresholds and an inability of the system to recover to the reference state (Beisner et al. 2003; Seastedt et al. 2008).

Interactions among disturbances and stressors may have cumulative effects (Chambers et al. 2014). Climate change already may be shifting fire regimes outside of the natural range of occurrence (i.e., longer wildfire seasons with more frequent and longer duration wildfires) (Westerling et al. 2006). Sagebrush ecosystems generally have low productivity, and the largest number of acres burned often occurs a year or two after warm, wet conditions in winter and spring that result in higher fine fuel loads (Littell et al. 2009). Thus, annual grass fire cycles may be promoted by warm, wet winters and a subsequent increase in establishment and growth of invasive winter annuals. These cycles may be exacerbated by rising atmospheric CO_2 concentrations, N deposition, and increases in human activities that result in soil surface disturbance and invasion corridors (Chambers et al. 2014). Modern deviations from historic conditions will likely continue to alter disturbance regimes and sagebrush ecosystem response to disturbances; thus, management strategies that rely on returning to historical or "pre-settlement" conditions may be insufficient, or even misguided, given novel ecosystem dynamics (Davies et al. 2009).

Integrating Resilience and Resistance Concepts With Sage-Grouse Habitat Requirements to Manage Wildfire and Invasive Annual Grass Threats at Landscape Scales

The changes in sagebrush ecosystem dynamics due to invasive annual species and longer, hotter, and drier fire seasons due to a warming climate make it unlikely that these threats can be ameliorated completely (Abatzoglou and Kolden 2011; USFWS 2013). Consequently, a strategic approach is necessary to conserve sagebrush habitat and sage-grouse (Wisdom et al. 2005; Meinke et al. 2009; Wisdom and Chambers 2009; Pyke 2011). This strategic approach requires the ability to (1) identify those locations that provide current or potential habitat for sage-grouse and (2) prioritize management actions based on the capacity of the ecosystem to respond in the desired manner and to effectively allocate resources to achieve desired objectives. Current understanding of the relationship of landscape cover of sagebrush to sage-grouse habitat provides the capacity to identify those locations on the landscape that have a high probability of

sage-grouse persistence (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Similarly, knowledge of the relationships of environmental characteristics, specifically soil temperature and moisture regimes, to ecological types and their inherent resilience and resistance gives us the capacity to prioritize management actions based on probable effectiveness of those actions (Wisdom and Chambers 2009; Brooks and Chambers 2011; Miller et al. 2013; Chambers et al. 2014; Chambers et al. *in press,*).

In this section, we discuss the use of landscape cover of sagebrush as an indicator of sage-grouse habitat, and the use of soil temperature and moisture regimes as an indicator of resilience to disturbance, resistance to invasive annual grasses and, ultimately, the capacity to achieve desired objectives. We then show how these two concepts can be coupled in a sage-grouse habitat matrix and used to determine potential management strategies at the landscape scales on which sage-grouse depends.

Landscape Cover of Sagebrush as an Indicator of Sage-Grouse Habitat

Landscape cover of sagebrush is closely related to the probability of maintaining active sage-grouse leks, and is used as one of the primary indicators of sage-grouse habitat potential at landscape scales (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Landscape cover of sagebrush less than about 25% has a low probability of sustaining active sage-grouse leks (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Above 25% landscape cover of sagebrush, the probability of maintaining active sage-grouse leks increases with increasing sagebrush landscape cover. At landscape cover of sagebrush ranging from 50 to 85%, the probability of sustaining sage-grouse leks becomes relatively constant (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). For purposes of prioritizing landscapes for sage-grouse habitat management, we use 25% as the level below which there is a low probability of maintaining sage-grouse leks and 65% as the level above which there is little additional increase in the probability of sustaining active leks with further increases of landscape cover of sagebrush (fig. 8; Knick et al. 2013). Between about 25% and 65% landscape sagebrush cover, increases in landscape cover of sagebrush have a constant positive relationship with sage-grouse lek probability (fig. 8; Knick et al. 2013). Restoration and management activities that result in an increase in the amount of sagebrush dominated landscape within areas of pre-existing landscape cover between 25% and 65% likely will result in a higher probability of sage-grouse persistence, while declines in landscape cover of sagebrush likely will result in reductions in sage-grouse (Knick et al. 2013). It is important to note that

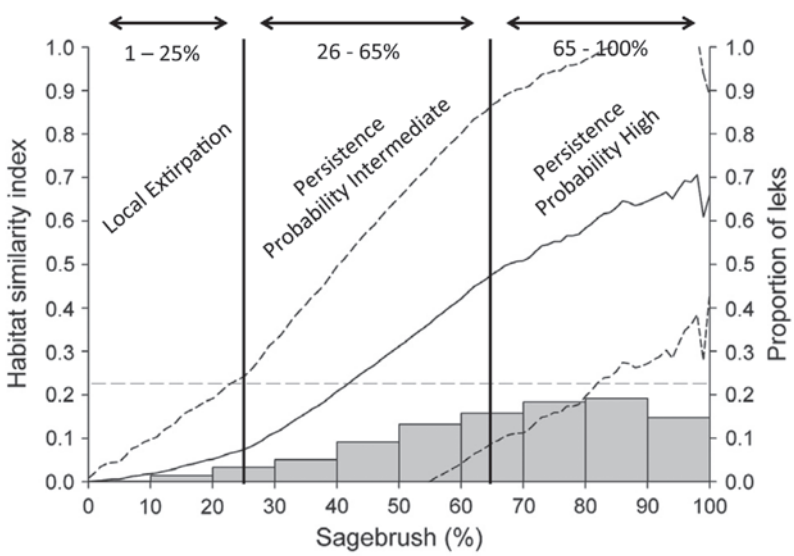


Figure 8. The proportion of sage-grouse leks and habitat similarity index (HSI) as related to the percent landscape cover of sagebrush. The HSI indicates the relationship of environmental variables at map locations across the western portion of the range to minimum requirements for sage-grouse defined by land cover, anthropogenic variables, soil, topography, and climate. HSI is the solid black line ± 1 SD (stippled lines). Proportion of leks are the grey bars. Dashed line indicates HSI values above which characterizes 90% of active leks (0.22). The categories at the top of the figure and the interpretation of lek persistence were added based on Aldridge et al. 2008; Wisdom et al. 2011; and Knick et al. 2013 (figure modified from Knick et al. 2013).

these data and interpretations relate only to persistence (i.e., whether or not a lek remains active) and it is likely that higher proportions of sagebrush cover or improved condition of sagebrush ecosystems may be required for population growth.

For the purposes of delineating sagebrush habitat relative to sage-grouse requirements for landscape cover of sagebrush, we calculated the percentage landscape sagebrush cover within each of the selected categories (1-25%, 26-65%, >65%) for the range of sage-grouse (fig. 9, 10). An explanation of how landscape cover of sagebrush is derived is in Appendix 2. Large areas of landscape sagebrush cover >65% are found primarily in Management Zones (MZ) II (Wyoming Basin), IV (Snake River Plains), and V (Northern Great Basin). In contrast, relatively small areas of landscape sagebrush cover >65% are located in MZ I (Great Plains), III (Southern Great Basin), VI (Columbia Basin), and VII (Colorado Plateau). Sagebrush is naturally less common in the Great Plains region compared to other parts of the range and previous work suggested that sage-grouse populations in MZ I may be more vulnerable to extirpation with further reductions in sagebrush cover (Wisdom et al. 2011). In the western portion of the range, where the threat of invasive annual grasses and wildfire is greatest, the area of sagebrush cover >65% differs among MZs. MZ III is a relatively arid and topographically diverse area in which the greatest extent of sagebrush cover >65% is in higher elevation, mountainous areas. MZs IV and V have relatively large extents of sagebrush cover >65% in relatively cooler and wetter areas, and MZs IV and VI have lower extents of sagebrush cover >65% in warmer and dryer areas and in areas with significant agricultural development. These differences in landscape cover of sagebrush indicate that different sets of management strategies may apply to the various MZs.

Soil Temperature and Moisture Regimes as Indicators of Ecosystem Resilience and Resistance

Potential resilience and resistance to invasive annual grasses reflect the biophysical conditions that an area is capable of supporting. In general, the highest potential resilience and resistance occur with ***cool*** to ***cold*** (frigid to cryic) soil temperature regimes and relatively ***moist*** (xeric to ustic) soil moisture regimes, while the lowest potential resilience and resistance occur with ***warm*** (mesic) soil temperatures and relatively ***dry*** (aridic) soil moisture regimes (Chambers et al. 2014, Chambers et al. *in press*). Definitions of soil temperature and moisture regimes are in Appendix 3. Productivity is elevated by high soil moisture and thus resilience is increased (Chambers et al. 2014); annual grass growth and reproduction is limited by cold soil temperatures and thus resistance is increased (Chambers et al. 2007). The timing of precipitation also is important because cheatgrass and many other invasive annual grasses are particularly well-adapted to Mediterranean type climates with cool and wet winters and warm and dry summers (Bradford and Lauenroth 2006; Bradley 2009). In contrast, areas that receive regular summer precipitation (ustic soil moisture regimes) often are dominated by warm and/or cool season grasses (Sala et al. 1997) that likely create a more competitive environment and result in greater resistance to annual grass invasion and spread (Bradford and Lauenroth 2006; Bradley 2009).

Much of the remaining sage-grouse habitat in MZs I (Great Plains), II (Wyoming Basin), VII (Colorado Plateau), and cool-to-cold or moist sites scattered across the range, are characterized by moderate to high resilience and resistance as indicated by soil temperature and moisture regimes (fig. 11). Sagebrush habitats across MZ I are unique from a range-wide perspective because soils are predominantly cool and ustic, or bordering on ustic as a result of summer precipitation; this soil moisture regime appears to result in higher resilience and resistance (Bradford and Lauenroth 2006).

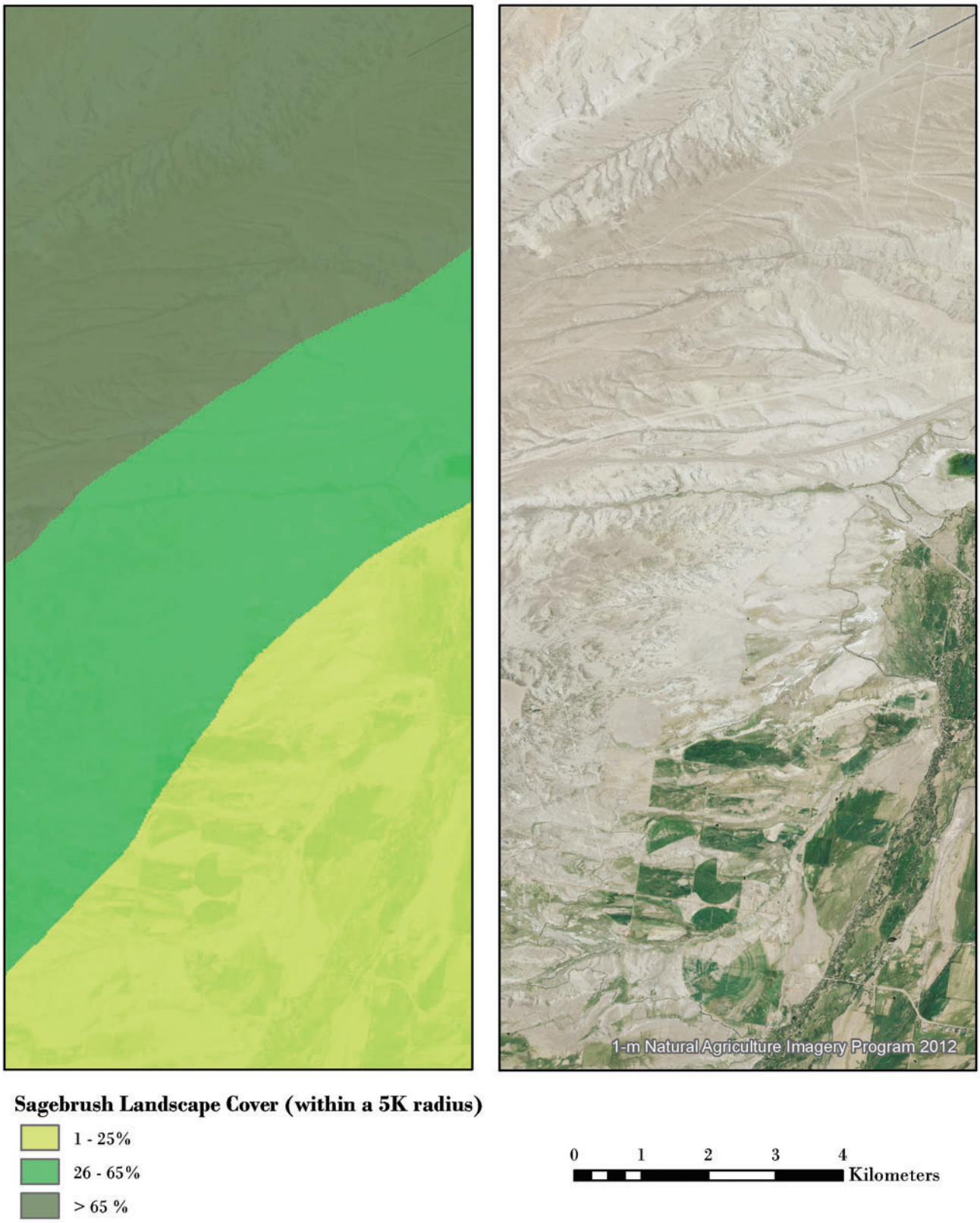


Figure 9. Landscape cover of sagebrush from 1-m National Agricultural Imagery (right) and the corresponding sagebrush landscape cover for the 1-25%, 26-65%, and >65% categories (left). See Appendix 2 for an explanation of how the categories are determined.

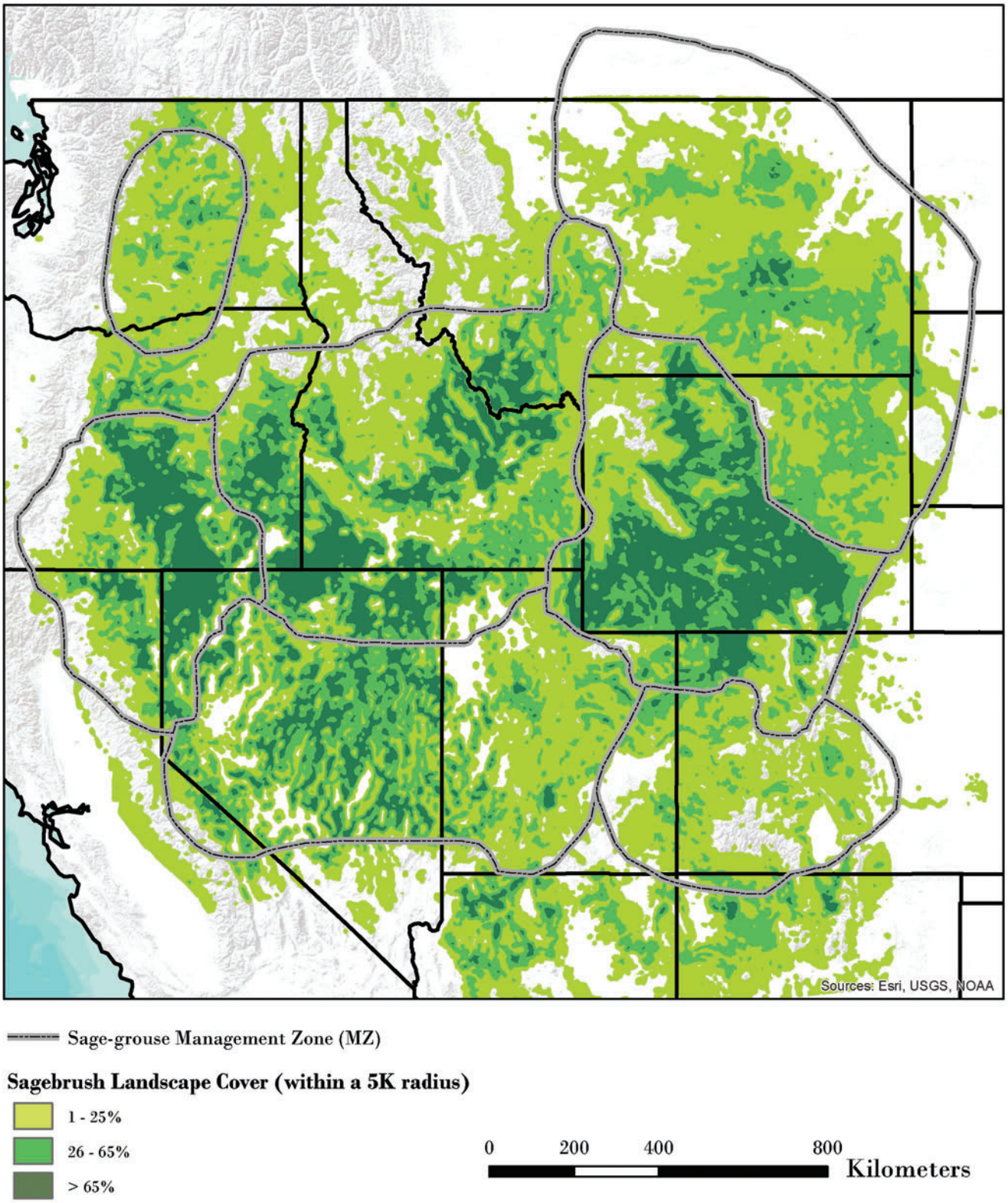


Figure 10. The landscape cover of sagebrush within each of three selected categories (1-25%, 26-65%, >65%) for the range of sage-grouse (Management Zones I – VII; Stiver et al. 2006). The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover.

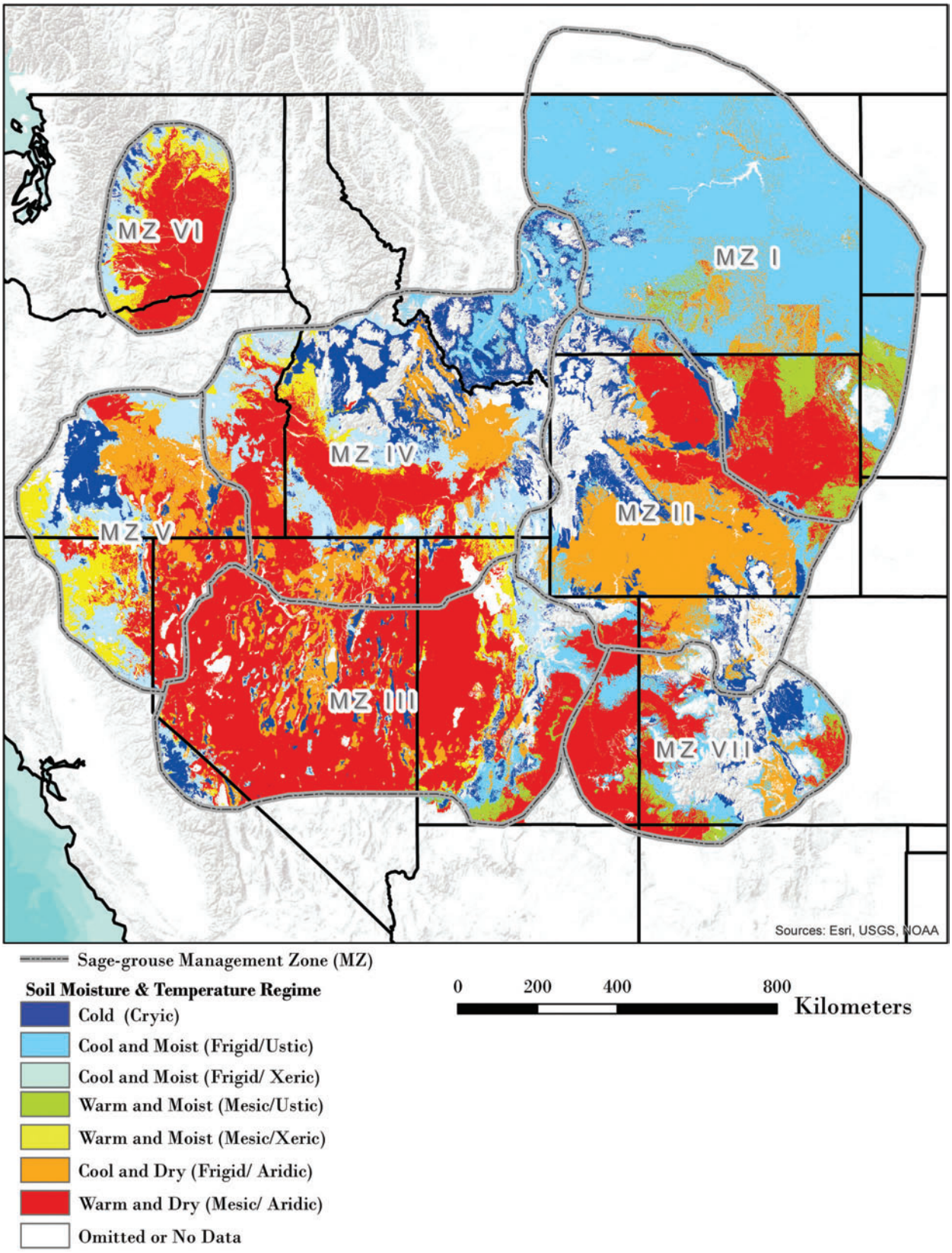


Figure 11. The soil temperature and moisture regimes for the range of sage-grouse (Management Zones I – VII; Stiver et al. 2006). Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b).

However, significant portions of MZs III (Southern Great Basin), much of IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin) are characterized largely by either warm and dry, or warm to cool and moist ecological types with moderate to low resilience and resistance (fig. 11; table 1). Areas within these MZs that have warm and dry soils are typically characterized by Wyoming big sagebrush ecosystems with low to moderately low resilience and resistance and are currently of greatest concern for sage-grouse conservation (fig. 12A). Areas with warm to cool soil temperature regimes and moist precipitation regimes are typically characterized by either Wyoming or mountain big sagebrush, have moderate to moderately low resilience and resistance,

Table 1. Predominant sagebrush ecological types in Sage-Grouse Management Zones III, IV, V, and VI based on soil temperature and soil moisture regimes, typical characteristics, and resilience to disturbance and resistance to invasive annual grasses (modified from Miller et al. 2014 a,b). Relative abundance of sagebrush species and composition of understory vegetation vary depending on Major Land Resource Area and ecological site type.

Ecological type	Characteristics	Resilience and resistance
Cold and Moist (Cryic/Xeric)	Ppt: 14 inches + Typical shrubs: *Mountain big sagebrush, snowfield sagebrush, snowberry, serviceberry, silver sagebrush, and/or low sagebrushes*	*Resilience* – **Moderately high**. Precipitation and productivity are generally high. Short growing seasons can decrease resilience on coldest sites. *Resistance*– **High**. Low climate suitability to invasive annual grasses
Cool and Moist (Frigid/Xeric)	Ppt: 12-22 inches Typical shrubs: *Mountain big sagebrush, antelope bitterbrush, snowberry, and/or low sagebrushes* Piñon pine and juniper potential in some areas	*Resilience* – **Moderately high**. Precipitation and productivity are generally high. Decreases in site productivity, herbaceous perennial species, and ecological conditions can decrease resilience. *Resistance* – **Moderate**. Climate suitability to invasive annual grasses is moderate, but increases as soil temperatures increase.
Warm and Moist (Mesic/Xeric)	Ppt: 12-16 inches Typical shrubs: *Wyoming big sagebrush, mountain big sagebrush, Bonneville big sagebrush, and/or low sagebrushes* Piñon pine and juniper potential in some areas	*Resilience* – **Moderate**. Precipitation and productivity are moderately high. Decreases in site productivity, herbaceous perennial species, and ecological conditions can decrease resilience. *Resistance* – **Moderately low**. Climate suitability to invasive annual grasses is moderately low, but increases as soil temperatures increase.
Cool and Dry (Frigid/Aridic)	Ppt: 6-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush, and/or low sagebrushes*	*Resilience* – **Low**. Effective precipitation limits site productivity. Decreases in site productivity, herbaceous perennial species, and ecological conditions further decrease resilience. *Resistance* – **Moderate**. Climate suitability to invasive annual grasses is moderate, but increases as soil temperatures increase.
Warm and Dry (Mesic/Aridic, bordering on Xeric)	Ppt: 8-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush and/or low sagebrushes*	*Resilience* – **Low.** Effective precipitation limits site productivity. Decreases in site productivity, herbaceous perennial species, and ecological conditions further decrease resilience. Cool season grasses susceptibility to grazing and fire, along with hot dry summer fire conditions, promote cheatgrass establishment and persistence. *Resistance* – **Low.** High climate suitability to cheatgrass and other invasive annual grasses. Resistance generally decreases as soil temperature increases, but establishment and growth are highly dependent on precipitation.

and have the potential for piñon and juniper expansion (Miller et al. 2014a; Chambers et al. *in press*). Many of these areas also are of conservation concern because piñon and juniper expansion and tree infilling can result in progressive loss of understory species and altered fire regimes (Miller et al. 2013). In contrast, areas with cool to cold soil temperature regimes and moist precipitation regimes have moderately high resilience and high resistance and are likely to recover in a reasonable amount of time following wildfires and other disturbances (Miller et al. 2013) (fig. 12B)

Figure 12. A Wyoming big sagebrush ecosystem with warm and dry soils in southeast Oregon (top) (photo by Richard F. Miller), compared to a mountain big sagebrush ecosystem with cool and moist soils in central Nevada (bottom) (photo by Jeanne C. Chambers).

Management Strategies Based on Landscape Cover of Sagebrush and Ecosystem Resilience and Resistance: The Sage-Grouse Habitat Matrix

Knowledge of the potential resilience and resistance of sagebrush ecosystems can be used in conjunction with sage-grouse habitat requirements to determine priority areas for management and identify effective management strategies at landscape scales (Wisdom and Chambers 2009). The sage-grouse habitat matrix (table 2) illustrates the relative resilience to disturbance and resistance to invasive annual grasses of sagebrush ecosystems in relation to the proportion of sagebrush cover on the landscape. As resilience and resistance go from high to low, as indicated by the rows in the matrix, decreases in sagebrush regeneration and abundance of perennial grasses and forbs progressively limit the capacity of a sagebrush ecosystem to recover after fire or other disturbances. The risk of annual invasives increases and the ability to successfully restore burned or otherwise disturbed areas decreases. As sagebrush cover goes from low to high within these same ecosystems, as indicated by the columns in the matrix, the capacity to provide adequate habitat cover for sage-grouse increases. Areas with less than 25% landscape cover of sagebrush are unlikely to provide adequate habitat for sage-grouse; areas with 26-65% landscape cover of sagebrush can provide habitat for sage-grouse but are at risk if sagebrush loss occurs without recovery; and areas with >65% landscape cover of sagebrush provide the necessary habitat conditions for sage-grouse to persist. Potential landscape scale management strategies can be determined by considering (1) resilience to disturbance, (2) resistance to invasive annuals, and (3) sage-grouse land cover requirements. Overarching management strategies to maintain or increase sage-grouse habitat at landscape scales based on these considerations are conservation, prevention, restoration, and monitoring and adaptive management (table 3; see Chambers et al. 2014). These strategies have been adapted for each of the primary agency programs including fire operations, fuels management, post-fire rehabilitation, and habitat restoration (table 4). Because sagebrush ecosystems occur over continuums of environmental conditions, such as soil temperature and moisture, and have differing land use histories and species composition, careful assessment of the area of concern always will be necessary to determine the relevance of a particular strategy (Pyke 2011; Chambers et al. 2014; Miller et al. 2014 a, b). The necessary information for conducting this type of assessment is found in the "Putting It All Together" section of this report.

Although the sage-grouse habitat matrix (table 2) can be viewed as partitioning land units into spatially discrete categories (i.e., landscapes or portions thereof can be categorized as belonging to one of nine categories), it is not meant to serve as a strict guide to spatial allocation of resources or to prescribe specific management strategies. Instead, the matrix should serve as a decision support tool for helping managers implement strategies that consider both the resilience and resistance of the landscape and landscape sagebrush cover requirements of sage-grouse. For example, low elevation Wyoming big sagebrush plant communities with relatively low resilience and resistance may provide important winter habitat resources for a given sage-grouse population. In a predominantly Wyoming big sagebrush area comprised of relatively low sagebrush landscape cover, a high level of management input may be needed to realize conservation benefits for sage-grouse. This doesn't mean that management activities should not be undertaken if critical or limiting sage-grouse habitat resources are present, but indicates that inputs will be intensive, potentially more expensive, and less likely to succeed relative to more resilient landscapes. It is up to the user of the matrix to determine how such tradeoffs influence management actions.

Table 2. Sage-grouse habitat matrix based on resilience and resistance concepts from Chambers et al. 2014, and sage-grouse habitat requirements from Aldridge et al. 2008, Wisdom et al. 2011, and Knick et al. 2013. Rows show the ecosystems relative resilience to disturbance and resistance to invasive annual grasses derived from the sagebrush ecological types in table 1 (1 = high resilience and resistance; 2 = moderate resilience and resistance; 3 = low resilience and resistance). Columns show the current proportion of the landscape (5-km rolling window) dominated by sagebrush (A = 1-25% land cover; B = 26-65% land cover; 3 = >65% land cover). Use of the matrix is explained in text. Overarching management strategies that consider resilience and resistance and landscape cover of sagebrush are in table 3. Potential management strategies specific to agency program areas, including fire operations, fuels management, post-fire rehabilitation, and habitat restoration are in table 4.

Ecosystem Resilience to Disturbance and Resistance to Invasive Annual Grasses	Proportion of Landscape Dominated by Sagebrush		
	Low 1-25% Too little sagebrush on the landscape significantly threatens likelihood of sage-grouse persistence.	**Moderate 26-65%** Sage-grouse are sensitive to the amount of sagebrush remaining on the landscape and populations could be at-risk with additional disturbances that remove sagebrush.	**High >65%** Sufficient sagebrush exists on the landscape and sage-grouse are highly likely to persist.
High	**1A** Natural sagebrush recovery is likely to occur, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**1B** Natural sagebrush recovery is likely to occur, but certain areas may lack connectivity.	**1C** Natural sagebrush recovery is likely to occur.
	Perennial herbaceous species are typically sufficient for recovery. Risk of annual invasives is low. Seeding/transplanting success is high. Recovery following inappropriate livestock use is often possible given changes in management.		
Moderate	**2A** Natural sagebrush recovery is likely on cooler and moister sites, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**2B** Natural sagebrush recovery is likely on cooler and moister sites, but certain areas may lack connectivity.	**2C** Natural sagebrush recovery is likely on cooler and moister sites.
	Perennial herbaceous species are usually adequate for recovery on cooler and moister sites. Risk of annual invasives is moderately high on warmer and drier sites. Seeding-transplanting success depends on site characteristics, and more than one intervention may be required especially on warmer and drier sites. Recovery following inappropriate livestock use depends on site characteristics and management.		
Low	**3A** Natural sagebrush recovery is not likely.	**3B** Natural sagebrush recovery may occur, but the time required will likely be too great and certain areas may lack connectivity.	**3C** Natural sagebrush recovery may occur, but the time required will likely be too great.
	Perennial herbaceous species are typically inadequate for recovery. Risk of annual invasives is high. Seeding/transplanting success depends on site characteristics, annual invasives, and post-treatment precipitation but is often low. More than one intervention likely will be required. Recovery following inappropriate livestock use is unlikely.		

Table 3. Potential management strategies based on resilience to disturbance, resistance to annual grass invasion, and sage-grouse habitat requirements based on Aldridge et al. 2008; Wisdom et al. 2011; and Knick et al. 2013 (adapted from Chambers et al. 2014).

Conserve – maintain or increase resilience to disturbance and resistance to invasive annuals in areas with high conservation value	
Priorities	• Ecosystems with low to moderate resilience to fire and resistance to invasive species that still have large patches of landscape sagebrush cover and adequate perennial grasses and forbs – *ecological types with warm and dry and cool and dry soil temperature/moisture regimes.* • Ecosystems with a high probability of providing habitat for sage-grouse, especially those with >65% landscape cover of sagebrush and adequate perennial herbaceous species – *all ecological types.*
Objective	• Minimize impacts of current and future human-caused disturbances and stressors.
Activities	• Immediately suppress fire in moderate to low resilience and resistance sagebrush and wooded shrublands to prevent an invasive annual grass-fire cycle. Large sagebrush patches are high priority for protection from wildfires. • Implement strategic fuel break networks to provide anchor points for suppression and reduce losses when wildfires escape initial attack. • Manage livestock grazing to prevent loss of perennial native grasses and forbs and biological soil crusts and allow natural regeneration. • Limit anthropogenic activities that cause surface disturbance, invasion, and fragmentation. (e.g., road and utility corridors, urban expansion, OHV use, and mineral/energy projects). • Detect and control new weed infestations.
Prevent – maintain or increase resilience and resistance of areas with declining ecological conditions that are at risk of conversion to a degraded, disturbed, or invaded state	
Priorities	• Ecosystems with moderate to high resilience and resistance – *ecological types with relatively cool and moist soil temperature and moisture regimes*. ○ Prioritize landscape patches that exhibit declining conditions due to annual grass invasion and/or tree expansion (e.g., at risk phase in State and Transition Models). • Ecosystems with a moderate to high probability of providing sage-grouse habitat, especially those with 26-65% landscape cover of sagebrush and adequate perennial native grasses and forbs – *all ecological types*.
Objectives	• Reduce fuel loads and decrease the risk of high intensity and high severity fire. • Increase abundance of perennial native grasses and forbs and of biological soil crusts where they naturally occur. • Decrease the longer-term risk of annual invasive grass dominance.
Activities	• Use mechanical treatments like cut and leave or mastication to remove trees, decrease woody fuels, and release native grasses and forbs in warm and moist big sagebrush ecosystems with relatively low resistance to annual invasive grasses that are in the early to mid-phase of piñon and/or juniper expansion. • Use prescribed fire or mechanical treatments to remove trees, decrease woody fuels, and release native grasses and forbs in cool and moist big sagebrush ecosystems with relatively high resistance to annual invasive grass that are in early to mid-phase of piñon and/or juniper expansion. • Actively manage post-treatment areas to increase perennial herbaceous species and minimize secondary weed invasion. • Consider the need for strategic fuel breaks to help constrain fire spread or otherwise augment suppression efforts.
Restore – increase resilience and resistance of disturbed, degraded, or invaded areas	

Priorities	• Areas burned by wildfire – *all ecological types*
	  ○ Prioritize areas with low to moderate resilience and resistance, and that have a reasonable expectation of recovery.
	  ○ Prioritize areas where perennial grasses and forbs have been depleted.
	  ○ Prioritize areas that experienced high severity fire.

(continued)

Table 3. (Continued).

	• Sage-grouse habitat – *all ecological types*
	  ○ Prioritize areas where restoration of sagebrush and/or perennial grasses is needed to create large patches of landscape cover of sagebrush or connect existing patches of sagebrush habitat.
	  ○ Prioritize areas with adequate landscape cover of sagebrush where restoration of perennial grasses and forbs is needed.
	• Areas affected by anthropogenic activities that cause surface disturbance, invasion, and fragmentation. (e.g., road and utility corridors, urban expansion, OHV use, and mineral/energy projects) – *all ecological types.*

Objectives	• Increase soil stability and curtail dust. • Control/suppress invasive annual grasses and other invasive plants. • Increase landscape cover of sagebrush. • Increase perennial grasses and forbs and biological soil crusts where they naturally occur. • Reduce the risk of large fires that burn sage-grouse habitat.
Activities	• Use integrated strategies to control/suppress annual invasive grass and other annual invaders. • Establish and maintain fuel breaks or greenstrips in areas dominated by invasive annual grasses that are adjacent to areas with >25% landscape sagebrush cover and adequate perennial native grasses and forbs. • Seed perennial grasses and forbs that are adapted to local conditions to increase cover of these species in areas where they are depleted. • Seed and/or transplant sagebrush to restore large patches of sagebrush cover and connect existing patches. • Repeat restoration treatments if they fail initially to ensure restoration success especially in warm and dry soil temperature moisture regimes where weather is often problematic for establishment. • Actively manage restored/rehabilitated areas to increase perennial herbaceous species and minimize secondary weed invasion.
Monitoring and Adaptive Management– implement comprehensive monitoring to track landscape change and management outcomes and provide the basis for adaptive management	
Priorities	• Regional environmental gradients to track changes in plant community and other ecosystem attributes and expansion or contraction of species ranges – *all ecological types.* • Assess treatment effectiveness – *all ecological types.*
Objectives	• Understand effects of wildfire, annual grass invasion, piñon and juniper expansion, climate change and other global stressors in sagebrush ecosystems • Increase understanding of the long- and short-term outcomes of management treatments.
Activities	• Establish a regional network of monitoring sites that includes major environmental gradients. • Collect pre- and post-treatment monitoring data for all major land treatments activities. • Collect data on ecosystem status and trends (for example, land cover type, ground cover, vegetation cover and height [native and invasive], phase of tree expansion, soil and site stability, oddities). • Use consistent methods to monitor indicators. • Use a cross-boundary approach that involves all major land owners. • Use a common data base for all monitoring results (e.g., Land Treatment Digital Library; http://greatbasin.wr.usgs.gov/ltdl/). • Develop monitoring products that track change and provide management implications and adaptations for future management. • Support and improve information sharing on treatment effectiveness and monitoring results across jurisdictional boundaries (e.g., Great Basin Fire Science Delivery Project; www.gbfiresci.org).

Table 4. Specific management strategies by agency program area for the cells within the sage-grouse habitat matrix (table 2). The rows indicate relative resilience and resistance (numbers) and the columns indicate landscape cover of sagebrush by category (letters). Resilience and resistance are based on soil temperature and moisture regimes (fig. 11) and their relationship to ecological types (table 1). Percentage of the landscape dominated by sagebrush is based on the capacity of large landscapes to support viable sage-grouse populations over the long term (fig. 8). Note that these guidelines are related to the sage-grouse habitat matrix, and do not preclude other factors from consideration when determining management priorities for program areas. The "Fire Operations" program area includes preparedness, prevention, and suppression activities.

High Resilience to Disturbance and Resistance to Invasive Annual Grasses (1A, 1B, 1C)	
Natural sagebrush recovery is likely to occur. Perennial herbaceous species are sufficient for recovery. Risk of invasive annual grasses is typically low.	
Fire Operations	• Fire suppression is typically third order priority, but varies with large fire risk and landscape condition (cells 1A, 1B, 1C). Scenarios requiring higher priority may include: ○ Areas of sagebrush that bridge large, contiguous expanses of sagebrush and that are important for providing connectivity for sage-grouse (cells 1B, 1C). ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 1A, 1B, 1C) ○ Areas with later phase (Phase III) post-settlement piñon and juniper that have high resistance to control, are subject to large and/or severe fires, and place adjacent sage-grouse habitat at risk (cells 1A, 1B). ○ All areas when critical burning environment conditions exist. These conditions may be identified by a number of products including, but not limited to: Predictive Services 7-Day Significant Fire Potential Forecasts; National Weather Service Fire Weather Watches and Red Flag Warnings; fire behavior forecasts or other local knowledge.
Fuels Management	• Fuels management to reduce large sagebrush stand losses is a second order priority, especially in cells 1B and 1C. Management activities include: ○ Strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Tree removal in early to mid-phase (Phases I, II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads. ○ Tree removal in later phase (Phase III), post-settlement piñon and juniper areas to reduce risks of large or high severity fires. Because these areas represent non-sage-grouse habitat, prescribed fire may be appropriate on cool and moist sites, but invasive plant control and restoration of sagebrush and perennial native grasses and forbs may be necessary.
Post-Fire Rehabilitation	• Post-fire rehabilitation is generally low priority (cells 1A, 1B, 1C). Areas of higher priority include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Steep slopes and soils with erosion potential.
Habitat Restoration and Recovery	• Restoration is typically passive and designed to increase or maintain perennial herbaceous species, biological soil crusts and landscape cover of sagebrush (cells 1A, 1B, 1C). Areas to consider for active restoration include: ○ Areas where perennial herbaceous cover density, or composition is inadequate for recovery after surface disturbance. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse.
Moderate Resilience to Disturbance and Resistance to Invasive Annuals (2A, 2B, 2C)	
Natural sagebrush recovery is likely to occur on cooler and moister sites, but the time required may be too great if large, contiguous areas lack sagebrush. Perennial herbaceous species are usually adequate for recovery on cooler and moister sites. Risk of invasive annual grasses is moderately high on warmer and drier sites.	
Fire Operations	• Fire suppression is typically second order priority (cells 2A, 2B, 2C). Scenarios requiring higher priority may include: ○ Areas of sagebrush that bridge large, contiguous expanses of sagebrush and that are important for providing connectivity for sage-grouse (cells 2B, 2C).

(continued)

Table 4. (Continued).

	○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 2A, 2B, 2C) ○ Areas with later phase (Phase III), post-settlement piñon and juniper that have high resistance to control, are subject to large and/or severe fires, and place adjacent sage-grouse habitat at risk (cells 2A, 2B). ○ Areas where annual grasslands place adjacent sage-grouse habitat at risk (cell 2A). ○ All areas when critical burning environment conditions exist. These conditions may be identified by a number of products including, but not limited to: Predictive Services 7-Day Significant Fire Potential Forecasts; National Weather Service Fire Weather Watches and Red Flag Warnings; fire behavior forecasts or other local knowledge.
Fuels Management	• Fuels management to reduce large sagebrush stand losses is a first order priority, especially in cells 2B and 2C. Management activities include: ○ Strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Tree removal in early to mid-phase (Phase I, II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads. ○ Tree removal in later phase (Phase III), post-settlement piñon and juniper areas to reduce risks of large or high severity fires. Because these areas represent non-sage-grouse habitat, prescribed fire may be appropriate on cool and moist sites, but restoration of sagebrush and perennial native grasses and forbs may be necessary.
Post-Fire Rehabilitation	• Post-fire rehabilitation is generally low priority (cells 2A, 2B, 2C) in cooler and moister areas. Areas of higher priority include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Relatively warm and dry areas where annual invasives are expanding. ○ Steep slopes with erosion potential.
Habitat Restoration and Recovery	• Restoration is typically passive on cooler and moister areas and is designed to increase or maintain perennial herbaceous species, biological soil crusts, and landscape cover of sagebrush (cells 2A, 2B, 2C). Areas to consider for active restoration include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery after surface disturbance. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Relatively warm and dry areas where annual invasives are expanding.

Low Resilience to Disturbance and Resistance to Invasive Annuals (3A, 3B, 3C)

Natural sagebrush recovery is not likely. Perennial herbaceous species are typically inadequate for recovery. Risk of invasive annual grasses is high.

Fire Operations	• Fire suppression priority depends on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). These areas may be a higher priority if they are adjacent to intact sage-grouse habitat or are essential for connectivity. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). These areas are higher priority if they have intact understories and if they are adjacent to sage-grouse habitat. ○ Areas with >65% landscape cover of sagebrush are first order priority (cell 3C). ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 3A, 3B, 3C).

(continued)

Table 4. (Continued).

Fuels Management	• Fuels management priority and management activities depend on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). Strategic placement of fuel breaks may be needed to reduce loss of adjacent sage-grouse habitat by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). These areas are higher priority if they have intact understories and if they are adjacent to sage-grouse habitat. Strategic placement of fuel breaks may be needed to reduce loss of large sagebrush stands by wildfire. ○ Areas with >65% landscape cover of sagebrush are first order priority (cell 3C). Strategic placement of fuel breaks may be needed to reduce loss of large sagebrush stands by wildfire. ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 3A, 3B, 3C). Strategic placement of fuel breaks may be needed to protect investments from repeated loss to wildfire.
Post-Fire Rehabilitation	• Post-fire rehabilitation priority and management activities depend on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). Exceptions include (1) sites that are relatively cool and moist and (2) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. In highly invaded areas, integrated strategies that include seeding of perennial herbaceous species and seeding and/or transplanting sagebrush will be required. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). Exceptions include (1) sites that are relatively cool and moist or that are not highly invaded, and (2) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. Seeding of perennial herbaceous species will be required where cover, density and species composition of these species is inadequate for recovery. Seeding and/or transplanting sagebrush as soon as possible is necessary for rehabilitating sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with >65% landscape cover of sagebrush are first order priority, especially if they are part of a larger, contiguous area of sagebrush (cell 3C). Seeding of perennial herbaceous species will be required where cover, density and species composition of these species is inadequate for recovery. Seeding and/or transplanting sagebrush as soon as possible is necessary for rehabilitating sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation.
Habitat Restoration and Recovery	• Restoration priority and management activities depends on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority. Exceptions include (1) surface disturbances and (2) areas adjacent to sage-grouse habitat where seeding can be used to prevent annual invasive spread (cell 3A). In highly invaded areas, integrated strategies that include seeding of perennial herbaceous species and seeding and/or transplanting sagebrush will be required. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). Exceptions include (1) surface disturbances, (2) sites that are relatively cool and moist or that are not highly invaded, and (3) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. Seeding of perennial herbaceous species may be required where cover, density and species composition of these species is inadequate. Seeding and/or transplanting sagebrush as soon as possible is necessary for restoring sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with >65% landscape cover of sagebrush are first order priority, especially if they are part of a larger, contiguous area of sagebrush (cell 3C). Seeding of perennial herbaceous species may be required where cover, density, and species composition of these species is inadequate. Seeding and/or transplanting sagebrush as soon as possible is necessary for restoring sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation.

Another important consideration is that ecological processes such as wildfire can occur either within or across categories in the sage-grouse habitat matrix and it is necessary to determine the appropriate spatial context when evaluating management opportunities based on resilience and resistance and sage-grouse habitat. For example, if critical sage-grouse habitat occurs in close proximity to landscapes comprised mainly of annual grass-dominated plant communities, then fire risk to adjacent sage-grouse habitat can increase dramatically (Balch et al. 2013). In this scenario, management actions could include reducing the influence of invasive annual grasses with a strategic fuel break on the perimeter of intact sagebrush. Thus, management actions may have value to sustaining existing sage-grouse habitat, even if these measures are applied in locations that are currently not habitat; the spatial relationships of sagebrush and invasive annual grasses should be considered when prioritizing management actions and associated conservation measures.

Informing Wildfire and Fuels Management Strategies to Conserve Sage-Grouse

Collectively, responses to wildfires and implementation of fuels management projects are important contributors to sage-grouse conservation. Resilience and resistance concepts provide a science-based background that can inform fire operations and fuels management strategies and allocation of scarce assets during periods of high fire activity. In fire operations, firefighter and public safety is the overriding objective in all decisions. In addition, land managers consider numerous other values at risk, including the Wildland-Urban Interface (WUI), habitats, and infrastructure when allocating assets and prioritizing efforts. Resilience and resistance concepts are especially relevant for evaluating tradeoffs related to current ecological conditions and rates of recovery and possible ecological consequences of different fire management activities. For example, prioritizing initial attack efforts based on ecological types and their resilience and resistance at fire locations is a possible future application of resilience and resistance concepts. Also, fire prevention efforts can be concentrated where human ignitions have commonly occurred near intact, high quality habitats that also have inherently low resilience and resistance.

Fuels management projects are often applied to (1) constrain or minimize fire spread; (2) alter species composition; (3) modify fire intensity, severity, or effects; or (4) create fuel breaks or anchor points that augment fire management efforts (fig. 13). These activities are selectively used based on the projected ecosystem response, anticipated fire patterns, and probability of success. For example, in areas that are difficult to restore due to low to moderate resilience, fuel treatments can be placed to minimize fire spread and conserve sagebrush habitat. In cooler and moister areas with moderate to high resilience and resistance, mechanical or prescribed fire treatments may be appropriate to prevent conifer expansion and dominance. Given projected climate change and longer fire seasons across the western United States, fuels management represents a proactive approach for modifying large fire trends. Fire operations and fuels management programs contribute to a strategic, landscape approach when coupled with data that illustrate the likelihood of fire occurrence, potential fire behavior, and risk assessments (Finney et al. 2010; Oregon Department of Forestry 2013). In tandem with resilience and resistance concepts, these data can further inform fire operations and fuels management decisions.

Figure 13. Fuel breaks may include roads, natural features, or other management imposed treatments intended to modify fire behavior or otherwise augment suppression efforts at the time of a fire. Such changes in fuel type and arrangement may improve suppression effectiveness by modifying flame length and fire intensity, and allow fire operations to be conducted more safely. The top photo shows a burnout operation along an existing road to remove available fuels ahead of an oncoming fire and constrain overall fire growth (photo by BLM Idaho Falls District). The bottom photo shows fuel breaks located along a road, which complimented fire control efforts when a fire intersected the fuel break and road from the right (photo by Ben Dyer, BLM).

Putting it all Together

Effective management and restoration of sage-grouse habitat will benefit from a collaborative approach that prioritizes the best management practices in the most appropriate places. This section describes an approach for assessing focal areas for sage-grouse habitat management based on widely available data, including (1) Priority Areas for Conservation (PACs), (2) breeding bird densities, (3) habitat suitability as indicated by the landscape cover of sagebrush, (4) resilience and resistance and dominant ecological types as indicated by soil temperature and moisture regimes, and (5) habitat threats as indicated by cover of cheatgrass, cover of piñon and juniper, and by fire history. Breeding bird density data are overlain with landscape cover of sagebrush and with resilience and resistance to spatially link sage-grouse populations with habitat conditions and risks. We illustrate the use of this step-down approach for evaluating focal areas for sage-grouse habitat management across the western portion of the range, and we provide a detailed example for a diverse area in the northeast corner of Nevada that is comprised largely of PACs with mixed land ownership. The sage-grouse habitat matrix (table 2) is used as a tool in the decision process, and guidelines are provided to assist in determining appropriate management strategies for the primary agency program areas (fire operations, fuels management, post-fire rehabilitation, habitat restoration) for each cell of the matrix.

We conclude with discussions of the tools available to aid in determining the suitability of an area for treatment and the most appropriate management treatments such as ecological site descriptions and state and transition models and of monitoring and adaptive management. Datasets used to compile the maps in the following sections are in Appendix 4.

Assessing Focal Areas for Sage-Grouse Habitat Management: Key Data Layers

Priority areas for conservation: The recent identification of sage-grouse strongholds, or Priority Areas for Conservation (PACs), greatly improves the ability to target management actions towards habitats expected to be critical for long-term viability of the species (fig. 14; USFWS 2013). Understanding and minimizing risks of large-scale loss of sagebrush and conversion to invasive annual grasses or piñon and juniper in and around PACs will be integral to maintaining sage-grouse distribution and stabilizing population trends. PACs were developed by individual states to identify those areas that are critical for ensuring adequate representation, redundance, and resilience to conserve sage-grouse populations. Methods differed among states; in general, PAC boundaries were identified based on (1) sage-grouse population data including breeding bird density, lek counts, telemetry, nesting areas, known distributions, and sightings/observations; and (2) habitat data including occupied habitat, suitable habitat, seasonal habitat, nesting and brood rearing areas, and connectivity areas or corridors. Sage-grouse habitats outside of PACs also are important in assessing focal areas for management where they provide connectivity between PACs (genetic and habitat linkages), seasonal habitats that may have been underestimated due to emphasis on lek sites to define priority areas, habitat restoration and population expansion opportunities, and flexibility for managing habitat changes that may result from climate change (USFWS 2013). If PAC boundaries are adjusted, they will need to be updated for future analyses.

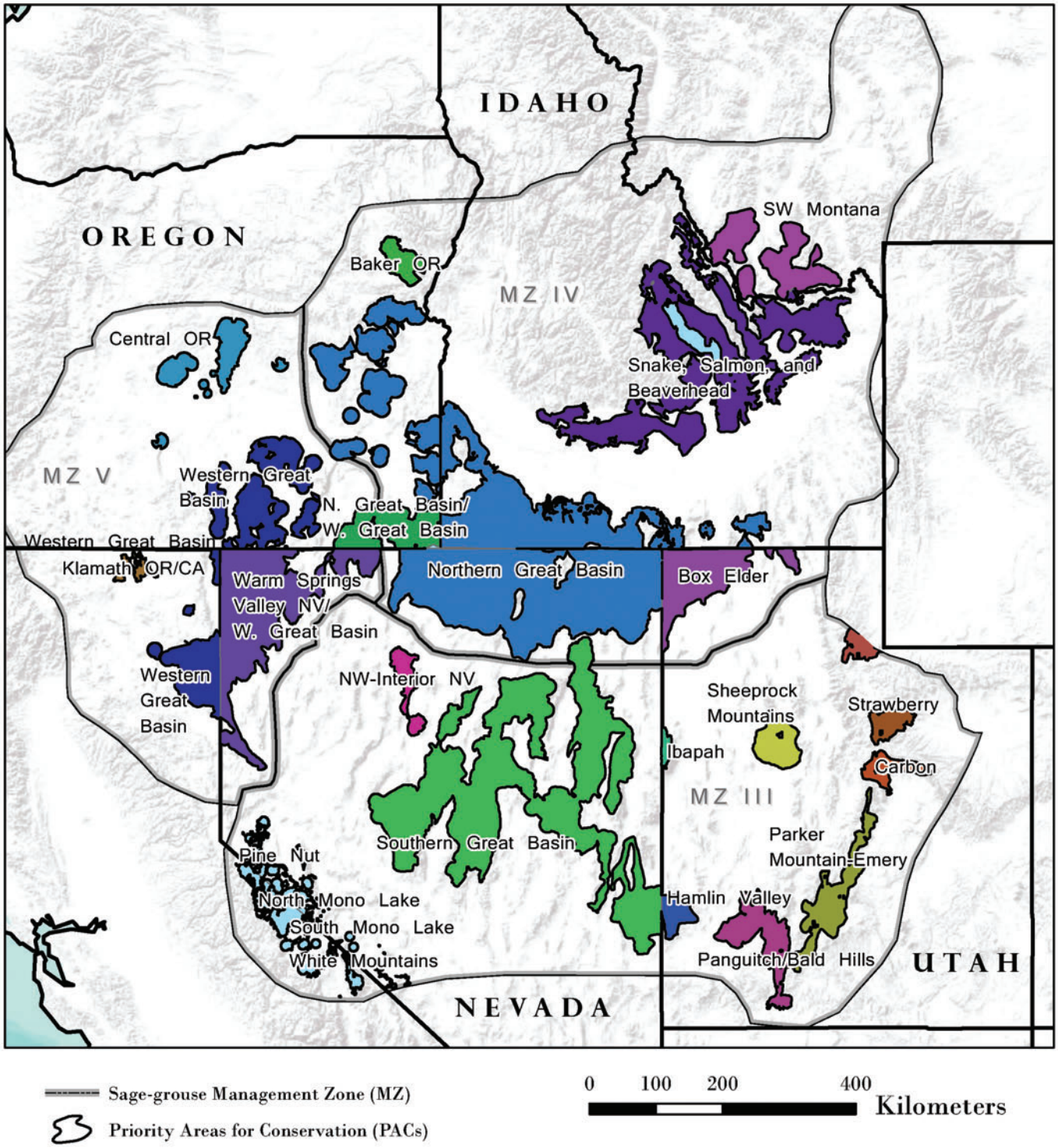


Figure 14. Priority Areas for Conservation (PACs) within the range of sage-grouse (USFWS 2013). Colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Breeding bird density: Range-wide breeding bird density areas provide one of the few accessible data sets for further prioritizing actions within and adjacent to PACs to maintain species distribution and abundance. Doherty et al. (2010b) developed a useful framework for incorporating population data in their range-wide breeding bird density analysis, which used maximum counts of males on leks (n = 4,885) to delineate breeding bird density areas that contain 25, 50, 75, and 100% of the known breeding population (fig. 15). Leks were mapped according to these abundance values and buffered by a 6.4 to 8.5 km (4.0 to 5.3 mi) radius to delineate nesting areas. Findings showed that while sage-grouse occupy extremely large landscapes, their breeding distribution is highly aggregated in comparably smaller identifiable population centers; 25% of the known population occurs within 3.9% (2.9 million ha; 7.2 million ac) of the species range, and 75% of birds are within 27.0% of the species range (20.4 million ha; 50.4 million ac) (Doherty et al. 2010b). The Doherty et al. (2010b) analysis emphasized breeding habitats primarily because little broad scale data exist for summer and winter habitat use areas. Even though the current breeding bird density data provide the most comprehensive data available, they do not include all existing sage-grouse populations. Incorporating finer scale seasonal habitat use data at local levels where it is available will ensure management actions encompass all seasonal habitat requirements.

For this assessment, we chose to use State-level breeding bird density results from Doherty et al. (2010b) instead of range-wide model results to ensure that important breeding areas in MZs III, IV, and V were not underweighted due to relatively higher bird densities in the eastern portion of the range. It is important to note that breeding density areas were identified using best available information in 2009, so these range-wide data do not reflect the most current lek count information or changes in conditions since the original analysis. Also, breeding density areas should not be viewed as rigid boundaries but rather as the means to prioritize landscapes regionally where step-down assessments and actions may be implemented quickly to conserve the most birds.

Landscape cover of sagebrush: Landscape cover of sagebrush is one of the key determinants of sage-grouse population persistence and, in combination with an understanding of resilience to disturbance and resistance to invasive annuals, provides essential information both for determining priority areas for management and appropriate management actions (fig. 10; tables 2 and 3). Landscape cover of sagebrush is a measure of large, contiguous patches of sagebrush on the landscape and is calculated from remote sensing databases such as LANDFIRE (see Appendix 4). We used the three cover categories of sagebrush landscape cover discussed previously to predict the likelihood of sustaining sage-grouse populations (1-25%, 25-65%, >65%). The sagebrush landscape cover datasets were created using a moving window to summarize the proportion of area (5-km [3.1-mi] radius) dominated by sagebrush surrounding each 30-m pixel and then assigned those areas to the three categories (see Appendix 2). Because available sagebrush cover from sources such as LANDFIRE does not exclude recent fire perimeters, it was necessary to either include these in the analysis of landscape cover of sagebrush or display them separately. Although areas that have burned since 2000 likely do not currently provide desired sage-grouse habitat, areas with the potential to support sagebrush ecological types can provide conservation benefits in the overall planning effort especially within long-term conservation areas like PACs. The landscape cover of sagebrush and recent fire perimeters are illustrated for the western portion of the range (fig.16) and northeast Nevada (fig. 17).

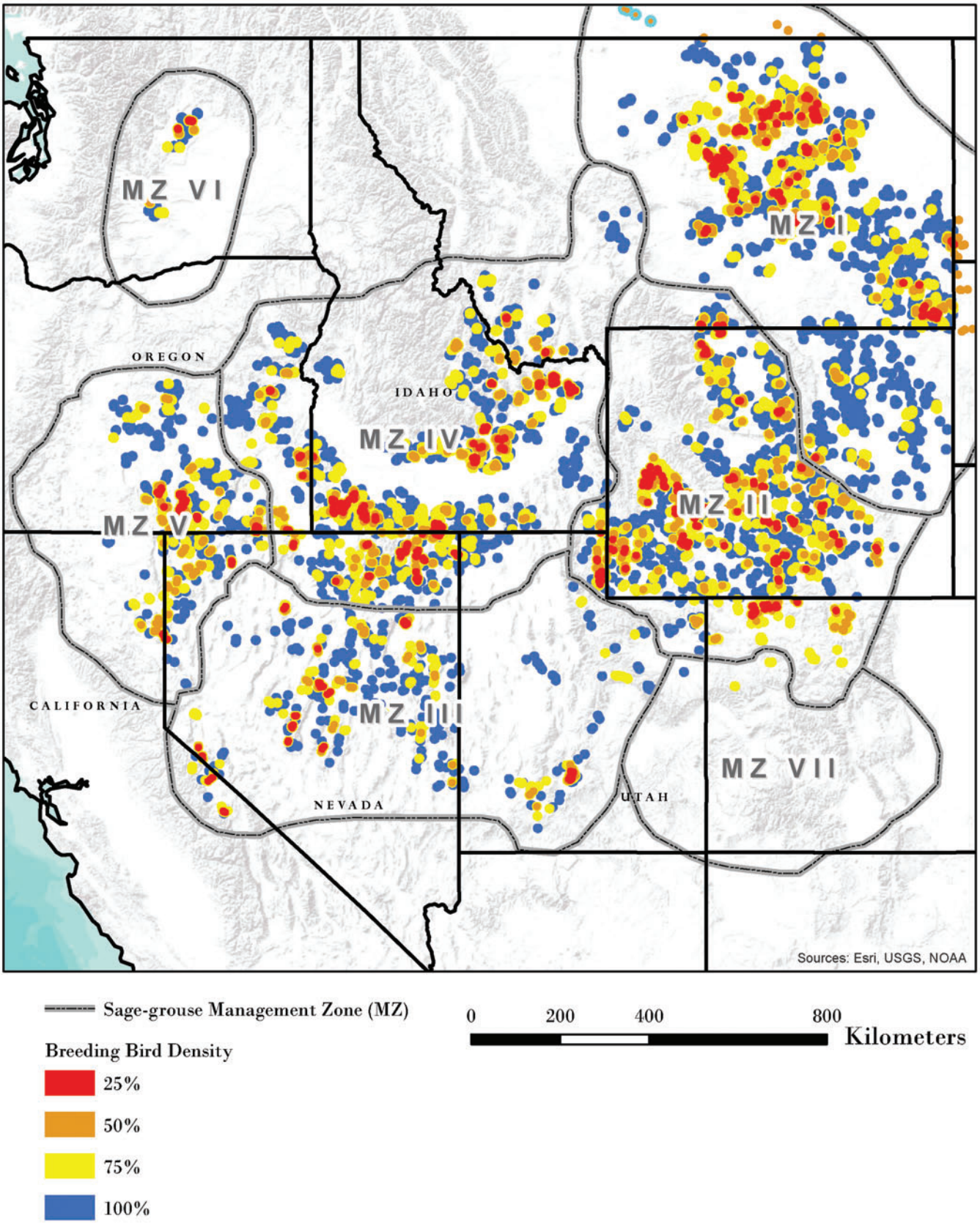


Figure 15. Range-wide sage-grouse breeding bird densities from Doherty et al. 2010. Points illustrate breeding bird density areas that contain 25, 50, 75, and 100% of the known breeding population and are based on maximum counts of males on leks (n = 4,885). Leks were mapped according to abundance values and buffered by 6.4 to 8.5 km (4.0 to 5.2 mi) to delineate nesting areas.

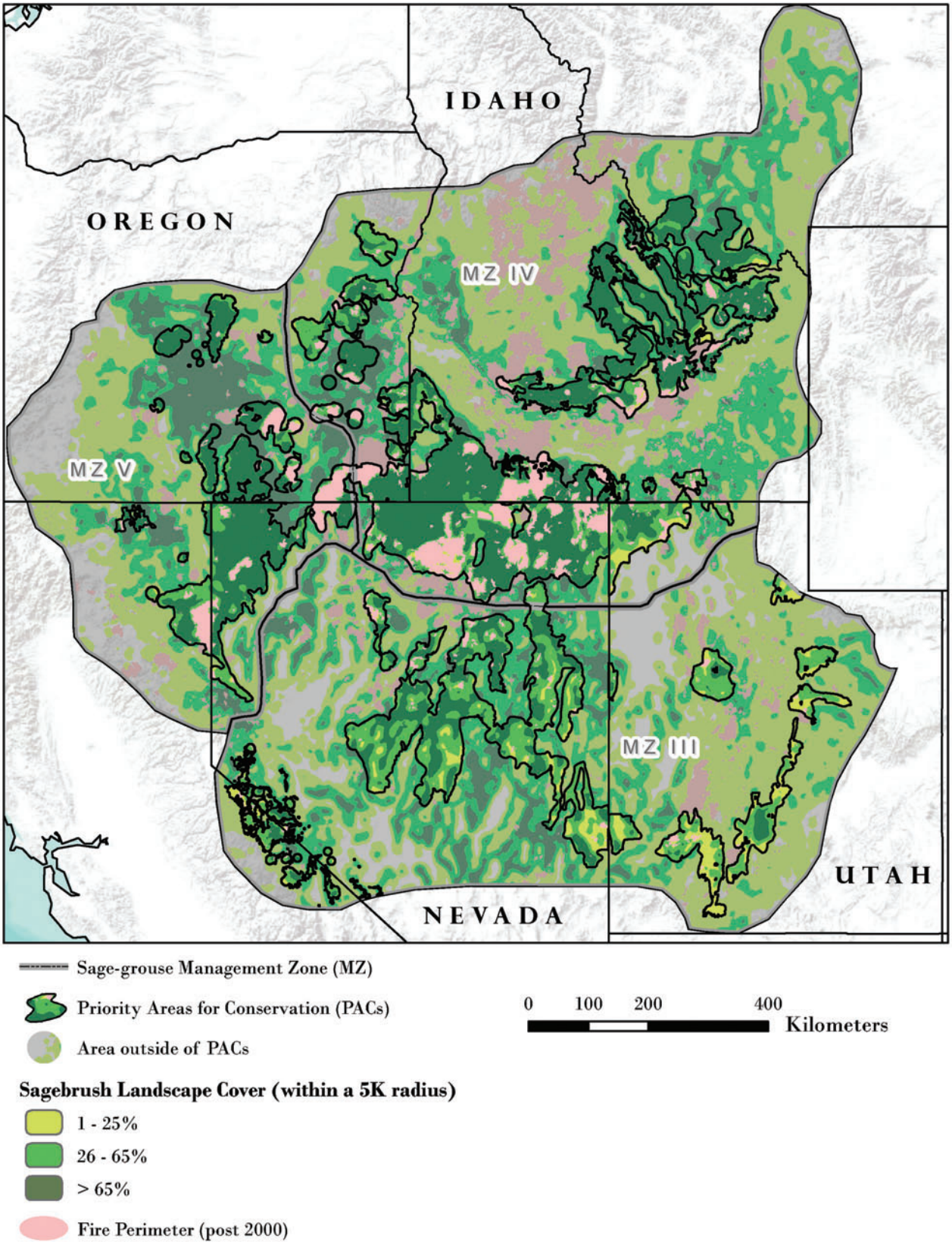


Figure 16. The landscape cover of sagebrush within each of three selected categories (1-25%, 26-65%, >65%) for Management Zones III, IV, and V (Stiver et al. 2006). The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover. Darker colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

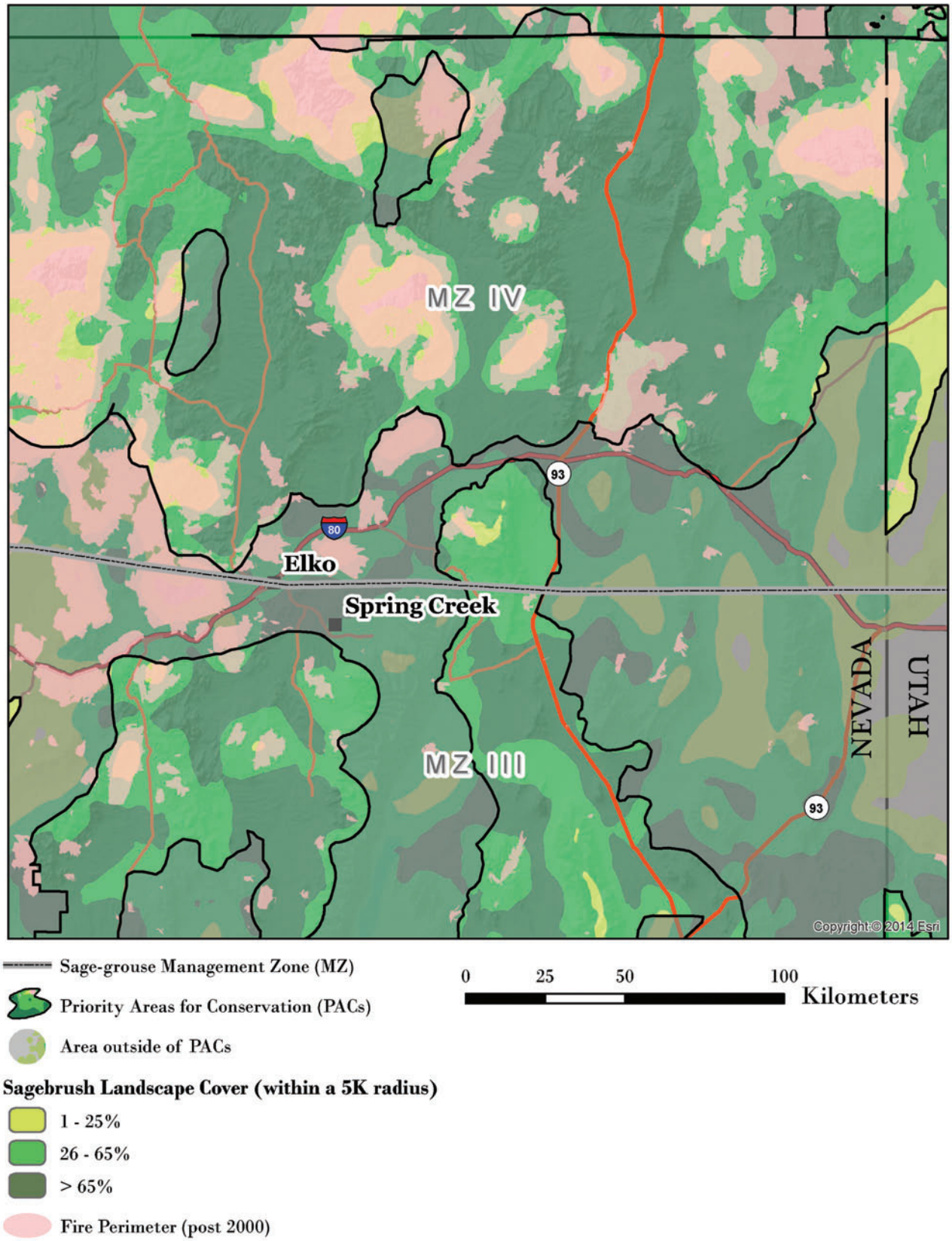


Figure 17. The landscape cover of sagebrush within each of the selected categories (1-25%, 26-65%, >65%) for the northeastern portion of Nevada. The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover. Darker colored polygons delineate Priority Areas for Conservation (USFWS 2013).

Resilience to disturbance and resistance to annuals: Soil temperature and moisture regimes are a strong indicator of ecological types and of resilience to disturbance and resistance to invasive annual plants (fig. 11; table 1). Resilience and resistance predictions coupled with landscape cover of sagebrush can provide critical information for determining focal areas for targeted management actions (tables 2, 3, and 4). The available data for the soil temperature and moisture regimes were recently compiled to predict resilience and resistance (see Appendix 3). These data, displayed for the western portion of the range and northeast Nevada (figs. 18 and 19), illustrate the spatial variability within the focal areas. Soil temperature and moisture regimes are two of the primary determinants of ecological types and of more detailed ecological site descriptions, which are described in the section on "Determining the Most Appropriate Management Treatments at the Project Scale."

Habitat threats: Examining additional land cover data or models of invasive annual grasses and piñon and/or juniper, can provide insights into the current extent of threats in a planning area (e.g., Manier et al. 2013). In addition, evaluating data on fire occurrence and size can provide information on fire history and the rate and pattern of change within the planning area. Data layers for cheatgrass cover have been derived from Landsat imagery (Peterson 2006, 2007) and from model predictions based on species occurrence, climate variables, and anthropogenic disturbance (e.g., the Bureau of Land Management [BLM] Rapid Ecoregional Assessments [REAs]). The REAs contain a large amount of geospatial data that may be useful in providing landscape scale information on invasive species, disturbances, and vegetation types across most of the range of sage-grouse (http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html). Similarly, geospatial data for piñon and/or juniper have been developed for various States (e.g., Nevada and Oregon) and are becoming increasingly available rangewide. In addition, more refined data products are often available at local scales. Land managers can evaluate the available land cover datasets and select those land covers with the highest resolution and accuracy for the focal area. Land cover of cheatgrass and piñon and/or juniper and the fire history of the western portion of the range and northeast Nevada are in figures 20-25.

Assessing Focal Areas for Sage-Grouse Habitat Management: Integrating Data Layers

Combining resilience and resistance concepts with sage-grouse habitat and population data can help land managers further gauge relative risks across large landscapes and determine where to focus limited resources to conserve sage-grouse populations. Intersecting breeding bird density areas with soil temperature and moisture regimes provides a spatial tool to depict landscapes with high bird concentrations that may have a higher relative risk of being negatively affected by fire and annual grasses (figs. 26, 27). For prioritization purposes, areas supporting 75% of birds (6.4 to 8.5 km [4.0 to 5.2 mi] buffer around leks) can be categorized as high density while remaining breeding bird density areas (75-100% category; 8.5-km [5.2-mi] buffer around leks) can be categorized as low density. Similarly, warm and dry types can be categorized as having relatively low resilience to fire and resistance to invasive species and all other soil temperature and moisture regimes can be categorized as having relatively moderate to high resilience and resistance. Intersecting breeding bird density areas with landscape cover of sagebrush provides another spatial component revealing large and intact habitat blocks and areas in need of potential restoration to provide continued connectivity (fig. 28).

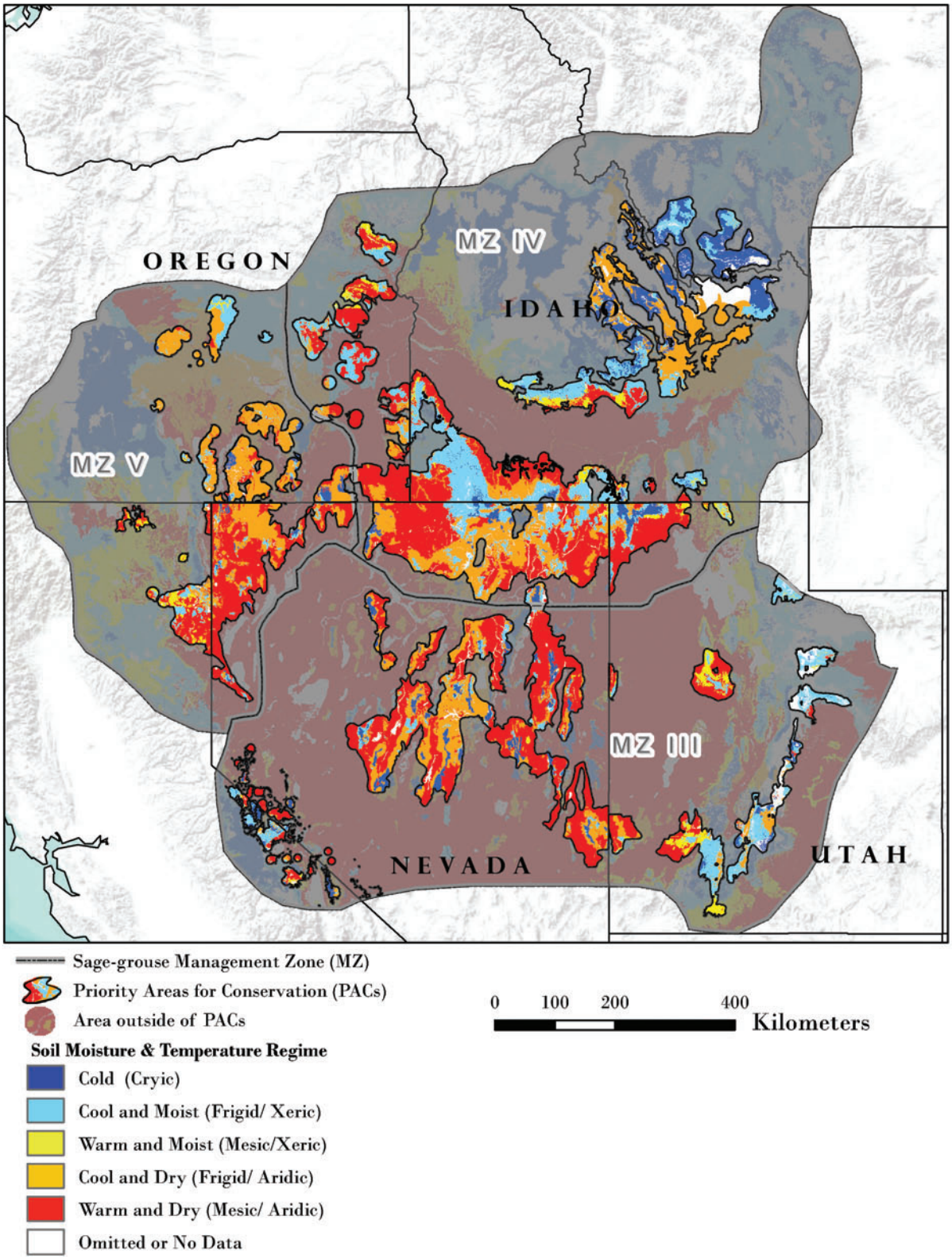


Figure 18. The soil temperature and moisture regimes within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b). Darker colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

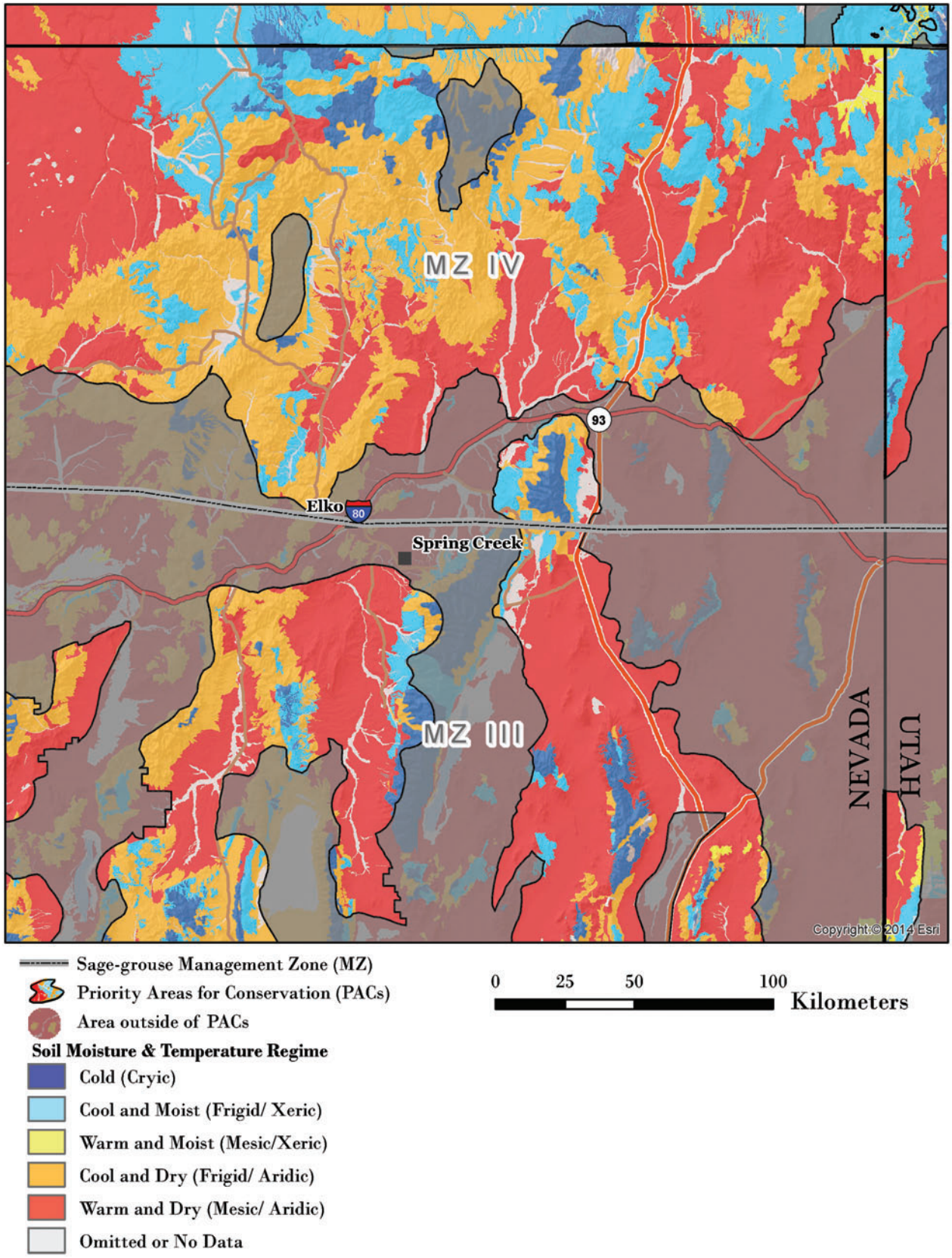


Figure 19. The soil temperature and moisture regimes for the northeast corner of Nevada. Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b). Darker colored polygons delineate Priority Areas for Conservation (USFWS 2013).

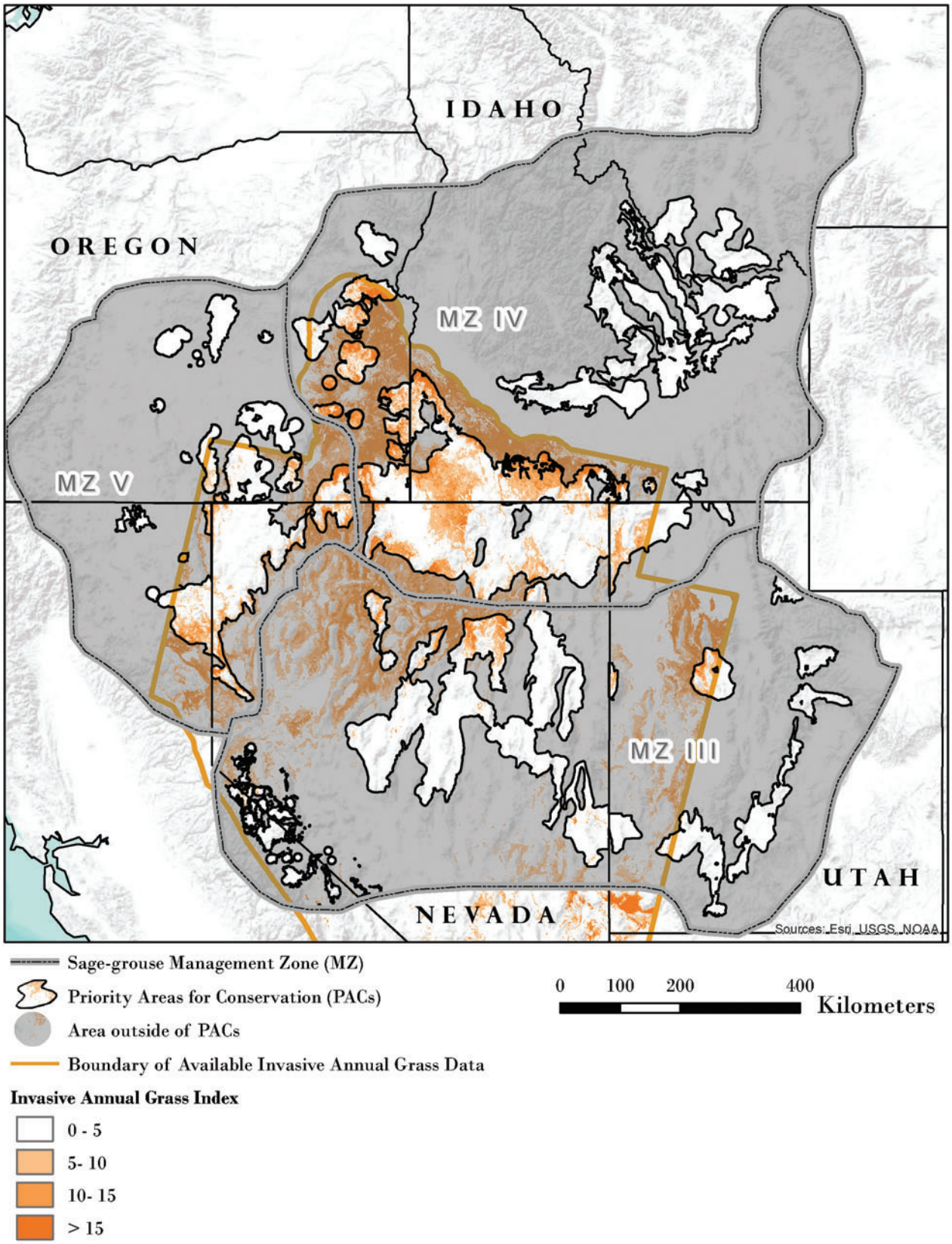


Figure 20. Invasive annual grass index for Nevada (Peterson 2006) and the Owhyee uplands (Peterson 2007) displayed for sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

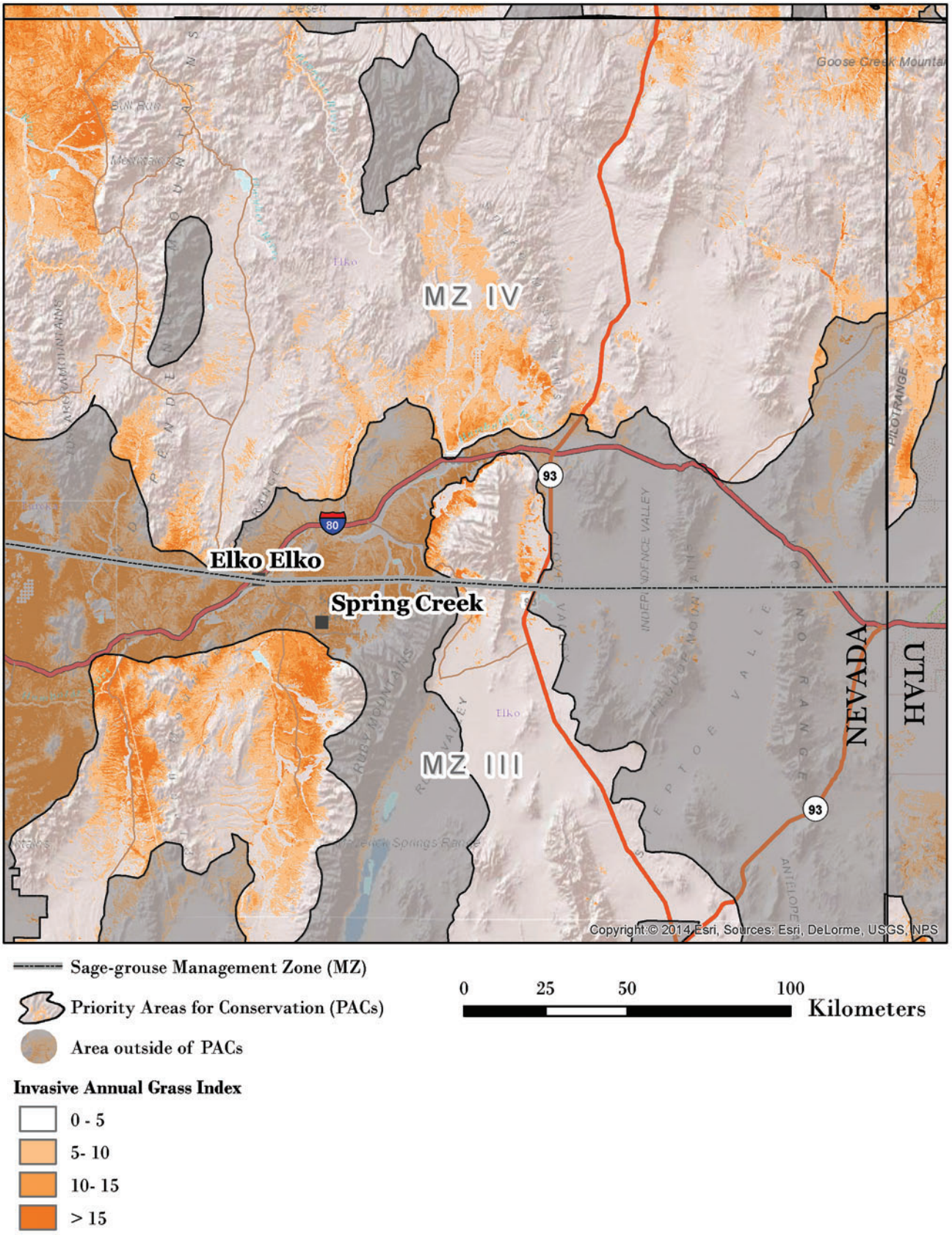


Figure 21. Invasive annual grass index for Nevada (Peterson 2006) and the Owhyee uplands (Peterson 2007) displayed for the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

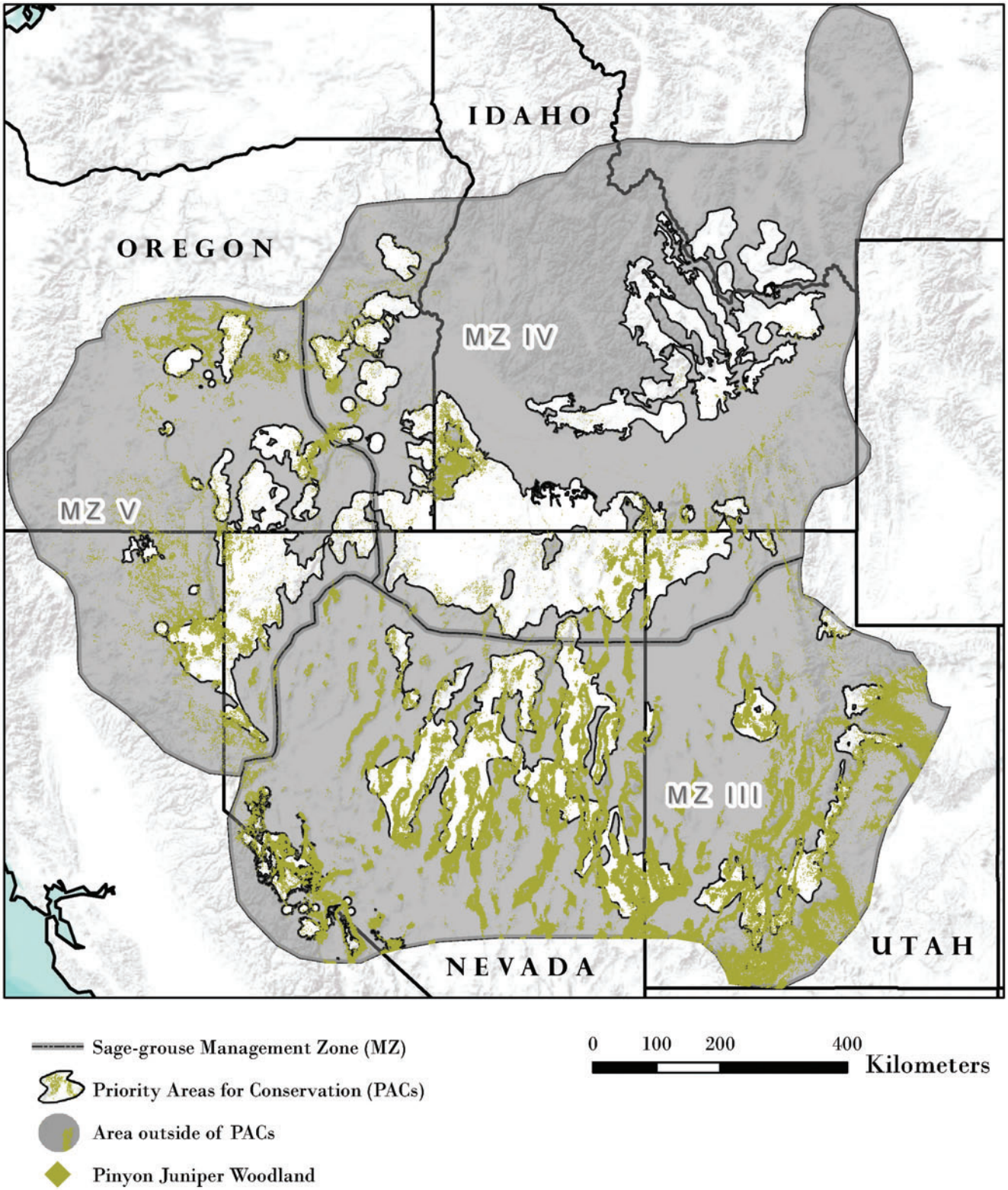


Figure 22. Piñon and/or juniper woodlands (USGS 2004; USGS 2013) within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Figure 23. Piñon and/or juniper woodlands (USGS 2004; USGS 2013) within the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

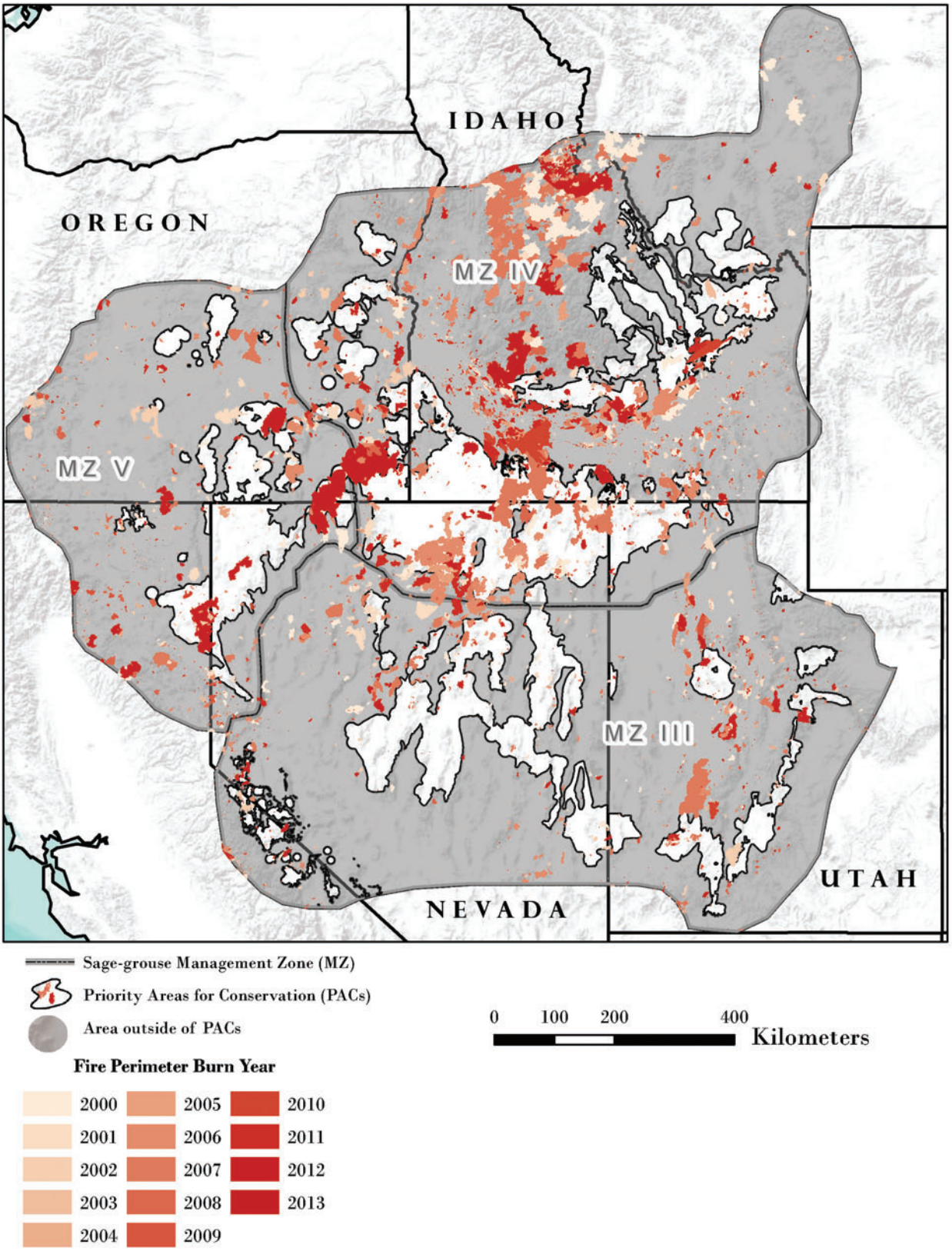


Figure 24. Fire perimeters (Walters et al. 2011; Butler and Bailey 2013) within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Ligher colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

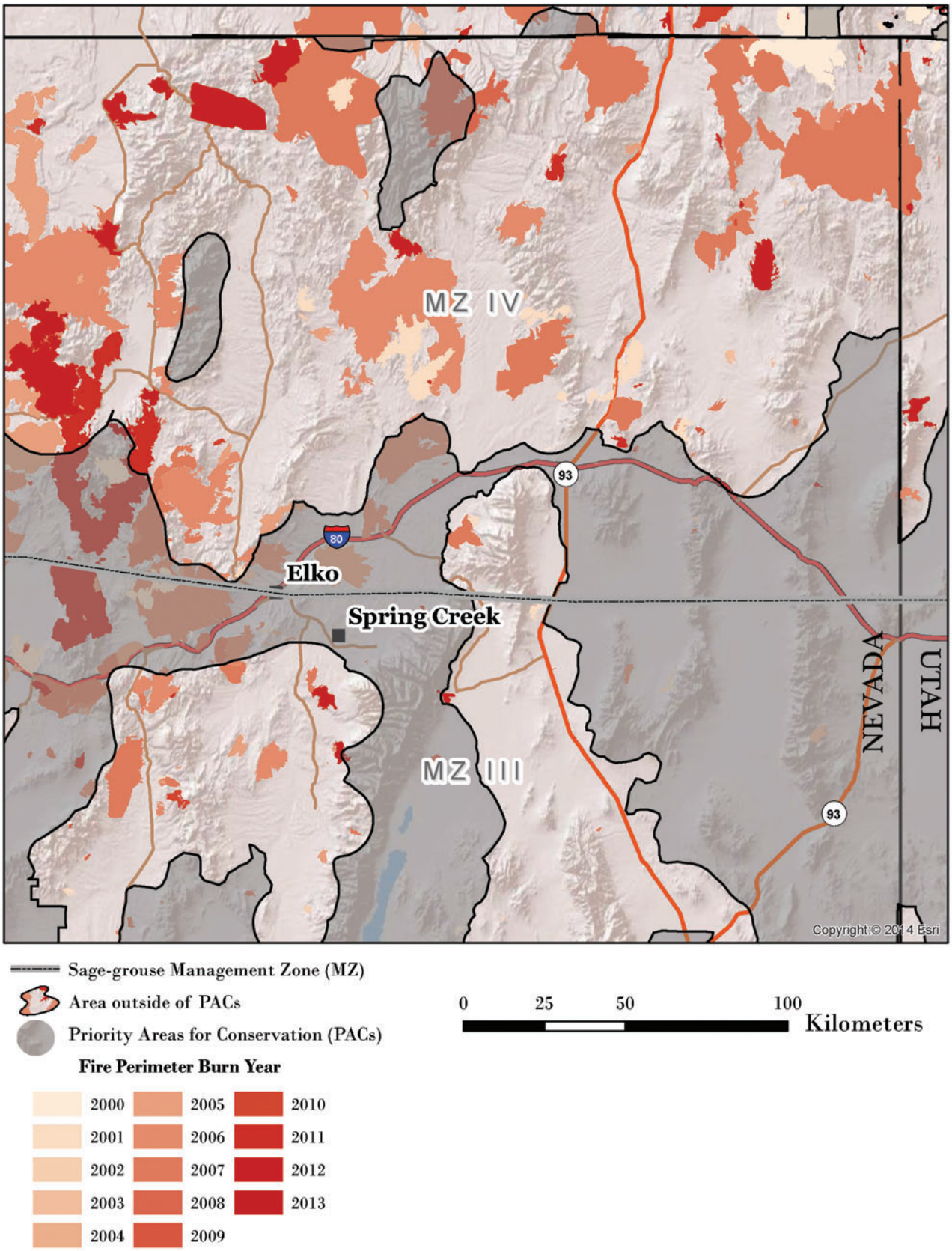


Figure 25. Fire perimeters (Walters et al. 2011; Butler and Bailey 2013) within the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

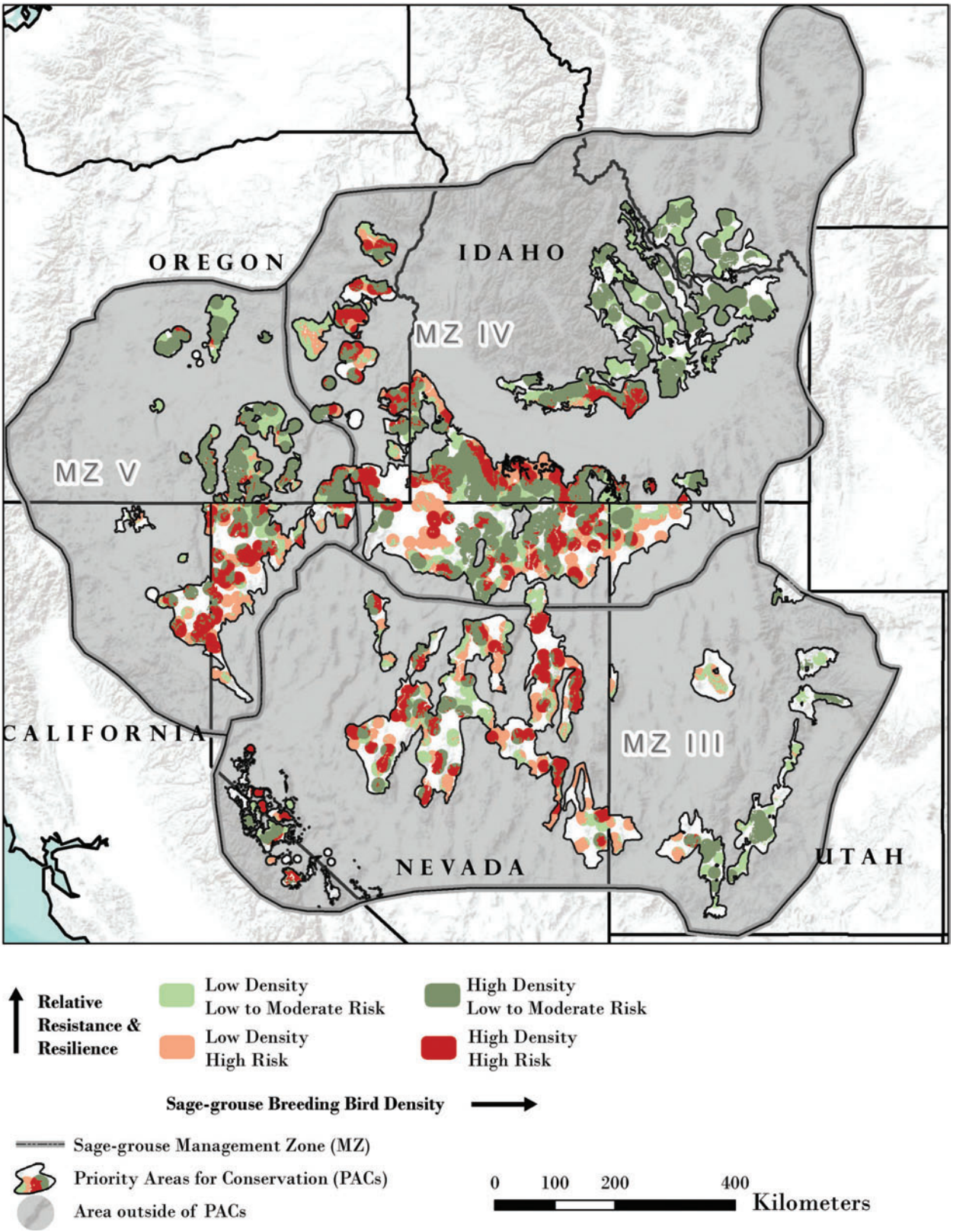


Figure 26. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to resilience and resistance within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Relative resilience and resistance groups are derived from soil moisture and temperature classes (Soil Survey Staff 2014a, b) as described in text, and indicate risk of invasive annual grasses and wildfire. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

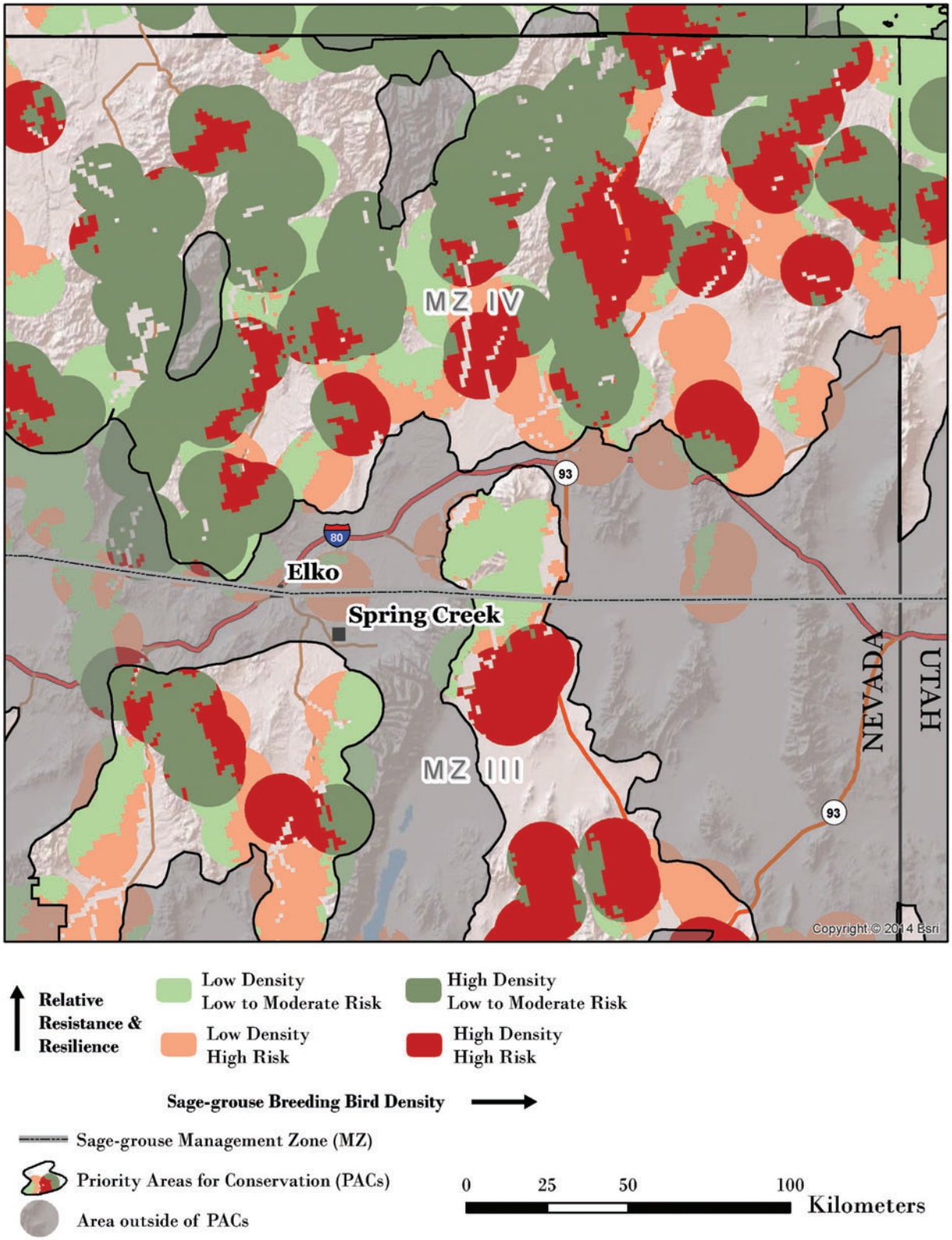


Figure 27. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to resilience and resistance in the northeast corner of Nevada. Relative resilience and resistance groups are derived from soil moisture and temperature classes (Soil Survey Staff 2014a, b) as described in text, and indicate risk of invasive annual grasses and wildfire. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

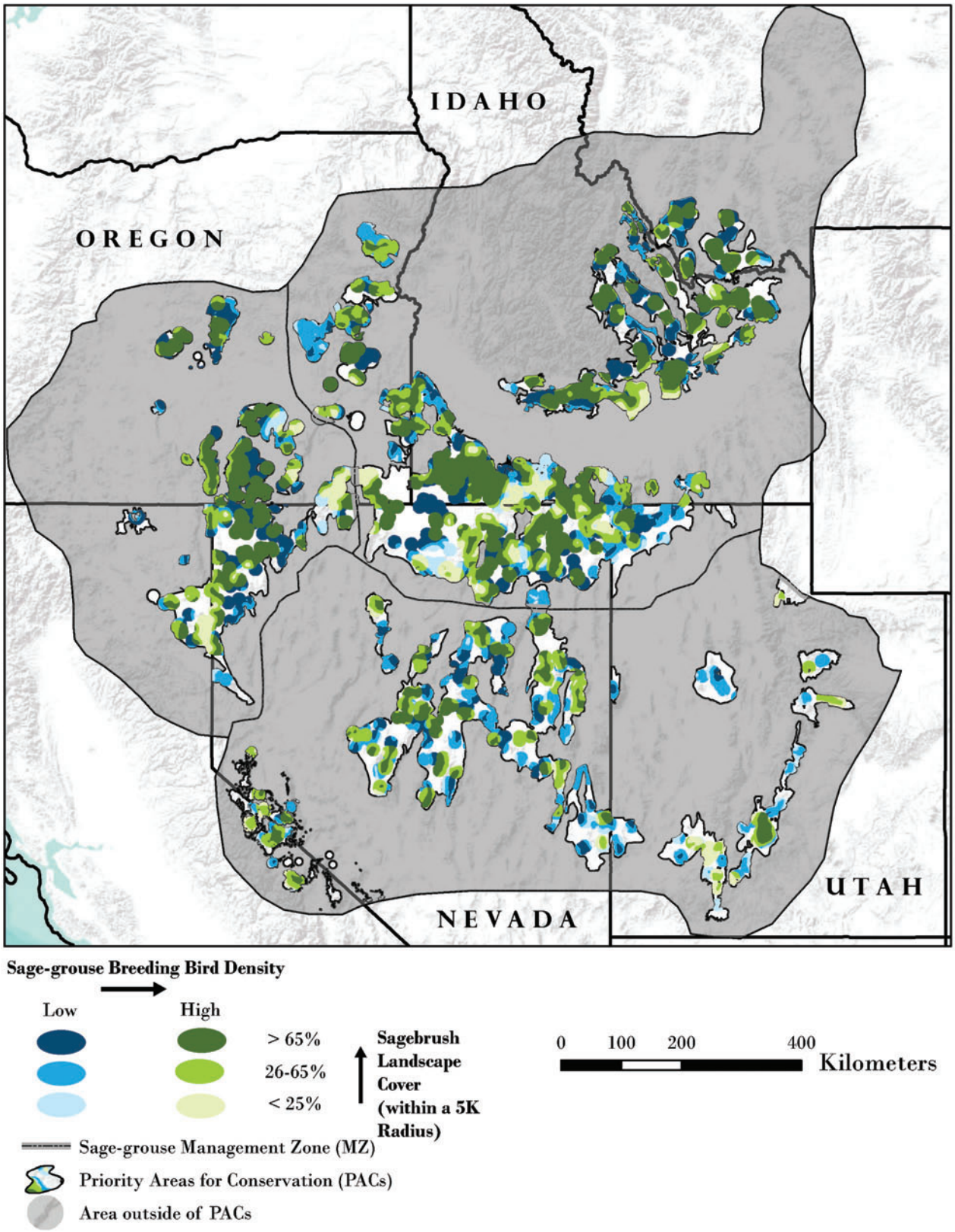


Figure 28. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to sagebrush cover. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Resilience and resistance and sagebrush cover combined with bird population density data provide land managers a way to evaluate trade-offs of particular management options at the landscape scale. For example, high density, low resilience and resistance landscapes with >65% sagebrush landscape cover may require immediate attention for conservation efforts because they currently support a high concentration of birds but have the lowest potential to recover to desired conditions post-fire and to resist invasive plants when disturbed. Similarly, high density but moderate-to-high resilience and resistance landscapes with 26-65% sagebrush cover may be priorities for preventative actions like conifer removal designed to increase the proportion of sagebrush cover and maintain ecosystem resilience and resistance. Mapping relative resilience and resistance and landscape cover of sagebrush for sage-grouse breeding areas should be viewed as a component of the assessment process that can help local managers allocate resources to accelerate planning and implementation.

Interpretations at the Management Zone (MZ) Scale: Western Portion of the Range

An examination of land cover and additional data layers for the western portion of the range reveals large differences among Management Zones (MZs) III, IV and V. MZs IV and V have larger areas with sagebrush cover >65% than MZ III (fig. 16). This may be partly explained by basin and range topography in MZ III, which is characterized by large differences in both environmental conditions and ecological types over relatively short distances. However, the cover of piñon and juniper in and adjacent to PACs in MZ III also is higher than in either MZ IV or V (fig. 22). The greater cover of piñon and juniper in MZ III appears to largely explain the smaller patches of sagebrush cover in the 26-65% and >65% categories.

Our capacity to quantify understory vegetation cover using remotely sensed data is currently limiting, but a visual examination of estimates for invasive annual grass (fig. 20; Peterson 2006, 2007) suggests a higher index (greater cover) in areas with relatively low resistance (warm soil temperatures) in all MZs (see fig. 18). This is consistent with current understanding of resistance to cheatgrass (Chambers et al. 2014; Chambers et al. *in press*). It is noteworthy that the invasive annual grass index is low for most of the central basin and range (central Nevada). Several factors may be contributing to the low index for this area including climate, the stage of piñon and juniper expansion and linked decrease in fire frequency, the relative lack of human development, and the relative lack of management treatments in recent decades (Wisdom et al. 2005; Miller et al. 2011). Not surprisingly, areas with a high annual grass index are outside or on the periphery of current PACs. However, it is likely that invasive annual grasses are present on many warmer sites and that they may increase following fire or other disturbances. In areas with low resistance to invasive annual grasses, they often exist in the understory of sagebrush ecosystems and are not detected by remote sensing platforms such as Landsat.

The number of hectares burned has been highest in MZ IV, adjacent areas in MZ V, and in areas with relatively low resilience and resistance in the northern portion of MZ III that have a high invasive annual grass index (figs. 18, 20, 24). A total of over 1.1 million hectares (2.7 million acres) burned in 2000 and 2006, while over 1.7 million hectares (4.2 million acres) burned in 2007 and 2012 and almost three quarters of these acres were in MZ IV (table 5). In some cases, these fires appear to be linked to the annual invasive grass index, but in others it clearly is not. At this point, there appears to be little relationship between cover of piñon and juniper and wildfire. Mega-fires comprised of hundreds of thousands of acres have burned in recent years, especially in MZ IV. These fires have occurred primarily in areas with low to moderate resilience and resistance and during periods with extreme burning conditions.

Table 5. The number of hectares (acres) burned in Management Zones III, IV, and V each year from 2000 to 2013.

Year	Management Zone III		Management Zone IV		Management Zone V		Total	
2000	155,159	(383,405)	868,118	(2,145,165)	88,871	(219,606)	1,112,148	(2,748,176)
2001	164,436	(406,330)	272,870	(674,276)	141,454	(349,541)	578,760	(1,430,147)
2002	85,969	(212,433)	100,308	(247,867)	113,555	(280,601)	299,833	(740,902)
2003	21,869	(54,038)	127,028	(313,892)	27,597	(68,192)	176,493	(436,123)
2004	20,477	(50,600)	11,344	(28,032)	13,037	(32,216)	44,858	(110,847)
2005	45,130	(111,520)	374,894	(926,382)	22,039	(54,458)	442,063	(1,092,360)
2006	198,762	(491,150)	860,368	(2,126,014)	117,452	(290,230)	1,176,582	(2,907,394)
2007	371,154	(917,140)	1,240,303	(3,064,853)	134,520	(332,406)	1,745,977	(4,314,399)
2008	14,015	(34,632)	109,151	(269,717)	43,949	(108,599)	167,115	(412,949)
2009	43,399	(107,242)	12,250	(30,271)	47,918	(118,408)	103,568	(255,921)
2010	31,597	(78,078)	280,662	(693,531)	21,940	(54,216)	334,200	(825,825)
2011	83,411	(206,114)	283,675	(700,977)	22,909	(56,608)	389,995	(963,699)
2012	203,680	(503,303)	946,514	(2,338,885)	574,308	(1,419,144)	1,724,501	(4,261,331)
2013	45,976	(113,610)	368,434	(910,419)	15,852	(39,170)	430,262	(1,063,199)
Total	1,485,034	(3,669,595)	5,855,920	(14,470,281)	1,385,400	(3,423,396)	8,726,354	(21,563,271)

Coupling breeding bird densities with landscape cover of sagebrush indicates that populations with low densities tend to occur in areas where sagebrush cover is in the 26-65% category, and few populations occur in areas with <25% sagebrush cover (fig. 27) (Knick et al. 2013). Combining the breeding bird densities with resilience and resistance indicates significant variability in risks among high density populations within PACs (fig. 26). A large proportion of remaining high density centers within PACs occurs on moderate-to-high resilience and resistance habitats, while low density/low resilience and resistance areas tend to occur along the periphery of PACs or are disproportionately located in MZ III and southern parts of MZ V.

Examination of other data layers suggests that different wildfire and invasive species threats exist across the western portion of the range, and that management should target the primary threats to sage-grouse habitat within focal areas. In MZs IV and V invasive annual grasses—especially on the periphery of the PACs—and wildfire are key threats. However, recent wildfires are not necessarily linked to invasive annual grasses. This suggests that management strategies for these MZs emphasize fire operations, fuels management focused on decreasing fire spread, and integrated strategies to control annual grasses and increase post-fire rehabilitation and restoration success. Differences in piñon and/or juniper landscape cover exist among MZs with 5,131,900 ha (12,681,202 ac) in MZ III, 528,377ha (1,305,649 ac) in MZ IV, and 558,880 ha (1,381,024 ac) in MZ V. Portions of MZs IV and V are still largely in early stages of juniper expansion indicating a need to address this threat before woodland succession progresses. Because of generally low resilience and resistance in MZ III, greater emphasis is needed on habitat conservation, specifically minimizing or eliminating stressors. Also, greater emphasis on reducing cover of piñon and juniper is needed to reduce woody fuels and increase sagebrush ecosystem resilience to fire by increasing the recovery potential of native understory species.

Interpretations at Regional and Local Land Management Scales: Northeast Nevada Example

The same land covers and data layers used to assess focal areas for sage-grouse habitat within MZs in the western portion of the species range can be used to evaluate focal areas for management in regional planning areas and land management planning units. The emphasis at the scale of the land planning area or management planning unit is on maintaining or increasing large contiguous areas of sagebrush habitat with covers in the 26-65% and especially >65% category. Resilience to disturbance and resistance to invasive annual grasses as indicated by soil temperature and moisture regimes is used to determine the most appropriate activities within the different cover categories. The sage-grouse habitat matrix in table 2 describes the capacity of areas with differing resilience and resistance to recover following disturbance and resist annual invasive grasses and provides the management implications for each of the different cover categories. Table 4 provides potential management strategies for the different sagebrush cover and resilience and resistance categories (cells) in the sage-grouse habitat matrix by agency program areas (fire operations, fuels management, post-fire rehabilitation, habitat restoration). Note that the guidelines in table 4 are related to the sage-grouse habitat matrix, and do not preclude other factors from consideration when determining management priorities for program areas.

Here, we provide an example of how to apply the concepts and tools discussed in this report by examining an important region identified in the MZ scale assessment. The northeastern corner of Nevada was selected to illustrate the diversity of sage-grouse habitat within planning areas and the need for proactive collaboration both within agencies and across jurisdictional boundaries in devising appropriate management strategies (figs. 17, 19, 21, 23, 25). This part of Nevada has large areas of invasive annual grasses and areas with piñon and juniper expansion, and it has experienced multiple large fires in the last decade. It includes a BLM Field Office, Forest Service (FS) land, State land, multiple private owners, and borders two States (fig. 29), which results in both complex ownership and natural complexity.

In the northeast corner of Nevada, an area 5,403,877 ha (13,353,271 ac) in size, numerous large fires have burned in and around PACs (fig. 25). Since 2000, a total of 1,144,317 ha (2,827,669 ac) have burned with the largest fires occurring in 2000, 2006, and 2007. This suggests that the primary management emphasis be on retaining existing areas of sagebrush in the 26-65% and especially >65% categories and promoting recovery of former sagebrush areas that have burned. Fire suppression in and around large, contiguous areas of sagebrush and also in and around successful habitat restoration or post-fire rehabilitation treatments is a first order priority. Fuels management also is a high priority and is focused on strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire without jeopardizing existing habitat quality. Also, in the eastern portion of the area, piñon and juniper land cover comprises 471,645 ha (1,165,459 ac) (fig. 23). In this area, management priorities include (1) targeted tree removal in early to mid-phase (Phase I and II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads, and (2) targeted tree removal in later phase (Phase III) post-settlement piñon and juniper areas to reduce risk of high severity fire. In areas with moderate to high resilience and resistance, post-fire rehabilitation focuses on accelerating sagebrush establishment and recovery of perennial native herbaceous species. These areas often are capable of unassisted recovery and seeding is likely needed only in areas where perennial native herbaceous species have been depleted (Miller et al. 2013). Seeding introduced species can retard recovery of native perennial grasses and forbs that are important to sage-grouse and should be avoided in these areas (Knutson et al. 2014). Seeding or transplanting of sagebrush may be needed to accelerate establishment in focal areas.

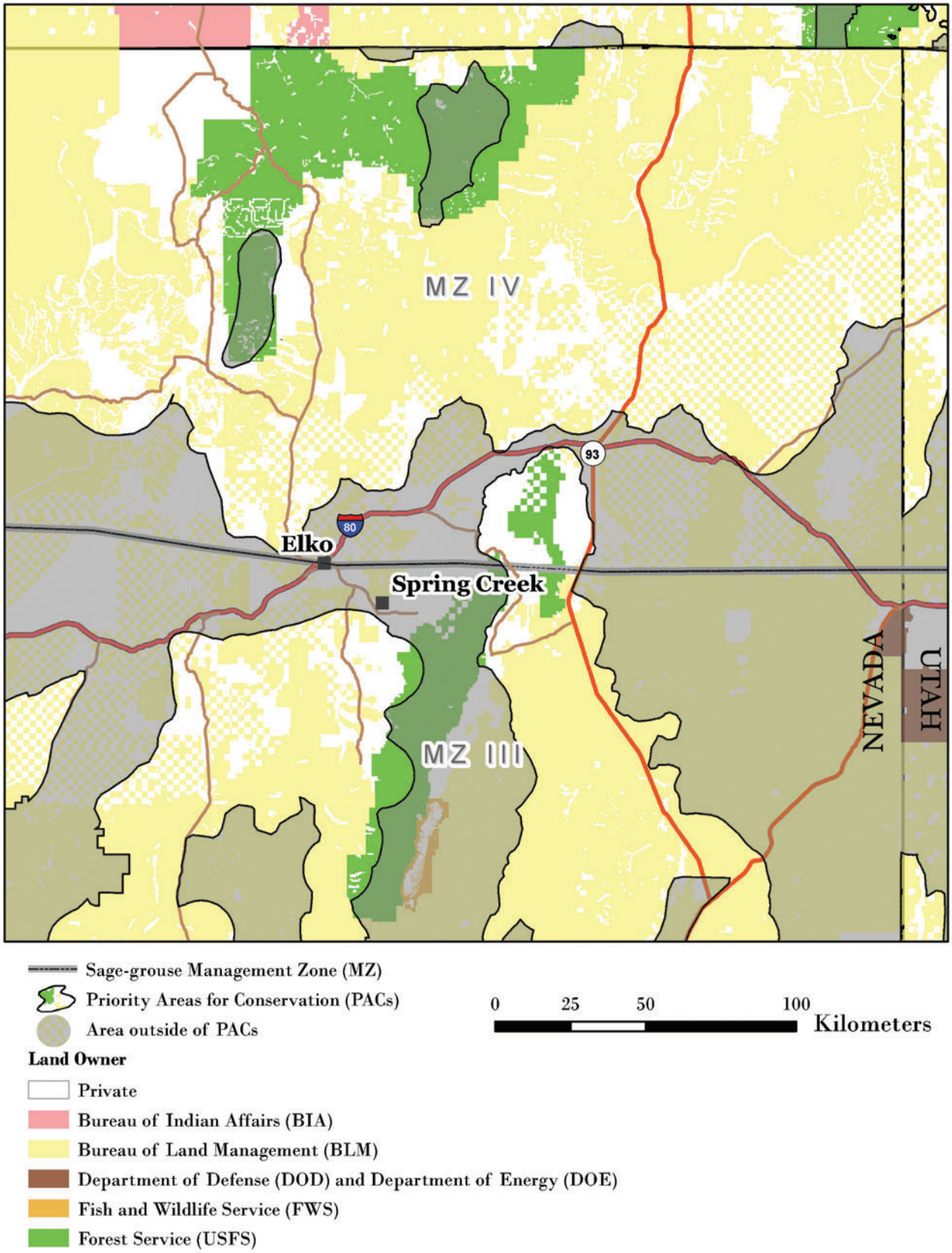


Figure 29. Land ownership for the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

In areas with lower resilience and resistance and high breeding bird densities, large, contiguous areas of sagebrush with intact understories are a high priority for conservation (figs. 17, 19, 27). In these areas, emphasis is on maintaining or increasing habitat conditions by minimizing stressors and disturbance. Post-fire rehabilitation and restoration activities focus on areas that increase connectivity among existing large areas of sagebrush. Because of low and variable precipitation, more than one intervention may be required to achieve restoration or rehabilitation goals. Appropriately managing livestock, wild horse and burro use (if applicable), and recreational use in focal areas is especially important to promote native perennial grass and forb growth and reproduction and to maintain or enhance resilience and resistance.

Determining the Most Appropriate Management Treatments at the Project Scale

Once focal areas and management priorities have been determined, potential treatment areas can be assessed to determine treatment feasibility and appropriate treatment methods. Different treatment options exist (figs. 30, 31) that differ in both suitability for a focal area and likely effectiveness. Field guides for sagebrush ecosystems and piñon and juniper expansion areas that incorporate resilience and resistance concepts are being developed to help guide managers through the process of determining both the suitability of an area for treatment and the most appropriate treatment. These guides are aligned with the different program areas and emphasize (1) fuel treatments (Miller et al. 2014a), (2) post-fire rehabilitation (Miller et al. 2014b), and (3) restoration (Pyke et al., in preparation). Additional information on implementing these types of management treatments is synthesized in Monsen et al. (2004) and Pyke (2011); additional information on treatment response is synthesized in Miller et al. (2013). In this section, we summarize the major steps in the process for determining the suitability of an area for treatment and the most appropriate treatment. We then provide an overview of two of the primary tools in the assessment process – ecological site descriptions (ESDs) and state and transition models (STMs). We conclude with a discussion of the importance of monitoring and adaptive management.

Steps in the process*:* Logical steps in the process of determining the suitability of an area for treatment and the most appropriate treatment(s) include (1) assessing the potential treatment area and identifying ecological sites, (2) determining the current successional state of the site, (3) selecting the appropriate action(s), and (4) monitoring and evaluation to determine post-treatment management. A general approach that uses questions to identify the information required in each step was developed (table 6). These questions can be modified to include the specific information needed for each program area and for treating different ecological sites. This format is used in the field guides described above.

Figure 30. Common vegetation treatments for sagebrush dominated ecosystems with relatively low resilience and resistance include seeding after wildfire in areas that lack sufficient native perennial grasses and forbs for recovery (top) (photo by Chad Boyd), and mowing sagebrush to reinvigorate native perennial grasses and forbs in the understory (bottom) (photo by Scott Schaff). Success of mowing treatments depends on having adequate perennial grasses and forbs on the site to resist invasive annual grasses and to promote recovery.

Figure 31. Vegetation treatments for sagebrush ecosystems exhibiting piñon and juniper expansion include cutting the trees with chainsaws and leaving them in place (top) (photo by Jeremy Roberts) and shredding them with a "bullhog" (middle) (photo by Bruce A. Roundy) on sites with relatively warm soils and moderately low resistance to cheatgrass. Prescribed fire (bottom) (photo by Jeanne C. Chambers) can be a viable treatment on sites with relatively cool and moist soils that have higher resilience to disturbance and resistance to invasive annual grasses. Treatment success depends on having adequate perennial grasses and forbs on the site to resist invasive annual grasses and promote recovery and will be highest on sites with relatively low densities of trees (Phase I to Phase II woodlands).

Table 6. General guidelines for conducting fuels management, fire rehabilitation, and restoration treatments (modified from Miller et al. 2007; Tausch et al. 2009; Pyke 2011; Chambers et al. 2013).

Steps in the process	Questions and considerations
I. Assess potential treatment area and identify ecological sites	1. Where are priority areas for fuels management, fire rehabilitation or restoration within the focal area? Consider sage-grouse habitat needs and resilience and resistance. 2. What are the topographic characteristics and soils of the area? Verify soils mapped to the location and determine soil temperature/moisture regimes. Collect information on soil texture, depth and basic chemistry for restoration projects. 3. How will topographic characteristics and soils affect vegetation recovery, plant establishment and erosion? Evaluate erosion risk based on topography and soil characteristics. 4. What are the potential native plant communities for the area? Match soil components to their correlated ESDs. This provides a list of potential species for the site(s).
II. Determine current state of the site	5. Is the area still within the reference state for the ecological site(s)?
III. Select appropriate action	6. How far do sites deviate from the reference state? How will treatment success be measured? 7. Do sufficient perennial shrubs and perennial grasses and forbs exist to facilitate recovery? 8. Are invasive species a minor component? 9. Do invasive species dominate the sites while native life forms are missing or severely under represented? If so, active restoration is required to restore habitat. 10. Are species from drier or warmer ecological sites present? Restoration with species from the drier or warmer sites should be considered. 11. Have soils or other aspects of the physical environment been altered? Sites may have crossed a threshold and represent a new ecological site type requiring new site-specific treatment/restoration approaches.
IV. Determine post-treatment management	12. How long should the sites be protected before land uses begin? In general, sites with lower resilience and resistance should be protected for longer periods. 13. How will monitoring be performed? Treatment effectiveness monitoring includes a complete set of measurements, analyses, and a report. 14. Are adjustments to the approach needed? Adaptive management is applied to future projects based on consistent findings from multiple locations.

Ecological site descriptions: ESDs and their associated STMs provide essential information for determining treatment feasibility and type of treatment. ESDs are part of a land classification system that describes the potential of a set of climate, topographic, and soil characteristics and natural disturbances to support a dynamic set of plant communities (Bestelmeyer et al. 2009; Stringham et al. 2003). NRCS soil survey data (http://soils.usda.gov/survey/), including soil temperature/moisture regimes and other soil characteristics, are integral to ESD development. ESDs have been developed by the NRCS and their partners to assist land management agencies and private land owners with making resource decisions, and are widely available for the Sage-grouse MZs except where soil surveys have not been completed (for a detailed description of ESDs and access to available ESDs see: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/). ESDs assist managers to step-down generalized vegetation dynamics, including the concepts of resilience and resistance, to local scales. For example, variability in soil characteristics and the local environment (e.g., average annual precipitation as indicated by soil moisture regime) can strongly influence both plant community resilience to fire as well as the resistance of a plant community to invasive annual grasses after fire (table 1). Within a particular ESD, there is a similar level of resilience to disturbance and resistance to invasive annuals and this information can be used to determine the most appropriate management actions.

State and transition models: STMs are a central component of ecological site descriptions that are widely used by managers to illustrate changes in plant communities and associated soil properties, causes of change, and effects of management interventions (Stringham et al. 2003; Briske et al. 2005; USDA NRCS 2007) including in sagebrush ecosystems (Forbis et al. 2006; Barbour et al. 2007; Boyd and Svejcar 2009; Holmes and Miller 2010; Chambers et al. *in press*). These models use ***state*** (a relatively stable set of plant communities that are resilient to disturbance) and ***transition*** (the drivers of change among alternative states) to describe the range in composition and function of plant communities within ESDs (Stringham and others 2003; see Appendix 1 for definitions). The reference state is based on the natural range of conditions associated with natural disturbance regimes and often includes several plant communities (***phases***) that differ in dominant plant species relative to type and time since disturbance (Caudle et al. 2013). Alternative states describe new sets of communities that result from factors such as inappropriate livestock use, invasion by annual grasses, or changes in fire regimes. Changes or transitions among states often are characterized by ***thresholds*** that may persist over time without active intervention, potentially causing irreversible changes in community composition, structure, and function. ***Restoration pathways*** are used to identify the environmental conditions and management actions required for return to a previous state. Detailed STMs that follow current interagency guidelines (Caudle et al. 2013), are aligned with the ecological types (table 1), and are generally applicable to MZs III (Southern Great Basin), IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin) are provided in Appendix 5.

A generalized STM to illustrate the use of STMs is shown in figure 32 for the warm and dry Wyoming big sagebrush ecological type. This ecological type occurs at relatively low elevations in the western part of the range and has low to moderate resilience to disturbance and management treatments and low resistance to invasion (table 1). This type is abundant in the western portion of the range, but as the STM suggests, it is highly susceptible to conversion to invasive annual grass and repeated fire and is difficult to restore. Intact sagebrush areas remaining in the reference state within this ecological type are a high priority for conservation. Invaded states or locations with intact sagebrush that lack adequate native perennial understory are a high priority for restoration where they bridge large, contiguous areas of sagebrush. However, practical methods to accomplish this are largely experimental and/or costly and further development, including adaptive science and management, is needed.

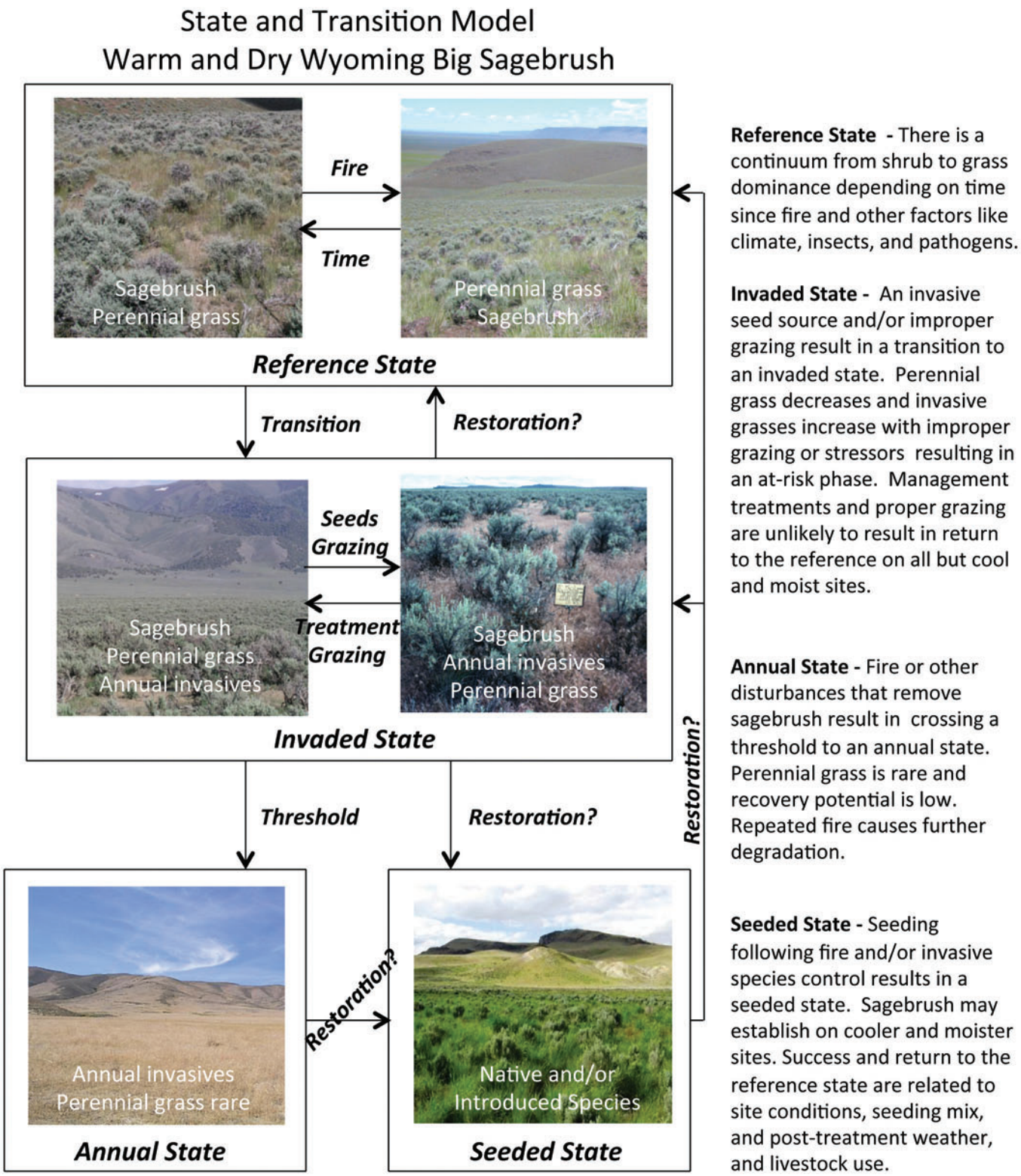


Figure 32. A state and transition model that illustrates vegetation dynamics and restoration pathways for the warm and dry, Wyoming big sagebrush ecological type. This ecological type occurs at relatively low elevations in the western part of the range and has low to moderate resilience to disturbance and management treatments and low resistance to invasion.

Monitoring and adaptive management: Monitoring programs designed to track ecosystem changes in response to both stressors and management actions can be used to increase understanding of ecosystem resilience and resistance, realign management approaches and treatments, and implement adaptive management (Reever-Morghan et al. 2006; Herrick et al. 2012). Information is increasing on likely changes in sagebrush ecosystems with additional stress and climate warming, but a large degree of uncertainty still exits. Currently, the NRCS National Resource Inventory is being used on private lands and is being implemented on public lands managed by BLM to monitor trends in vegetation attributes and land health at the landscape scale under the AIM (Assessment Inventory and Monitoring) strategy. Strategic placement of monitoring sites and repeated measurements of ecosystem status and trends (e.g., land cover type, ground cover, vegetation cover and height of native and invasive species, phase of tree expansion, soil and site stability, oddities) can be used to decrease uncertainty and increase effectiveness of management decisions. Ideally, monitoring sites span environmental/productivity gradients and sagebrush ecological types that characterize sage-grouse habitat. Of particular importance are (1) ecotones between ecological types where changes in response to climate are expected to be largest (Loehle 2000; Stohlgren et al. 2000), (2) ecological types with climatic conditions and soils that are exhibiting invasion and repeated fires, and (3) ecological types with climatic conditions and soils that are exhibiting tree expansion and increased fire risk. Monitoring the response of sagebrush ecosystems to management treatments, including both pre- and post-treatment data, is a first order priority because it provides information on treatment effectiveness that can be used to adjust methodologies.

Monitoring activities are most beneficial when consistent approaches are used among and within agencies to collect, analyze, and report monitoring data. Currently, effectiveness monitoring databases that are used by multiple agencies do not exist. However, several databases have been developed for tracking fire-related and invasive-species management activities. The National Fire Plan Operations and Reporting System (NFPORS) is an interdepartmental and interagency database that accounts for hazardous fuel reduction, burned area rehabilitation and community assistance activities. To our knowledge, NFPORS is not capable of storing and retrieving the type of effectiveness monitoring information that is needed for adaptive management. The FEAT FIREMON Integrated (FFI; https://www.frames.gov/partner-sites/ffi/ffi-home/) is a monitoring software tool designed to assist managers with collection, storage and analysis of ecological information. It was constructed through a complementary integration of the Fire Ecology Assessment Tool (FEAT) and FIREMON. This tool allows the user to select among multiple techniques for effectiveness monitoring. If effectiveness monitoring techniques were agreed on by the agencies, FFI does provide databases with standard structures that could be used in inter-agency effectiveness monitoring. Also, the National Invasive Species Information Management System (NISIMS) is designed to reduce redundant data entry regarding invasive species inventory, management and effectiveness monitoring with the goal of providing information that can be used to determine effective treatments for invasive species. However, NISIMS is currently available only within the BLM.

Common databases can be used by agency partners to record and share monitoring data. The Land Treatment Digital Library (LTDL [USGS 2010]) provides a method of archiving and collecting common information for land treatments and might be used as a framework for data storage and retrieval. Provided databases are relational (maintain a common field for connecting them), creating single corporate databases is not necessary. However, barriers that hinder database access within and among agencies and governmental departments may need to be lowered while still maintaining adequate data security. The LTDL has demonstrated how

this can work by accessing a variety of databases to populate useful information relating to land treatments.

For effectiveness of treatments to be easily useable for adaptive management, the agencies involved will need to agree on monitoring methods and a common data storage and retrieval system. Once data can be retrieved, similar treatment projects can be evaluated to determine how well they achieve objectives for sage-grouse habitat, such as the criteria outlined in documents like the Habitat Assessment Framework (Stiver et al. 2006). Results of monitoring activities on treatment effectiveness are most useful when shared across jurisdictional boundaries, and several mechanisms are currently in place to improve information sharing (e.g., the Great Basin Fire Science Delivery Project; www.gbfiresci.org).

References

Abatzoglou, J. T.; Kolden, C. A. 2011. Climate change in western US deserts: potential for increased wildfire and invasive annual grasses. Rangeland Ecology and Management 64:471-478.

Aldridge, C. L.; Nielsen, S. E.; Beyer, H. L.; Boyce, M. S.; Connelly, J. W.; Knick, S. T.; Schroeder, M. A. 2008. Range-wide patterns of greater sage-grouse persistence. Diversity and Distributions 14:983–994.

Alexander, E. B.; Mallory, J. I.; Colwell, W. L. 1993. Soil-elevation relationships on a volcanic plateau in the southern Cascade Range, northern California, USA. Catena 20:113-128.

Allen, C. R.; Gunderson, L.; Johnson, A. R. 2005. The use of discontinuities and functional groups to assess relative resilience in complex systems. Ecosystems 8:958-966.

Arredondo, J. T.; Jones, T.A.; Johnson, D. A. 1998. Seedling growth of Intermountain perennial and weedy annual grasses. Journal of Range Management 51:584-589.

Atamian, M.T.; Sedinger, J.S.; Heaton, J.S.; Blomberg, E.J. 2010. Landscape-level assessment of brood rearing habitat for greater sage-grouse in Nevada. Journal of Wildlife Management 74: 1533–1543.

Balch, J. K.; Bradley, B. A.; D'Antonio, C. M.; Gomez-Dans, J. 2013. Introduced annual grass increases regional fire activity across the arid western USA (1980–2009). Global Change Biology 19:173-183.

Barbour, R. J.; Hemstrom, M. A.; Hayes, J. L. 2007. The Interior Northwest Landscape Analysis System: a step toward understanding integrated landscape analysis. Landscape and Urban Planning 80:333-344.

Baruch-Mordo, S; Evans, J. S.; Severson, J. P.; Naugle; D.E.; Maestas, J. D.; Kiesecker, J. M.; Falkowski, M. J.; Christian A. Hagen, C. A.; Reese, K. P. 2013. Saving sage-grouse from the trees: A proactive solution to reducing a key threat to a candidate species. Biological Conservation 167:233-241.

Bates, J.D.; Sharp, R.N.; Davies, K.W. 2013. Sagebrush steppe recovery after fire varies by development phase of *Juniperus occidentalis* woodland. International Journal of Wildland Fire 23:117-130.

Beck, J. L.; Mitchell, D.L. 2000. Influences of livestock grazing on sage grouse habitat. Wildlife Society Bulletin 28:993-1002.

Beisner B. E.; Haydon, D. T.; Cuddington. K. 2003. Alternative stable states in ecology. Frontiers in Ecology 1:376-382

Bestelmeyer, B. T.; Tugel, A. J.; Peacock, G. L. J.; Robinett, D. G.; Shaver, P. L.; Brown, J. R.; Herrick, J. E.; Sanchez, H.; Havstad, K.M. 2009. State-and transition models for heterogeneous landscapes: a strategy for development and application. Rangeland Ecology and Management 62:1-15

Blank R. S.; Morgan, T. 2012. Suppression of *Bromus tectorum* L. by established perennial grasses: potential mechanisms – Part One. Applied Environmental Soil Science 2012: Article ID 632172. 9 p. doi:10.1155/2012/632172.

Blomberg, E. J.; Sedinger, J. S.; Atamian, M. T.; Nonne, D. V. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3(6):55. Online: http://dx.doi.org/10.1890/ES11-00304.1.

Booth, M. S.; Caldwell, M. M.; Stark, J. M. 2003. Overlapping resource use in three Great Basin species: implications for community invisibility and vegetation dynamics. Journal of Ecology 91:36-48.

Boyd, C. S.; Svejcar, T. J. 2009. Managing complex problems in rangeland ecosystems. Rangeland Ecology and Management 62:491-499.

Bradford, J. B.; Lauenroth, W. K. 2006. Controls over invasion of Bromus tectorum: the importance of climate, soil, disturbance and seed availability. Journal of Vegetation Science 17:693-704.

Bradley B.A. 2009. Regional analysis of the impacts of climate change on cheatgrass invasion shows potential risk and opportunity. Global Change Biology 15:196-208 doi: 10.1111/j.1365-2486.2008.01709.x.

Bradley, B. A.; Mustard, J. F. 2005. Identifying land cover variability distinct from land cover change: cheatgrass in the Great Basin. Remote Sensing of Environment 94:204-213.

Briske, D. D.; Fuhlendorf, S. D.; Smeins, F. E. 2005. State-and-transition models, thresholds, rangeland health: a synthesis of ecological concepts and perspectives. Rangeland Ecology and Management 58:1-10.

Brooks M. L.; Chambers, J. C. 2011. Resistance to invasion and resilience to fire in desert shrublands of North America. Rangeland Ecology and Management 64:431–438.

Brooks, M. L.; D'Antonio, C. M.; Richardson, D. M.; Grace, J. B.; Keeley, J. E.; DiTomaso, J. M.; Hobbs, R. J.; Pellant, M.; Pyke, D. 2004. Effects of invasive alien plants on fire regimes. BioScience 54:677-688.

Brown, J. K.; Smith, J. K. 2000. Wildland fire in ecosystems: Effects of fire on flora. Gen.Tech. Rep. RMRS- GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

Butler, B. B.; Bailey, A. 2013. Disturbance history (Historical Wildland Fires). Updated 8/9/2013. Wildland Fire Decision Support System. Online: https://wfdss.usgs.gov/wfdss/WFDSS_Data_Downloads.shtml. [Accessed 5 March 2014].

Casazza, M. L.; Coates, P. S.; Overton; C. T. 2011. Linking habitat selection and brood success in Greater Sage-Grouse. In: Sandercock, B.K.; Martin, K.; Segelbacher, G., eds. Ecology, conservation, and management of grouse. Studies in Avian Biology 39., Berkeley, CA: University of California Press: 151-167.

Caudle, D.; DiBenedetto, J.; Karl, M.; Sanchez, H.; Talbot, C. 2013. Interagency ecological site handbook for rangelands. Online: http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf [Accessed 17 June 2014].

Chambers, J. C.; Bradley, B.A.; Brown, C.A.; D'Antonio, C.; Germino, M. J.; Hardegree, S. P; Grace, J. B.; Miller, R. F.; Pyke, D. A. 2014. Resilience to stress and disturbance, and resistance to *Bromus tectorum* L. invasion in the cold desert shrublands of western North America. Ecosystems 17: 360-375

Chambers, J.C.; Miller, R. F.; Board, D. I.; Grace, J. B.; Pyke, D. A.; Roundy, B. A.; Schupp, E. W.; Tausch, R. J. [In press].Resilience and resistance of sagebrush ecosystems: implications for state and transition models and management treatments. Rangeland Ecology and Management.

Chambers, J. C.; Pendleton, B. K.; Sada, D. W.; Ostoja, S. M.; Brooks, M. L.. 2013. Maintaining and restoring sustainable ecosystems. In: Chambers, J. C.; Brooks, M. L.; Pendleton, B. K.; Raish, C. B., eds. The Southern Nevada Agency Partnership Science and Research Synthesis: Science to support land management in southern Nevada. Gen. Tech. Rep. RMRS-GTR-303. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station:125-154.

Chambers, J. C.; Roundy, B. A.; Blank, R. R.; Meyer, S. E.; Whittaker, A. 2007. What makes Great Basin sagebrush ecosystems invasible by *Bromus tectorum*? Ecological Monographs 77:117-145.

Condon L.; Weisberg, P. L.; Chambers, J. C. 2011. Abiotic and biotic influences on *Bromus tectorum* invasion and *Artemisia tridentata* recovery after fire. International Journal of Wildland Fire 20:1-8.

Connelly, J. W.; Hagen, C. A.; Schroeder, M. A. 2011a. Characteristics and dynamics of greater sage-grouse populations. In: Knick, S.T.; Connelly J.W., eds. Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. University of California Press, Berkeley, CA: 53-68.

Connelly, J. W.; Rinkes, E. T.; Braun, C. E. 2011b. Characteristics of greater sage-grouse habitats: a landscape species at micro and macro scales. In: Knick, S.T.; Connelly, J.W., eds. Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. University of California Press, Berkeley, CA: 69-84.

D'Antonio C. M.; Thomsen M. 2004. Ecological resistance in theory and practice. Weed Technology 18:1572-1577.

D'Antonio C. M.; Vitousek, P. M. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23:63-87.

Dahlgren R. A; Boettinger, J. L.; Huntington, G. L.; Amundson, R. G. 1997. Soil development along an elevational transect in the western Sierra Nevada. Geoderma 78:207-236.

Davies, K. W.; Boyd, C. S.; Beck, J. L.; Bates, J. D.; Svejcar, T. J.; Gregg, M. A. 2011. Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144: 2573–2584.

Davies, K. W.; Svejcar, T. J.; Bates, J. D. 2009. Interaction of historical and nonhistorical disturbances maintains native plant communities. Ecological Applications 19(6): 1536–1545.

Davies G. M.; Bakker, J. D.; Dettweiler-Robinson, E.; Dunwiddie, P. W.; Hall, S.A.; Downs, J.; Evans, J. 2012. Trajectories of change in sagebrush-steppe vegetation communities in relation to multiple wildfires. Ecological Applications 22:1562-1577.

Doherty, K. E.; Naugle, D. E.; Walker, B. L.; Graham, J. M. 2008. Greater sage-grouse winter habitat selection and energy development. Journal of Wildlife Management 72:187-195.

Doherty, K. E.; Naugle, D. E.; Walker, B. L. 2010a. Greater Sage-Grouse Nesting Habitat: The Importance of Managing at Multiple Scales. Journal of Wildlife Management 74:1544-1553.

Doherty, K. E.; Tack, J. D.; Evans, J. S.; Naugle, D. E 2010b. Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning. BLM completion report: Agreement # L10PG00911. Online: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/fish__wildlife_and/sage-grouse.Par.6386.File.dat/MOU%20on%20Greater%20Sage-Grouse.pdf [Accessed 17 June 2014].

Eckert, R. E.; Peterson, F. F.; Meurisse, M. S.; Stephens, J. L. 1986. Effects of soil-surface morphology on emergence and survival of seedlings in big sagebrush communities. Journal Range Management 39:414-420

Finney, M. A.; McHugh, C. W.; Grenfell, I. 2010. Continental-scale simulation of burn probabilities, flame lengths, and fire size distributions for the United States. In: Viegas, D. X., ed. Fourth international conference on forest fire research; Coimbra, Portugal; 13-18 November 2010. Associacao para o Desenvolvimento da Aerodinamica Industrial. 12 p.

Folke C.; Carpenter, S.; Walker, B.; Scheffer, M.; Elmqvist, T.; Gunderson, L.; Holling, C. S. 2004. Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Ecology, Evolution, and Systematics 35:557-581.

Forbis, T. A.; Provencher, L.; Frid, L.; Medlyn, G. 2006. Great Basin land management planning using ecological modeling. Environmental Management 38:62-83.

Frost, C. C. 1998. Presettlement fire frequency regimes of the United States. A first approximation. In: Pruden, T. T.; Brennan, L. A., eds. Fire in ecosystem management: shifting the paradigm from suppression to prescription. Proceedings 20th Tall Timbers Fire Ecology Conference. Tallahassee, FL: Tall Timbers Research Station: 70-82.

Herrick, J. E.; Duniway, M. C.; Pyke, D. A.; Bestelmeyer, B. T.; Wills, S. A.; Brown, J. R.; Karl, J. W.; Havstad, K. M. 2012. A holistic strategy for adaptive land management. Journal of Soil and Water Conservation 67: 105A-113A.

Holling C. S. 1973. Resilience and stability in ecological systems. Annual Review of Ecology and Systematics 4:1-23.

Holmes, A. A.; Miller, R. F. 2010. State-and-transition models for assessing grasshopper sparrow habitat use. Journal of Wildlife Management 74:1834–1840. doi: 10.2193/2009-417.

Jackson S. T. 2006. Vegetation, environment, and time: The origination and termination of ecosystems. Journal of Vegetation Science 17:549-557.

James, J. J.; Drenovsky, R. A.; Monaco, T. A.; Rinella, M. J. 2011. Managing soil nitrogen to restore annual grass-infested plant communities: Effective strategy or incomplete framework? Ecological Applications 21:490-502

Johnson D. D.; Miller, R. F. 2006. Structure and development of expanding western juniper woodlands as influenced by two topographic variables. Forest Ecology and Management 229:7-15.

Johnson, D. H.; Holloran, M. J.; Connelly, J. W.; Hanser, S. E.; Amundson, C. L.; Knick, S. T. 2011. Influence of environmental and anthropogenic features on greater sage-grouse populations. In: Knick S. T.; Connelly, J. W., eds. Greater sage-grouse – ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. Berkeley, CA: University of California Press: 407-450.

Kaltenecker, .J. H.; Wicklow-Howard, M., Pellant, M. 1999. Biological soil crusts: natural barriers to *Bromus tectorum* L. establishment in the northern Great Basin, USA. In: Eldridge D.; Freudenberger D., eds. Proceedings of the VI International Rangeland Congress; Aitkenvale, Queensland, Australia: 109-111.

Keeley, J. 2009. Fire intensity, fire severity and burn severity: A brief review and suggested usage. International Journal of Wildland Fire 18:116–126.

Kirol, C. P.; Beck, J. L.; Dinkins, J. B.; Conover, M. R. 2012. Microhabitat selection for nesting and brood rearing by the greater sage-grouse in xeric big sagebrush. The Condor 114(1):75-89.

Knapp, P. A. 1996. Cheatgass (*Bromus tectorum*) dominance in the Great Basin Desert. Global Environmental Change 6:37-52.

Knick, S. T.; Hanser, S. E.; Preston, K. L. 2013. Modeling ecological minimum requirements for distribution of greater sage-grouse leks: Implications for population connectivity across their western range, U.S.A. Ecology and Evolution 3(6):1539–1551.

Knutson, K. C.; Pyke, D. A.; Wirth, T. A.; Arkle, R. S.; Pilliod, D. S.; Brooks, M. L.; Chambers, J. C.; Grace, J. B. 2014. Long-term effects of reseeding after wildfire on vegetation composition in the Great Basin shrub steppe. Journal of Applied Ecology. doi: 10.1111/1365-2664.12309.

Littell, J. S.; McKenzie, D.; Peterson, D. L.; Westerling, A. L. 2009. Climate and wildfire area burned in the western U.S. ecoprovinces, 1916-2003. Ecological Applications 19:1003-1021.

Lockyer, Z. B. 2012. Greater sage-grouse (*Centrocercus urophasianus*) nest predators, nest survival, and nesting habitat at multiple spatial scales. M.S. thesis. Department of Biological Sciences, Idaho State University, Pocatello, ID.

Loehle, C. 2000. Forest ecotone response to climate change: Sensitivity to temperature response functional forms. Canadian Journal of Forest Research 30: 1362-1645.

Mack, R. N.; Pyke, D. A. 1983. Demography of *Bromus tectorum*: Variation in time and space. Journal of Ecology 71: 6993.

Manier, D. J.; Wood, D. J. A.; Bowen, Z. H.; Donovan, R. M.; Holloran, M. J.; Juliusson, L. M.; Mayne, K. S.; Oyler-McCance, S. J.; Quamen, F. R.; Saher, D. J.; Titolo, A. J. 2013. Summary of science, activities, programs and policies that influence the rangewide conservation of greater sage-grouse (*Centrocercus urophasianus*). Open-File Report 2013-1098. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey. 297 p.

Meinke, C. W.; Knick, S. T.; Pyke, D. A. 2009. A spatial model to prioritize sagebrush landscapes in the Intermountain West (U.S.A.) for restoration. Restoration Ecology 17:652-659.

Mensing, S.; Livingston, S.; Barker, P. 2006. Long-term fire history in Great Basin sagebrush reconstructed from macroscopic charcoal in spring sediments, Newark Valley, Nevada. Western North American Naturalist 66:64-77.

Merrill K. R.; Meyer, S. E.; Coleman, C. E. 2012, Population genetic analysis of *Bromus tectorum* (Poaceae) indicates recent range expansion may be facilitated by specialist geonotypes. American Journal of Botany 99:529-537.

Meyer S. E.; Garvin, S. C.; Beckstead, J. 2001. Factors mediating cheatgrass invasion of intact salt desert shrubland. In: McArthur, D. E.; Fairbanks, D. J., comps. Shrubland ecosystem genetics and biodiversity: proceedings. Proc. RMRS-P-21. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 224-232.

Miller, R. F; Bates, J. D.; Svejcar, T. J.; Pierson, F. B.; Eddleman, L. E. 2005. Biology, ecology, and management of western juniper. Tech. Bull. 152. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Miller, R.F.; Bates, J.D.; Svejcar, T.J.; Pierson, F.B.; Eddleman, L.E. 2007. Western juniper field guide: asking the right questions to select appropriate management actions. Geological Survey Circular 1321. Reston, VA: U.S. Department of the Interior, Geological Survey,

Miller R. F; Chambers, J. C.; Pellant, M. 2014a. A field guide to selecting the most appropriate treatments in sagebrush and pinyon-juniper ecosystems in the Great Basin: Evaluating resilience to disturbance and resistance to invasive annual grasses and predicting vegetation response. Gen. Tech. Rep. RMRS-GTR-322. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller R. F.; Chambers, J. C.; Pellant, M.[In preparation]. A field guide for rapid assessment of post-wildfire recovery potential in sagebrush and pinon-juniper ecosystems in the Great Basin: Evaluating resilience to disturbance and resistance to invasive annual grasses and predicting vegetation response. Gen. Tech. Rep. RMRS-GTR-###. . Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, R. F.; Chambers, J. C.; Pyke, D. A.; Pierson, F. B.; Williams, C. J. 2013. A review of fire effects on vegetation and soils in the Great Basin Region: Response and ecological site characteristics. Gen. Tech. Rep. RMRS-GTR-308. Fort Collins, CO: Department of Agriculture, Forest Service, Rocky Mountain Research Station. 136 p.

Miller, R. F.; Eddleman, L L. 2001. Spatial and temporal changes of sage grouse habitat in the sagebrush biome. Bulletin 151. Corvallis, OR: Oregon State University, Agricultural Experiment Station.

Miller, R. F.; Heyerdahl, E. K. 2008. Fine-scale variation of historical fire regimes in sagebrush-steppe and juniper woodlands: an example from California, USA. International Journal of Wildland Fire 17: 245-254.

Miller R. F.; Knick, S. T.; Pyke, D. A.; Meinke, C. W.; Hanser, S. E.; Wisdom, M. J.; Hild, A. L. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. In: Knick S. T.; Connelly, J. W. eds. Greater sage-grouse – ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. Berkeley, CA: University of California Press: 145-185.

Miller, R.F.; Svejcar, T.J.; Rose, J.A. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management 53:574-585.

Miller, R. F.; Tausch, R. J.; McArthur, E. D.; Johnson, D. D.; Sanderson, S. C. 2008. Age structure and expansion of piñon-juniper woodlands: A regional perspective in the Intermountain West. Res. Pap. RMRS-RP-69. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15 p.

Monsen, Stephen B.; Stevens, Richard; Shaw, Nancy L., comps. 2004. Restoring western ranges and wildlands. Gen. Tech. Rep. RMRS-GTR-136-vol-1, 2, and 3. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 884 p. + appendices and index.

Murphy, T.; Naugle, D. E.; Eardley, R.; Maestas, J. D.; Griffiths, T.; Pellant, M.; Stiver, S. J. 2013. Trial by fire: Improving our ability to reduce wildfire impacts to sage-grouse and sagebrush ecosystems through accelerated partner collaboration. Rangelands 32:2–10.

Oregon Department of Forestry. 2013. West wide wildfire risk assessment final report. Salem, OR: Oregon Department of Forestry. 105 p. Online: http://www.odf.state.or.us/gis/data/Fire/West_Wide_Assessment/WWA_FinalReport.pdf [Accessed 17 June 2014].

Peterson, E. B. 2006. A map of invasive annual grasses in Nevada derived from multitemporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.

Peterson, E. B. 2007. A map of annual grasses in the Owyhee Uplands, Spring 2006, derived from multi-temporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.

Pyke, D. A. 2011. Restoring and rehabilitating sagebrush habitats. In: Knick, S. T.; Connelly, J. W., eds. Greater sage-grouse: Ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. Berkeley, CA: University of California Press: 531-548.

Pyke, D. A., M. Pellant, S. T. Knick, J. L. Beck, P. S. Doescher, E. W. Schupp, J. C. Chambers, R. F. Miller, B. A. Roundy, M. Brunson, and J. D. McIver. [In preparation]. Field guide for restoration of sagebrush-steppe ecosystems with special emphasis on Greater Sage-Grouse habitat- considerations to increase the likelihood of success at local to regional levels. U.S. Geological Circular, Reston, VA.

Ramakrishnan A. P.; Meyer, S. E.; Fairbanks, D. J.; Coleman, C. E. 2006. Ecological significance of microsatellite variation in western North American populations of *Bromus tectorum*. Plant Species Biology 21:61-73.

Redford, K. H.; Amoto, G.; Baillie, J.; Beldomenico, P.; Bennett, E. L.; Clum, N.; Cook, R.; Fonseca, G.; Hedges, S.; Launay, F.; Lieberman, S.; Mace, G. M.; Murayama, A.; Putnam, A.; Robinson, J. G.; Rosenbaum, H.; Sanderson, E. W.; Stuart, S. N.; Thomas, P.; Thorbjarnarson, J. 2011. What does it mean to successfully conserve a (vertebrate) species? Bioscience 61:39-48.

Reever-Morghan, K. J.; Sheley, R. L.; Svejcar, T. J. 2006. Successful adaptive management: The integration of research and management. Rangeland Ecology and Management 59:216-219.

Reisner, M. D.; Grace, J. B.; Pyke, D. A.; Doescher, P. S. 2013. Conditions favouring *Bromus tectorum* dominance of endangered sagebrush steppe ecosystems. Journal of Applied Ecology 50:1039-1049.

Roundy, B. A.; Young, K.; Cline, N.; Hulet, A.; Miller, R. F.; Tausch, R. J.; Chambers, J. C.; Rau, B. [In press]. Piñon-juniper reduction effects on soil temperature and water availability of the resource growth pool. Rangeland Ecology and Management.

Rowland, M. M.; Leu, M.; Finn, S. P.; Hanser, S.; Suring, L. H.; Boys, J. M.; Meinke, C. W.; Knick, S. T.; Wisdom, M. J. 2006. Assessment of threats to sagebrush habitats and associated species of concern in the Wyoming Basins. Version 1, March 2005. Unpublished report on file at: USGS Biological Resources Discipline, Snake River Field Station, Boise, ID.

Sala, O. E.; Lauenroth,W. K.; Gollucio, R. A. 1997. Plant functional types in temperate semi-arid regions. In: Smith, T. M.; Shugart, H. H.; Woodward, F. I., eds. Plant functional types. Cambridge, UK: Cambridge University Press: 217-233.

Seastedt T. R.; Hobbs, R. J.; Suding, K. N. 2008. Management of novel ecosystems: Are novel approaches required? Frontiers in Ecology and Environment 6:547-553.

Smith, S. D.; Nowak, R. S.; 1990. Ecophysiology of plants in the Intermountain lowlands. In: Osmond, C. B.; Pitelka, L. F.; Hidy, G. M., eds. Plant Biology of the Basin and Range. Springer-Verlag: 179-242.

Soil Survey Staff. 2014a. Soil Survey Geographic (SSURGO) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014].

Soil Survey Staff. 2014b. U.S. General Soil Map (STATSGO2) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014].

Stiver, S. J.; Apa, A. D.; Bohne, J. R.; Bunnell, S. D.; Deibert, P. A.; Gardner, S. C.; Hilliard, M. A.; McCarthy, C. W.; Schroeder, M. A. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Unpublished report on file at: Western Association of Fish and Wildlife Agencies, Cheyenne, WY.

Stohlgren, T. J.; Owen, A. J.; Lee, M. 2000. Monitoring shifts in plant diversity in response to climate change: a method for landscapes. Biodiversity and Conservation 9:165-186.

Stringham, T. K.; Krueger, W. C.; Shaver, P. L. 2003. State and transition modeling: An ecological process approach. Journal of Range Management 56:106–113.

Tausch, R. J.; Miller, R. R.; Roundy, B. A.; Chambers, J. C. 2009. Piñon and juniper field guide: asking the right questions to select appropriate management actions. Circular 1335. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey. 94 p. Online: http://pubs.usgs.gov/circ/1335/. [Accessed 17 June 2014].

USDA Natural Resources Conservation Service [USDA-NRCS]. 2007. National soil survey handbook, Title 430-VI. Online: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054242/. [Accessed 17 June 2014].

U.S. Fish and Wildlife Service [USFWS]. 2010. Endangered and threatened wildlife and plants; 12-month findings for petitions to list the greater sage-grouse (*Centrocercus urophasianus*) as threatened or endangered; proposed rule. Fed. Register 75, 13910–14014. Online: http://www.fws.gov/policy/library/2010/2010-5132.pdf.

U.S. Fish and Wildlife Service [USFWS]. 2013. Greater sage-grouse (*Centrocercus urophasianus*) conservation objectives: Final Report. Denver, CO: U.S. Fish and Wildlife Service. 91 p.

U.S. Geological Survey (USGS). 2010. Land Treatment Digital Database. Online: http://ltdl.wr.usgs.gov/. [Accessed 17 June 2014].

U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 17 June 2014].

U.S. Geological Survey (USGS) National Gap Analysis Program. 2004. Provisional digital land cover map for the southwestern United States. Version 1.0. Logan: Utah State University, College of Natural Resources, RS/GIS Laboratory. Online: http://earth.gis.usu.edu/swgap/landcover.html. [Accessed 9 June 2014].

Walters, S. P.; Schneider, N. J.; Guthrie, J. D. 2011. Geospatial Multi-Agency Coordination (GeoMAC) wildland fire perimeters, 2008. Data Series 612: Washington, DC: U.S. Department of the Interior, U.S. Geological Survey. 6 p.

West, N.E. 1983a. Intermountain salt-desert shrubland. In: West, N.E., ed. Temperate deserts and semi-deserts. Amsterdam, The Netherlands: Elsevier Publishing Company: 375-378.

West, N. E. 1983b. Great Basin-Colorado Plateau sagebrush semi-desert. In: West, N. E., ed. Temperate deserts and semi-deserts. Amsterdam, The Netherlands: Elsevier Publishing Company: 331-350

West, N. E.; Young, J. A. 2000. Intermountain valleys and lower mountain slopes. In: Barbour, M. B.; Billings, W. D., eds. North American terrestrial vegetation. Cambridge, UK: Cambridge University Press: 256-284

Westerling A. L.; Hidalgo, H. G.; Cayan, D. R.; Swetnam, T. W. 2006. Warming and early spring increase U.S. forest wildfire activity. Science 313: 940-943.

Wisdom, M. J.; Chambers, J. C. 2009. A landscape approach for ecologically-based management of Great Basin shrublands. Restoration Ecology 17:740-749.

Wisdom, M. J.; Meinke, C. W.; Knick, S. T.; Schroeder, M. A. 2011. Factors associated with extirpation of sage-grouse. In: Knick, S. T.; Connelly, J. W., eds. Greater sage-Grouse: Ecology and conservation of a landscape species and its habitats. Studies in Avian Biology 38. Berkeley, CA: University of California Press: 451-474.

Wisdom, M. J.; Rowland, M. M.; Suring, L. H. eds. 2005. Habitat threats in the sagebrush ecosystem: Methods of regional assessment and applications in the Great Basin. Lawrence, KS: Alliance Communications Group, Allen Press. 301 p.

Appendix 1. Definitions of Terms Used in This Document

At-Risk Community Phase — A community phase that can be designated within the reference state and also in alternative states. This community phase is the most vulnerable to transition to an alternative state (Caudle et al. 2013).

Community Phase — A unique assemblage of plants and associated soil properties that can occur within a state (Caudle et al. 2013).

Ecological Site (ES) — An Ecological Site (ES) is a conceptual division of the landscape that is defined as a distinctive kind of land based on recurring soil, landform, geological, and climate characteristics that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its ability to respond similarly to management actions and natural disturbances (Caudle et al. 2013).

Ecological Site Descriptions (ESD) — The documentation of the characteristics of an ecological site. The documentation includes the data used to define the distinctive properties and characteristics of the ecological site; the biotic and abiotic characteristics that differentiate the site (i.e., climate, topography, soil characteristics, plant communities); and the ecological dynamics of the site that describes how changes in disturbance processes and management can affect the site. An ESD also provides interpretations about the land uses and ecosystem services that a particular ecological site can support and management alternatives for achieving land management (Caudle et al. 2013).

Ecological Type — A category of land with a distinctive (i.e., mappable) combination of landscape elements. The elements making up an ecological type are climate, geology, geomorphology, soils, and potential natural vegetation. Ecological types differ from each other in their ability to produce vegetation and respond to management and natural disturbances (Caudle et al. 2013).

Historical Range of Variability — Range of variability in disturbances, stressors, and ecosystem attributes that allows for maintenance of ecosystem resilience and resistance and that can be used to provide management targets (modified from Jackson 2006).

Resilience — Ability of a species and/or its habitat to recover from stresses and disturbances. Resilient ecosystems regain their fundamental structure, processes, and functioning when altered by stresses like increased CO_2 , nitrogen deposition, and drought and to disturbances like land development and fire (Allen et al. 2005; Holling 1973).

Resistance — Capacity of an ecosystem to retain its fundamental structure, processes and functioning (or remain largely unchanged) despite stresses, disturbances, or invasive species (Folke et al. 2004).

Resistance to Invasion — Abiotic and biotic attributes and ecological processes of an ecosystem that limit the population growth of an invading species (D'Antonio and Thomsen 2004).

Restoration Pathways — Restoration pathways describe the environmental conditions and practices that are required for a state to recover that has undergone a transition (Caudle et al. 2013).

State — A state is a suite of community phases and their inherent soil properties that interact with the abiotic and biotic environment to produce persistent functional and structural attributes associated with a characteristic range of variability (adapted from Briske et al. 2008).

State-and-Transition Model — A method to organize and communicate complex information about the relationships between vegetation, soil, animals, hydrology, disturbances (fire, lack of fire, grazing and browsing, drought, unusually wet periods, insects and disease), and management actions on an ecological site (Caudle et al. 2013).

Thresholds — Conditions sufficient to modify ecosystem structure and function beyond the limits of ecological resilience, resulting in the formation of alternative states (Briske et al. 2008).

Transition — Transitions describe the biotic or abiotic variables or events, acting independently or in combination, that contributes directly to loss of state resilience and result in shifts between states. Transitions are often triggered by disturbances, including natural events (climatic events or fire) and/or management actions (grazing, burning, fire suppression). They can occur quickly as in the case of catastrophic events like fire or flood, or over a long period of time as in the case of a gradual shift in climate patterns or repeated stresses like frequent fires (Caudle et al. 2013).

Appendix 2. An Explanation of the Use of Landscape Measures to Describe Sagebrush Habitat

Understanding landscape concepts of plant cover relative to typical management unit concepts of plant cover is important for prioritizing lands for management of sage-grouse. Ground cover measurements of sagebrush made at a management unit (for example, line-intercept measurements) should not be confused for landscape cover and may not relate well to landscape cover since the areas of examination differ vastly (square meters for management units and square kilometers for landscapes).

A landscape is defined rather arbitrarily as a large area in total spatial extent, somewhere in size between sites (acres or square miles) and regions (100,000s of square miles). The basic unit of a landscape is a patch, which is defined as a bounded area characterized by a similar set of conditions. A habitat patch, for example, may be the polygonal area on a map representing a single land cover type. Landscapes are composed of a mosaic of patches. The arrangement of these patches (the landscape configuration or pattern) has a large influence on the way a landscape functions and for landscape species, such as sage-grouse, sagebrush habitat patches are extremely important for predicting if this bird will be present within the area (Connelly et al. 2011).

Remotely sensed data of land cover is typically used to represent landscapes. These data may combine several sources of data and may include ancillary data, such as elevation, to improve the interpretation of data. These data are organized into pixels that contain a size or grain of land area. For example, LandSat Thematic Mapper spectral data used in determining vegetation cover generally have pixels that represent ground areas of 900 m^2 (30- x 30-m). Each pixel's spectral signature can be interpreted to determine what type of vegetation dominates that pixel. Groups of adjacent pixels with the same dominant vegetation are clustered together into polygons that form patches.

Landscape cover of sagebrush is determined initially by using this vegetation cover map, but a 'rolling window' of a predetermined size (e.g., 5 km^2 or 5,556 pixels that are 30- by 30-m in size) is moved across the region one pixel at a time. The central pixel of the 'window' is reassigned a value for the proportion of pixels where sagebrush is the dominant vegetation. The process is repeated until pixels within the region are completely reassigned to represent the landscape cover of sagebrush within for the region drawn from a 5 km^2 window.

Appendix 3. An Explanation of Soil Temperature and Moisture Regimes Used to Describe Sagebrush Ecosystems

Soil climate regimes (temperature and moisture) are used in Soil Taxonomy to classify soils; they are important to consider in land management decisions, in part, because of the significant influence on the amounts and kinds of vegetation that soils support. Soil temperature and moisture regimes are assigned to soil map unit components as part of the National Cooperative Soil Survey program. Soil survey spatial and tabular data for the Sage-grouse Management Zones (Stiver et al. 2006) were obtained for each State within the zones at the Geospatial Data Gateway (http://datagateway.nrcs.usda.gov/). Gridded Soil Survey Geographic (gSSURGO) file geodatabases were used to display a 10-meter raster dataset. Multiple soil components made up a soil map unit, and soil moisture and temperature regimes were linked to individual soil map components. Soil components with the same soil moisture and temperature class regime were aggregated, and the dominant soil moisture and temperature regime within each soil map unit was used to characterize the temperature and moisture regime. Only temperature and moisture regimes applicable to sagebrush ecosystems were displayed.

Abbreviated definitions of each soil temperature and moisture regime class are listed below. Complete descriptions can be found in *Keys to Soil Taxonsomy, 11th edition*, available at ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/keys/2010_Keys_to_Soil_Taxonomy.pdf.

Soil temperature regimes	
Cryic (Cold)	Soils that have a mean annual soil temperature of <8 °C, and do not have permafrost, at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Frigid (Cool)	Soils that have a mean annual soil temperature of <8 °C and the difference between mean summer and mean winter soil temperatures is >6 °C at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Mesic (Warm)	Soils that have a mean annual soil temperature of 8-15 °C and the difference between mean summer and mean winter soil temperatures is >6 °C at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Soil moisture regimes	
Ustic (summer precipitation)	Generally there is some plant-available moisture during the growing season, although significant periods of drought may occur. Summer precipitation allows presence of warm season plant species.
Xeric (Moist; generally mapped at >12 inches mean annual precipitation)	Characteristic of arid regions. The soil is dry for at least half the growing season and moist for less than 90 consecutive days.
Aridic (Dry; generally mapped at <12 inches mean annual precipitation)	Characteristic of arid regions. The soil is dry for at least half the growing season and moist for less than 90 consecutive days.

Note: Soil moisture regimes are further divided into moisture subclasses, which are often used to indicate soils that are transitional to another moisture regime. For example, a soil with an Aridic moisture regime and a Xeric moisture subclass may be described as "Aridic bordering on Xeric." Understanding these gradients becomes increasingly important when making interpretations and decisions at the site scale where aspect, slope, and soils affect the actual moisture regime on that site. More information on taxonomic moisture subclasses is available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053576.

Appendix 4. Data Sources for the Maps in This Report

Dataset	Citation	Link
Geomac fire perimeters	Walters, S.P.; Schneider, N.J.; Guthrie, J.D. 2011. Geospatial Multi-Agency Coordination (GeoMAC) wildland fire perimeters, 2008. Data Series 612. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey.6 p.	http://pubs.er.usgs.gov/publication/ds612
WFDSS fire perimeters	Butler, B. B.; Bailey, A. 2013. Disturbance history (Historical wildland fires). Updated 8/9/2013. Wildland Fire Decision Support System. Online: https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml [Accessed 5 March 2014].	https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml or https://wfdss.usgs.gov/wfdss/WFDSSData_Downloads.shtml
Piñon and juniper land cover	U.S. Geological Survery (USGS) National Gap Analysis Program. 2004. Provisional digital land cover map for the southwestern United States. Version 1.0. Logan, UT: Utah State University, College of Natural Resources, RS/GIS Laboratory.	http://earth.gis.usu.edu/swgap/landcover.html
Piñon and juniper land cover	U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 13 March 2014].	http://www.landfire.gov/NationalProductDescriptions21.php
Nevada invasive annual grass index	Peterson, E. B. 2006. A map of invasive annual grasses in Nevada derived from multitemporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.	http://heritage.nv.gov/node/167
Owhyee upland annual grass index	Peterson, E. B. 2007. A map of annual grasses in the Owyhee Uplands, Spring 2006, derived from multitemporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.	http://heritage.nv.gov/sites/default/files/library/anngrowy_text_print.pdf
Soil data (SSURGO)	Soil Survey Staff. 2014a. Soil Survey Geographic (SSURGO) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014a].	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
Soil data (STATSGO)	Soil Survey Staff. 2014b. U.S. General Soil Map (STATSGO2) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014b].	

Soil temperature and moisture regime data	Campbell, S. B. 2014. Soil temperature and moisture regime data for the range of greater sage-grouse. Data product. Portland, OR: USDA Natural Resources Conservation Service. Online: https://www.sciencebase.gov/catalog/folder/537f8be5e4b021317a872f1b?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal [Accessed 17 June 2014].	https://www.sciencebase.gov/catalog/folder/537f8be5e4b021317a872f1b?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal
Sage-grouse management zones	Stiver, S. J.; Apa, A. D.; Bohne, J. R.; Bunnell, S. D.; Deibert, P. A.; Gardner, S. C.; Hilliard, M. A.; McCarthy, C. W.; Schroeder, M. A. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Unpublished report on file at: Western Association of Fish and Wildlife Agencies, Cheyenne, WY.	
Breeding bird densities	Doherty, K. E.; Tack, J. D.; Evans, J. S.; Naugle, D. E. 2010. Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning. BLM completion report: Agreement # L10PG00911.	http://scholar.google.com/scholar?q=doherty+2010+breeding+bird&hl=en&as_sdt=0&as_vis=1&oi=scholart&sa=X&ei=JqQbU7HUAqfD2QW8xYFY&ved=0CCUQgQMwAA
Sagebrush land cover	U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 13 March 2014].	http://www.landfire.gov/NationalProductDescriptions21.php

Appendix 5. State-and-transition models (STMs) for five generalized ecological types for big sagebrush (from Chambers et al. *in press*; Miller et al. 2014 a, b)

These STMs represent groupings of ecological sites that are characterized by Wyoming or mountain big sagebrush, span a range of soil moisture/temperature regimes (warm/dry to cold/moist), and characterize a large portion of Management Zones III (Southern Great Basin), IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin). Large boxes illustrate states that are comprised of community phases (smaller boxes). Transitions among states are shown with arrows starting with T; restoration pathways are shown with arrows starting with R. The "at risk" community phase is most vulnerable to transition to an alternative state. Precipitation Zone is designated as PZ.

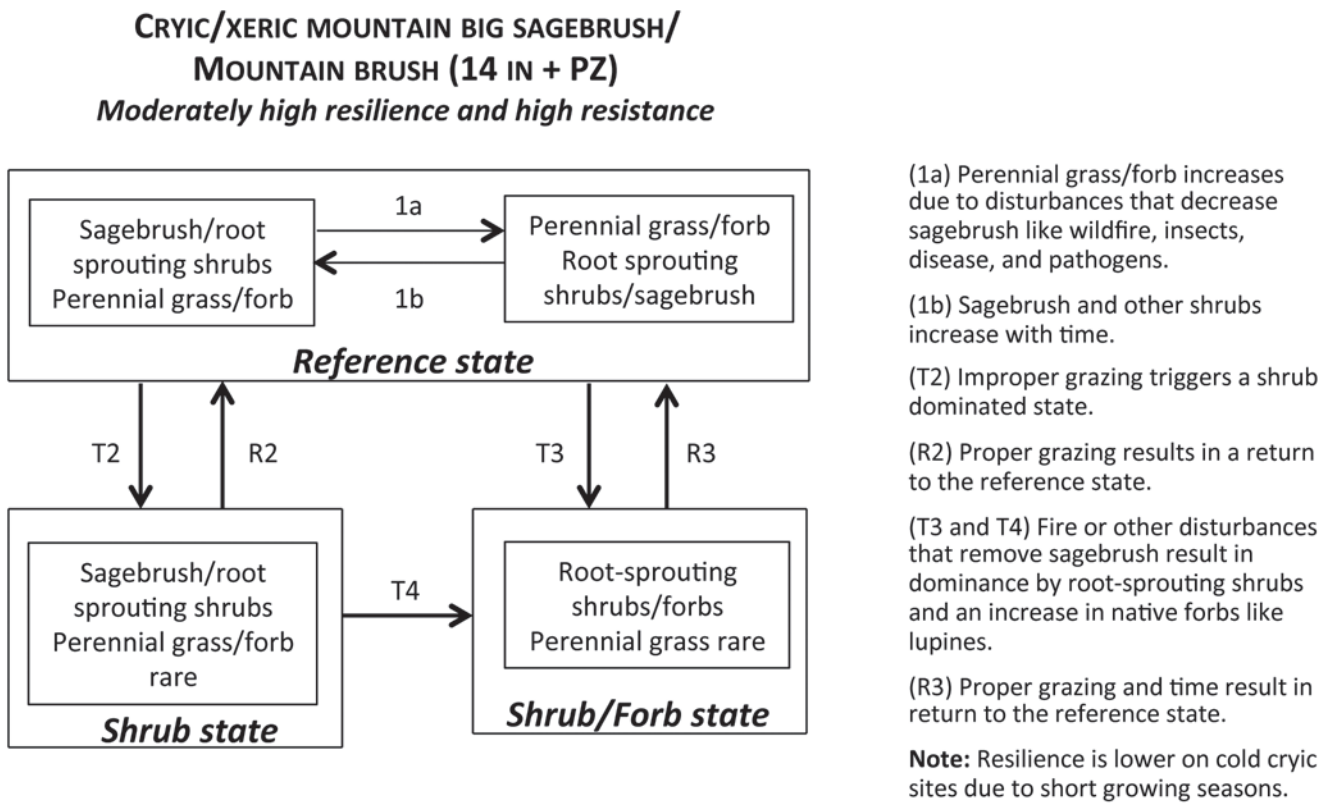
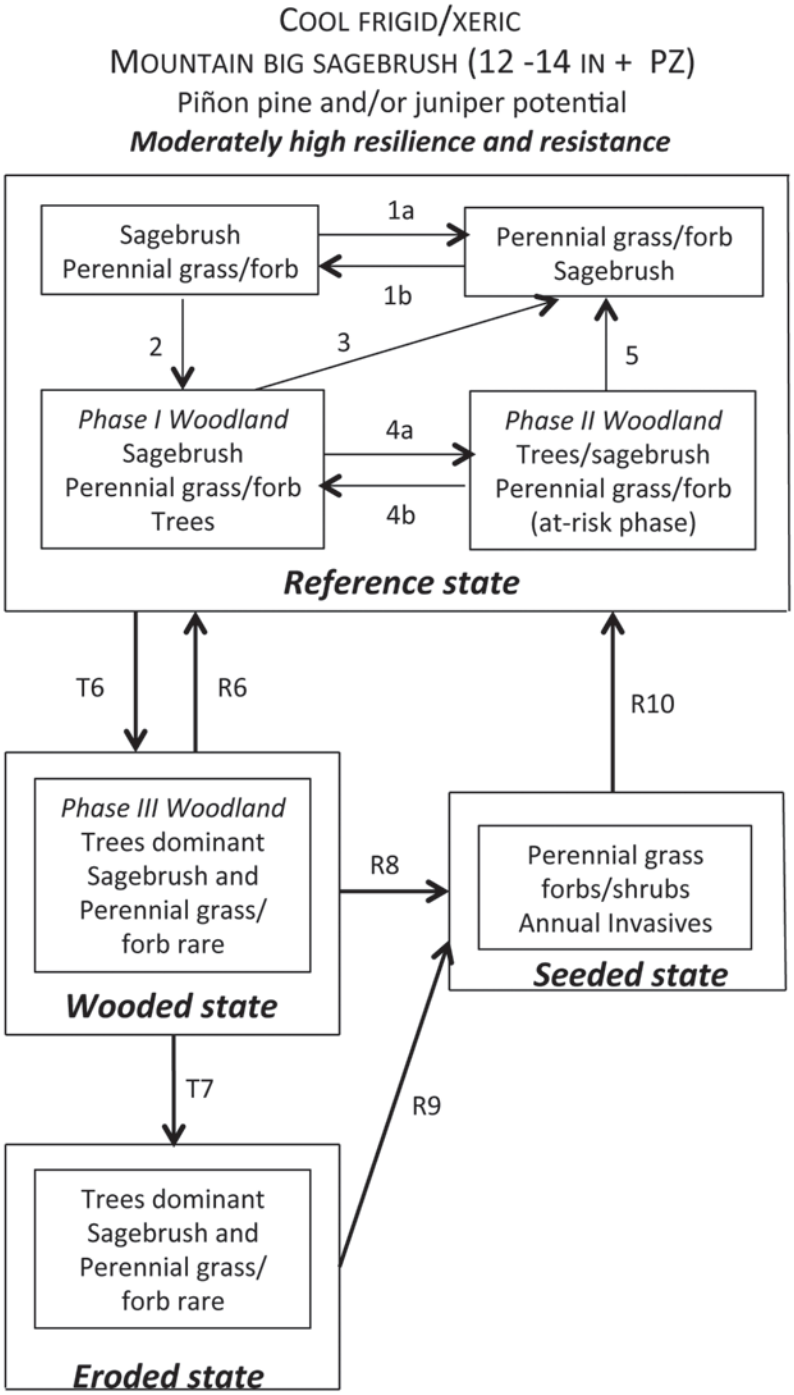


Figure A.5A. STM for a cryic/xeric mountain big sagebrush/mountain brush ecological type characterized by moderately high resilience and high resistance.



(1a) Disturbances such as wildfire, insects, disease, and pathogens result in less sagebrush and more perennial grass/forb.

(1b) Sagebrush increases with time .

(2) Time combined with seed sources for piñon and/or juniper trigger a Phase I Woodland.

(3 and 5) Fire and or fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore perennial grass/forb and sagebrush dominance.

(4a) Increasing tree abundance results in a Phase II woodland with depleted perennial grass/forb and shrubs and an at-risk phase.

(4b) Fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore perennial grass/forb and sagebrush dominance.

(T6) Infilling of trees and/or improper grazing can result in a biotic threshold crossing to a wooded state with increased risk of high severity crown fires .

(R6) Fire, herbicides and/or mechanical treatments that remove trees may restore perennial grass/forb and sagebrush dominance.

(T7) An irreversible abiotic threshold crossing to an eroded state can occur depending on soils, slope, and understory species.

(R8 and R9) Seeding after fire may be required on sites with depleted perennial grass/forb, but seeding with aggressive introduced species can decrease native perennial grass/forb. Annual invasives are typically rare. Seeded eroded states may have lower productivity.

(R10) Depending on seed mix and grazing, return to the reference state may be possible if an irreversible threshold has not been crossed.

Figure A.5B. STM for a cool frigid/xeric mountain big sagebrush ecological type that has piñon pine and/or juniper potential and is characterized by moderately high resilience and resistance.

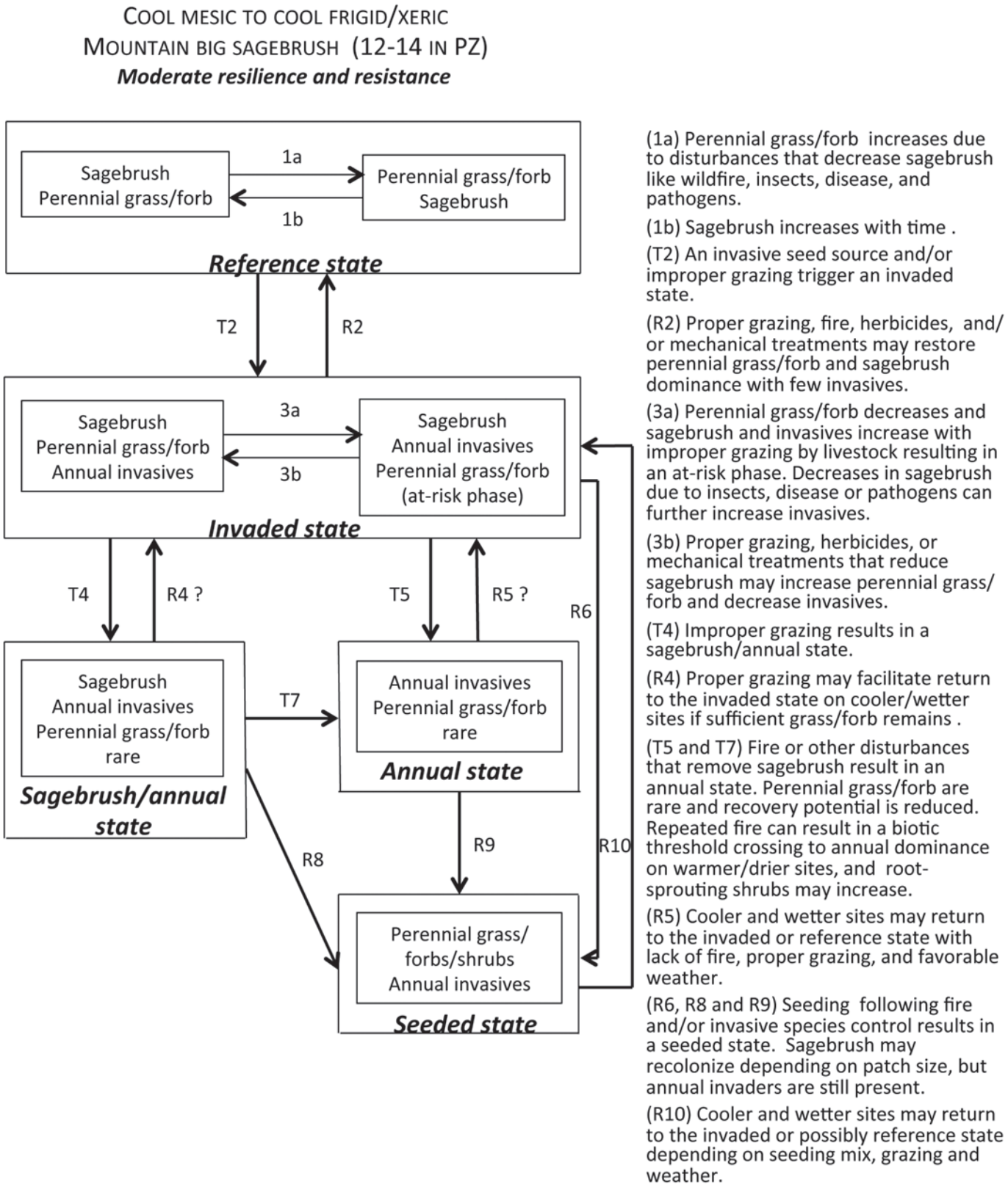


Figure A.5C. STM for a cool mesic to cool frigid/xeric mountain big sagebrush ecological type that is characterized by moderate resilience and resistance.

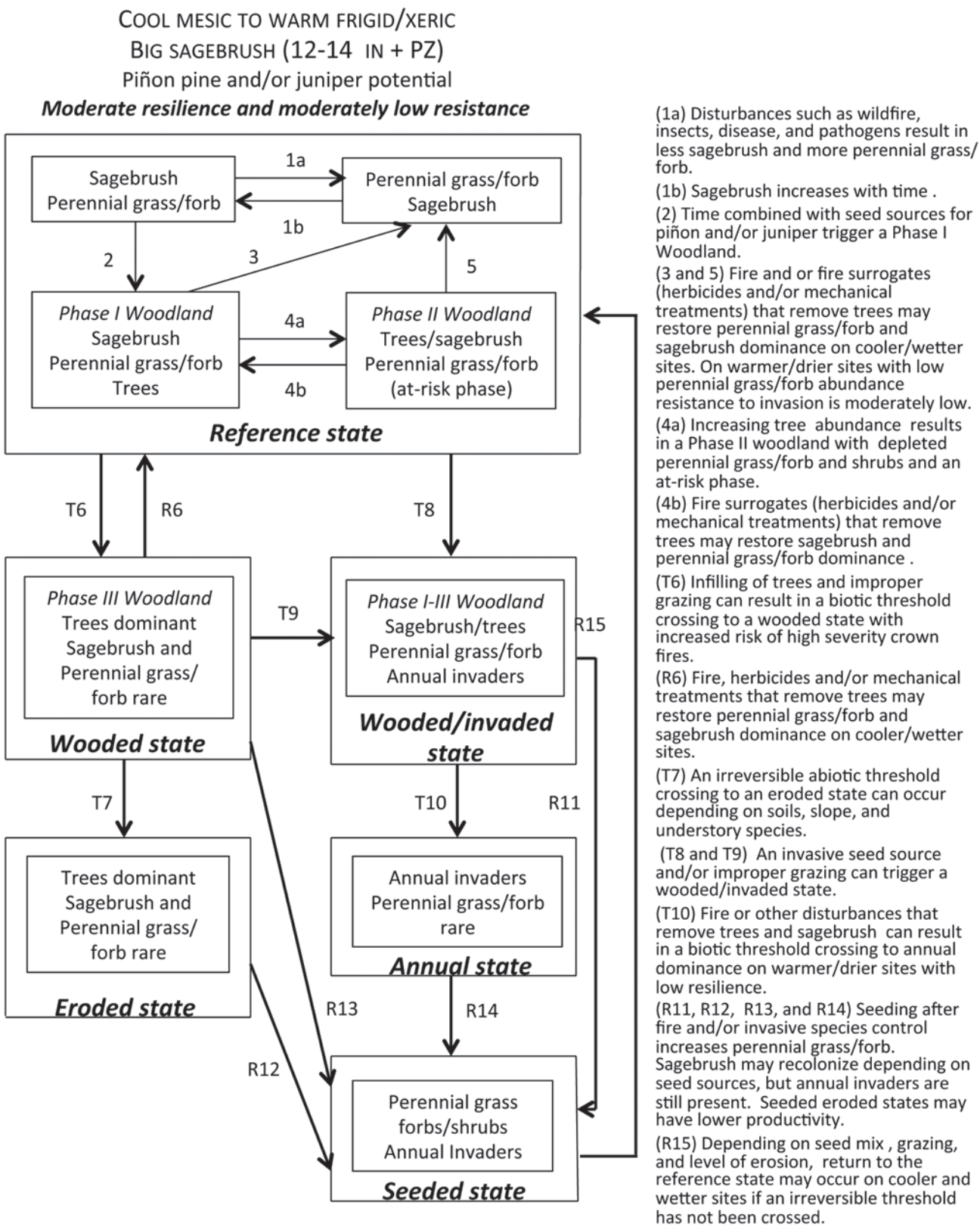
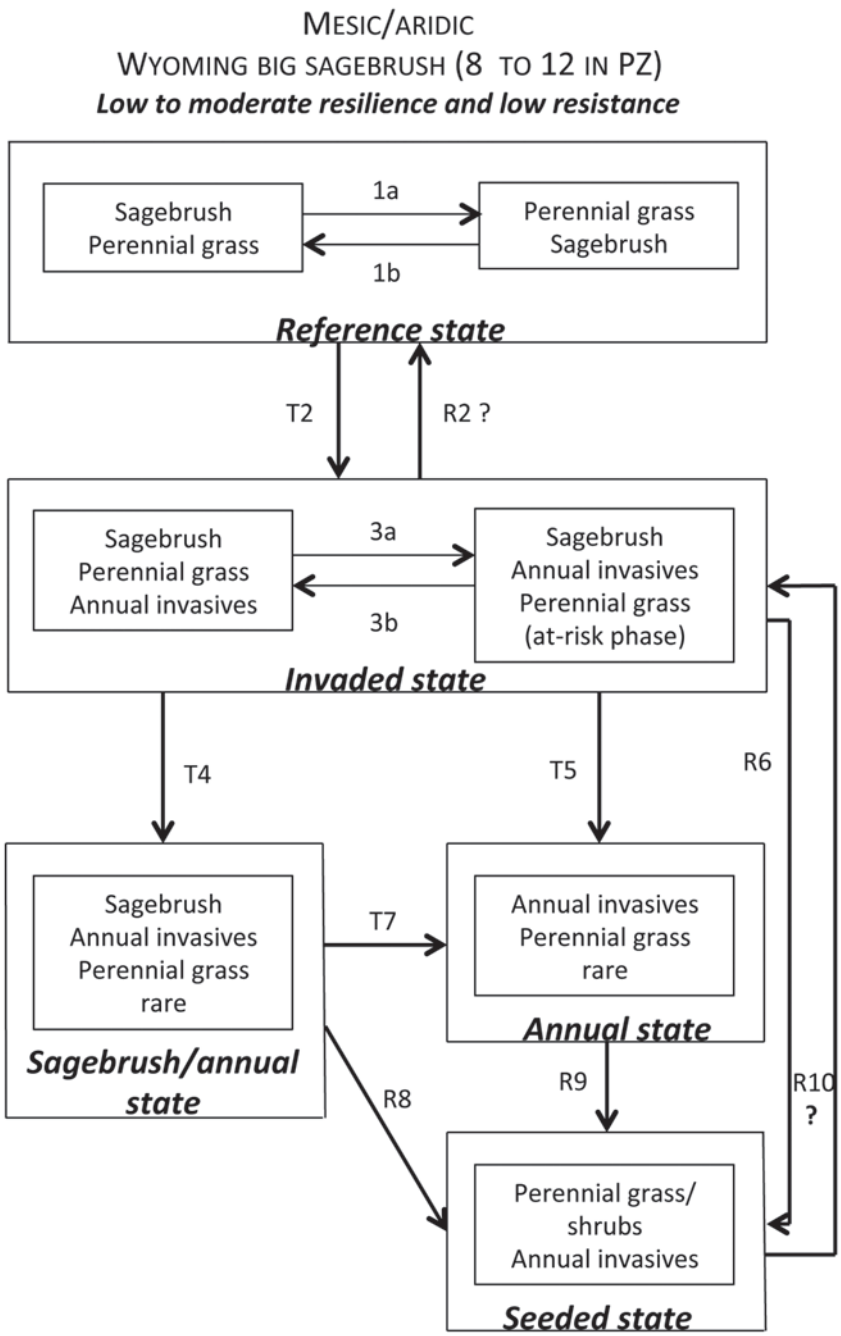


Figure A.5D. STM for a cool mesic to warm frigid/xeric mountain big sagebrush ecological type type that has piñon pine and/or juniper potential and is characterized by moderate resilience and moderately low resistance.



(1a) Perennial grass increases due to disturbances that decrease sagebrush like wildfire, insects, disease, and pathogens.
(1b) Sagebrush increases with time .
(T2) An invasive seed source and/or improper grazing trigger an invaded state.
(R2) Proper grazing, fire, herbicides and/or mechanical treatments are unlikely to result in return to the reference state on all but the coolest and wettest sites.
(3a) Perennial grass decreases and both sagebrush and invasives increase with improper grazing resulting in an at-risk phase. Decreases in sagebrush due to insects, disease or pathogens can further increase invasives.
(3b) Proper grazing and herbicides or mechanical treatments that reduce sagebrush may restore perennial grass and decrease invaders on wetter sites (10-12”). Outcomes are less certain on drier sites (8-10”) and/or low abundance of perennial grass.
(T4) Improper grazing triggers a largely irreversible threshold to a sagebrush/annual state.
(T 5 and T7) Fire or other disturbances that remove sagebrush result in an annual state. Perennial grass is rare and recovery potential is low due to low precipitation, mesic soil temperatures, and competition from annual invasives. Repeated fire can cause further degradation.
(R6, R8 and R9) Seeding following fire and/or invasive species control results in a seeded state. Sagebrush may recolonize depending on patch size, but annual invasives are still present.
(R10) Seeding effectiveness and return to the invaded state are related to site conditions, seeding mix, and post-treatment weather.

Figure A.5E. STM for a mesic/aridic Wyoming big sagebrush ecological type with low to moderate resilience and low resistance.

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Appendix H – Attachment 2

Greater Sage-Grouse Wildfire, Invasive Annual Grasses & Conifer Expansion Assessment

June 2014

Suggested Citation:

Greater Sage-Grouse Wildfire, Invasive Annual Grasses & Conifer Expansion Assessment (Fire and Invasive Assessment Tool (FIAT)). June 2014. Prepared by Fire and Invasive Assessment Team (Appendix 5). 43 pages.

Introduction and Background

The purpose of this assessment is to identify priority habitat areas and management strategies to reduce the threats to Greater Sage-Grouse resulting from impacts of invasive annual grasses, wildfires, and conifer expansion. The Conservation Objectives Team (COT) report (USFWS 2013) and other scientific publications identify wildfire and conversion of sagebrush habitat to invasive annual grass dominated vegetative communities as two of the primary threats to the sustainability of Greater Sage-Grouse (*Centrocercus urophasianus*, hereafter sage-grouse) in the western portion of the species range. For the purposes of this assessment protocol, invasive species are limited to, and hereafter referred to, as **invasive annual grasses** (e.g., primarily cheatgrass [*Bromus tectorum*]). Conifer expansion (also called encroachment) is also addressed in this assessment.

The United States Fish and Wildlife Service (USFWS) will consider the amelioration of impacts, location and extent of treatments, degree of fire risk reduction, locations for suppression priorities, and other proactive measures to conserve sage-grouse in their 2015 listing decision. This determination will be made based in part upon information contained in the United States (US) Department of the Interior, Bureau of Land Management (BLM) resource management plan (RMP) amendments and Forest Service land resource management plan (LRMP) amendments, including this assessment.

This assessment is based in part on National Resources Conservation Service (NRCS) soil surveys that include geospatial information on soil temperature and moisture regimes associated with resistance and resiliency properties (see following section on *Soil Temperature and Moisture Regimes)*. While this assessment is applicable across the range of sage-grouse, the analysis is limited to Western Association of Fish and Wildlife Management Agencies' (WAFWA) Management Zones III, IV, and V (roughly the Great Basin region) because of the significant issues associated with invasive annual grasses and the high level of wildfires in this region. The utility of this assessment process is dependent on incorporating improved information and geospatial data as it becomes available. Although the resistance and resilience concepts have broad applications (e.g., infrastructure development), this assessment is limited to developing strategies to reduce threats to sage-grouse habitat (e.g., invasive annual grasses and wildfires).

Draft Greater Sage-Grouse Environmental Impact Statements (EISs) contain a suggested framework in the appendices ("Draft Greater Sage-Grouse Wildland Fire and Invasive Species Assessment") that provided a consistent approach to conduct these assessments. The current protocol was developed by the Fire and Invasive Species Team (FIAT), a team of wildland fire specialists and other resource specialists and managers, to specifically incorporate resistance to invasive annual grasses and resilience after disturbance principles into the assessment protocol. This protocol is also referred to as the Fire and Invasive Tool. In October 2013, the BLM, Forest Service, and USFWS agreed to incorporate this approach into the final EISs.

The cornerstone of the FIAT protocol is recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014) and the USFWS-sponsored project with the Western Association of Fish and Wildlife Agencies (WAFWA) to assemble an interdisciplinary team to provide additional information on wildland fire and invasive plants and to develop strategies for addressing

these issues. This interagency collaboration between rangeland scientists, fire specialists, and sage-grouse biologists resulted in the development of a strategic, multi-scale approach for employing ecosystem resilience and resistance concepts to manage threats to sage-grouse habitats from wildfire and invasive annual grasses (Chambers et al. 2014). This paper has been published as a Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-326 and is posted online at http://www.fs.fed.us/rm/pubs/rmrs_gtr326.pdf. It serves as the reference and basis for the protocol described in this assessment.

The assessment process sets the stage for:

- Identifying important sage-grouse occupied habitats and baseline data layers important in defining and prioritizing sage-grouse habitats
- Assessing the resistance to invasive annual grasses and resilience after disturbance and prioritizing focal habitats for conservation and restoration
- Identifying geospatially explicit management strategies to conserve sage-grouse habitats

Management strategies are types of actions or treatments that managers typically implement to resolve resource issues. They can be divided into proactive approaches (e.g., fuels management and habitat recovery/restoration) and reactive approaches (e.g., fire operations and post-fire rehabilitation). Proactive management strategies can favorably modify wildfire behavior and restore or improve desirable habitat with greater resistance to invasive annual grasses and/or resilience after disturbances such as wildfires. Reactive management strategies are employed to reduce the loss of sage-grouse habitat from wildfires or stabilize soils and reduce impacts of invasive annual grasses in sage-grouse habitat after wildfires. Proactive management strategies will result in long-term sage-grouse habitat improvement and stability, while reactive management strategies are essential to reducing current impacts of wildfires on sage-grouse habitat, thus maintaining long-term habitat stability. Management strategies include:

Proactive Strategies-

1. **Fuels Management** includes projects that are designed to change vegetation composition and/or structure to modify fire behavior characteristics for the purpose of aiding in fire suppression and reducing fire extent.

2. **Habitat Restoration/Recovery**
    a. Recovery, referred to as passive restoration (Pyke 2011), is focused on changes in land use (e.g., improved livestock grazing practices) to achieve a desired outcome where the plant community has not crossed a biotic or physical threshold.
    b. Restoration is equivalent to active restoration (Pyke 2011) and is needed when desired species or structural groups are poorly represented in the community and reseeding, often preceded by removal of undesirable species, is required. Note: The Fuels Management program supports recovery/restoration projects through its objective to restore and maintain resilient landscapes.

Reactive Strategies-

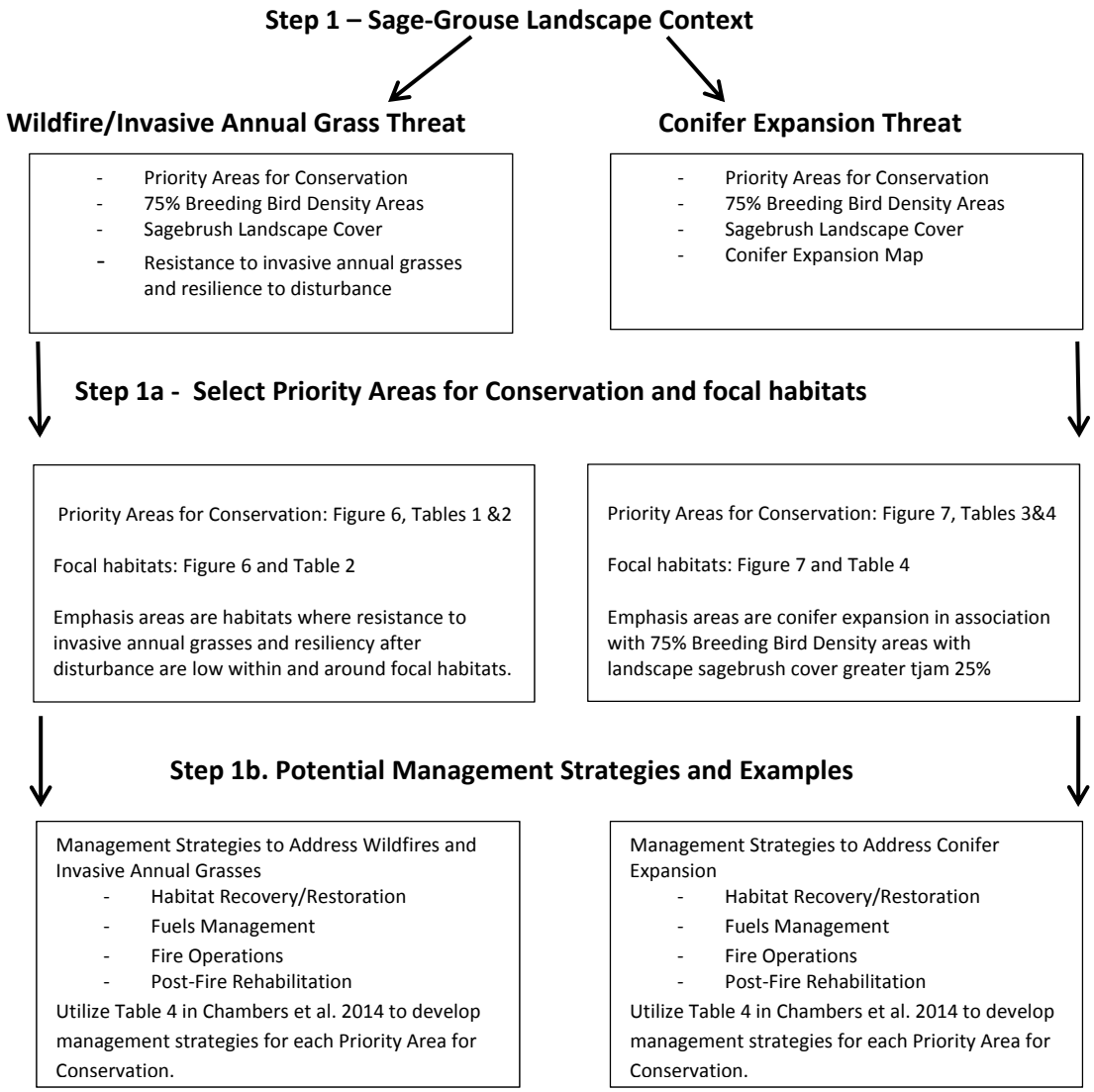
3. **Fire Operations** includes preparedness, prevention, and suppression activities. When discussing specific components of fire operations, the terms fire preparedness, fire prevention and fire suppression are used.

4. **Post-Fire Rehabilitation** includes the BLM's Emergency Stabilization and Rehabilitation (ES&R) Program and the Forest Service's Burned Area Emergency Response (BAER) Program. Policy limits application of funds from 1 to 3 years, thus treatments to restore or enhance habitat after this period of time are considered habitat recovery/restoration.

The assessment process included two steps with sub-elements. First, important Priority Areas for Conservation (PACs) and focal habitats are identified (**Step 1a**). Second, potential management **strategies** (described above) are identified to conserve or restore focal habitats threatened by wildfires, invasive annual grasses, and conifer expansion (primarily pinyon pine and/or juniper species; **Step 1b**). Focal habitats are the portions of a PAC with important habitat characteristics, bird populations, and threats (e.g., wildfires, invasive annual grasses, and conifer expansion) where this assessment will be applied. Areas adjacent to or near the focal habitats can be considered for management treatments such as fire control and fuels management if these locations can reduce wildfire impacts to focal habitats. Soil temperature and moisture regimes are used to characterize capacity for resistance to invasive annual grasses and resilience after disturbance (primarily wildfires) within focal habitats to assist in identifying appropriate management strategies, especially in areas with good habitat characteristics that have low recovery potential following disturbance. Soil moisture and temperature regime relationships have not been quantified to the same degree as for conifer expansion; however, Chambers et al. 2014) discuss preliminary correlations between these two variables.

The results of Steps 1a and 1b, along with associated geospatial data files, are available to local management units to complete Step 2 of the assessment process. Step 2 is conducted by local management units to address wildfire, invasive annual grasses, and conifer expansion in or near focal habitat areas. First, local information and geospatial data are collected and evaluated to apply and improve on Step 1 focal habitat area geospatial data (**Step 2a**). Second, focal habitat activity and implementation plans are developed and include prioritized management **tactics and treatments** to implement effective, fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation strategies (**Step 2b**). This assessment will work best if Step 2b is done across management units (internal and externally across BLM and Forest Service administrative units and with other entities). **Figure 1**, Assessment Flow Chart, contains an illustration of the steps in the assessment process.

This analysis does not necessarily address the full suite of actions needed to maintain the current distribution and connectivity of sage-grouse habitats across the Great Basin because resources available to the federal agencies are limited at this time. Future efforts designed to maintain and connect habitats across the range will be needed as current focal areas are addressed and additional resources become available.



Step 2 – Management Unit Applications for Invasive Annual Grasses and Conifer Expansion

Step 2a

1) Evaluate the accuracy and utility of Step 1 geospatial layers and incorporate relevant local information.
2) Develop framework for incorporating management strategies to initiate implementation/activity plans.

Step 2b

Develop collaborative implementation/activity plans to address threats to focal habitats in Priority Areas for Conservation.

Figure 1, Assessment Flow Chart

Step 1

The first component of the Wildfire and Invasive Annual Grasses Assessment describes the factors that collectively provide the sage-grouse landscape context. Step 1a provides this context by discussing PACs, breeding bird density (BBD), soil temperature and moisture regimes (indicators of resistance to annual grasses and resilience after disturbance), landscape sagebrush cover, and conifer expansion. See Chambers et al. 2014) for a detailed description of Invasive Annual Grass and Wildfire threats to sage-grouse habitat. Priority PACs and focal habitats are derived from the information provided in this sage-grouse landscape context section.

Step 1a- Sage-grouse landscape context

This component of the assessment identifies important PACs and associated focal habitats where wildfire, invasive annual grasses, and conifer expansion pose the most significant threats to sage-grouse.

The primary focus of this assessment is on sage-grouse populations across the WAFWA Management Zones III, IV, and V (**Figure 2**, Current PACs for WAFWA Management Zones III, IV, and V). Sage-grouse are considered a landscape species that require very large areas to meet their annual life history needs. Sage-grouse are highly clumped in their distribution (Doherty et al. 2010), and the amount of landscape cover in sagebrush is an important predictor of sage-grouse persistence in these population centers (Knick et al. 2013). States have used this information combined with local knowledge to identify PACs to help guide long-term conservation efforts. FIAT used data sets that were available across the three management zones as an initial step for prioritizing selected PACs and identifying focal habitats for fire and invasive annual grasses and conifer expansion assessments. These data sets (also described in Chambers et al. 2014) include:

Priority Areas for Conservation (PACs)

PACs have been identified by states as key areas that are necessary to maintain redundant, representative, and resilient sage-grouse populations (USFWS 2013; see Figure 2). A primary objective is to minimize threats within PACs (e.g., wildfire and invasive annual grasses impacts) to ensure the long-term viability of sage-grouse and its habitats. A secondary priority is to conserve sage-grouse habitats outside of PACs since they may also be important for habitat connectivity between PACs (genetic and habitat linkages), habitat restoration and population expansion opportunities, and flexibility for managing habitat changes that may result from climate change. PACs have also been identified by the USFWS as one of the reporting geographic areas that will be considered during listing determinations for sage-grouse.

The combination of PACs with BBD data (described below) assists us in identifying connectivity between populations. PAC boundaries may be modified in the future requiring adjustments in focal habitat areas and management strategy priorities.

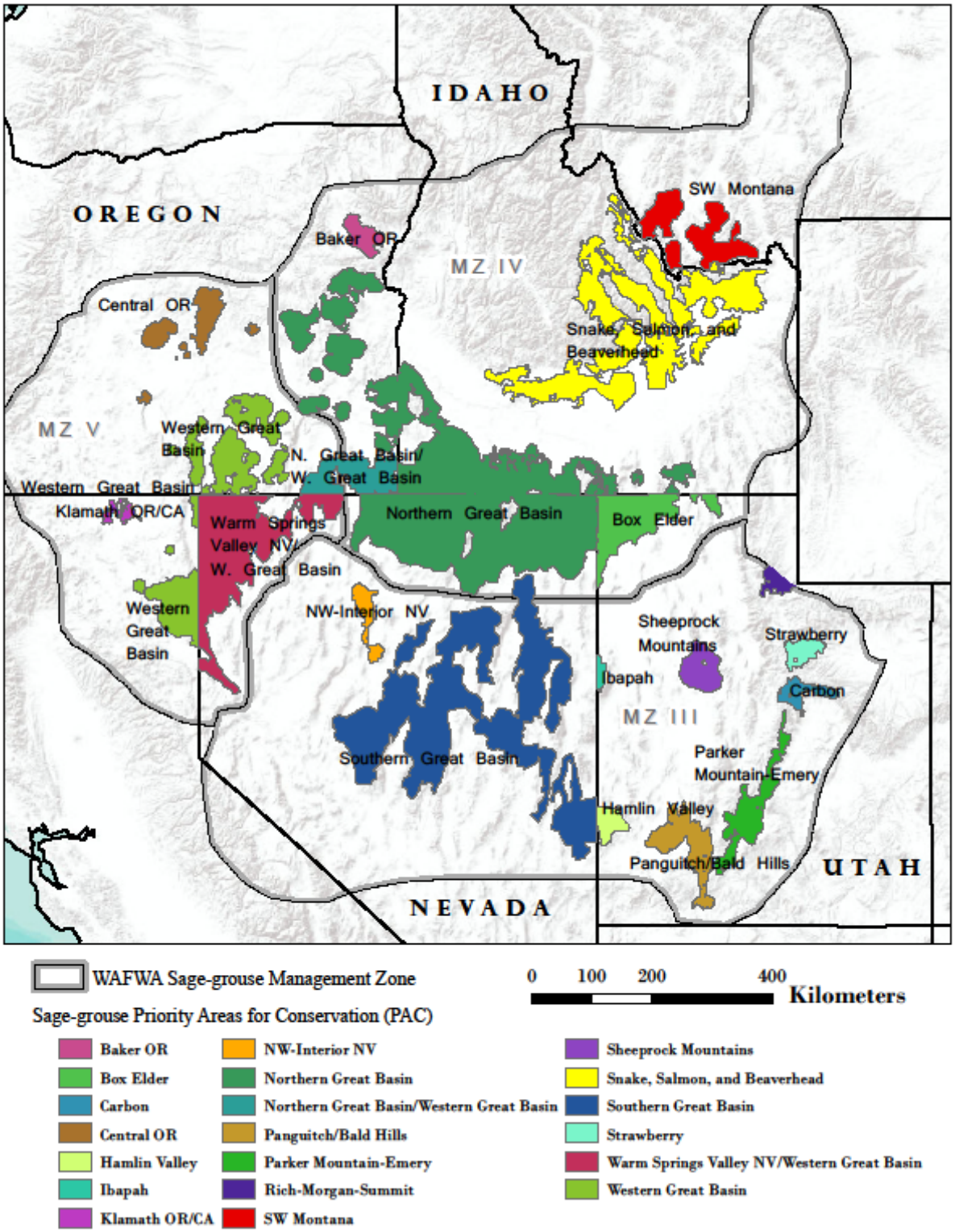


Figure 2, Current PACs for WAFWA Management Zones III, IV, and V. Bi-State sage-grouse populations were not included for this analysis and are being addressed in separate planning efforts.

Breeding Bird Density

Doherty et al. (2010) provided a useful framework for identifying population concentration centers in their range-wide BBD mapping. FIAT used maximum counts of males on leks (4,885 males) to delineate breeding bird density areas that contain 25, 50, 75, and 100 percent of the known breeding population. Leks were then mapped according to abundance values and buffered by 4 to 5.2 miles (6.4 to 8.5 kilometers) to delineate nesting areas. Findings showed that while sage-grouse occupy extremely large landscapes, their breeding distribution is highly aggregated in comparably smaller identifiable population centers; 25 percent of the known population occurs within 3.9 percent (7.2 million acres [2.92 million hectares]) of the species range, and 75 percent of birds are within 27 percent of the species range (50.5 million acres [20.4 million hectares]; Doherty et al. 2010). See **Figures 3**, Sage-Grouse Breeding Bird Density Thresholds.

This analysis places emphasis on breeding habitats because little broad/mid-scale data exists for associated brood-rearing (summer) and winter habitat use areas. Finer scale seasonal habitat use data should be incorporated (or, if not available studies, should be conducted) at local levels to ensure management actions encompass all seasonal habitat requirements. Federal administrative units should consult with state wildlife agencies for additional seasonal habitat information.

For this assessment, FIAT chose to use the 75 percent BBD as an indicator of high bird density areas that informed the approach used by state wildlife agencies to initially identify PACs. Range-wide BBD areas provide a means to further prioritize actions within relatively large PACs to maintain bird distribution and abundance. FIAT used state level BBD data from Doherty et al. (2010) instead of range-wide model results to ensure important breeding areas in Management Zones III, IV, and V were not underweighted due to relatively higher bird densities in the eastern portion of the range. BBD areas of 75 to 100 percent are included in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

Note that breeding density areas were identified using best available information in 2009, so this range-wide data does not reflect the most current lek count information and changes in conditions since the original analysis. Subsequent analysis should use the most current information available. Also, BBD areas should not be viewed as rigid boundaries but rather as a means to regionally prioritize landscapes where step down assessments and actions should be implemented quickly to conserve the most birds.

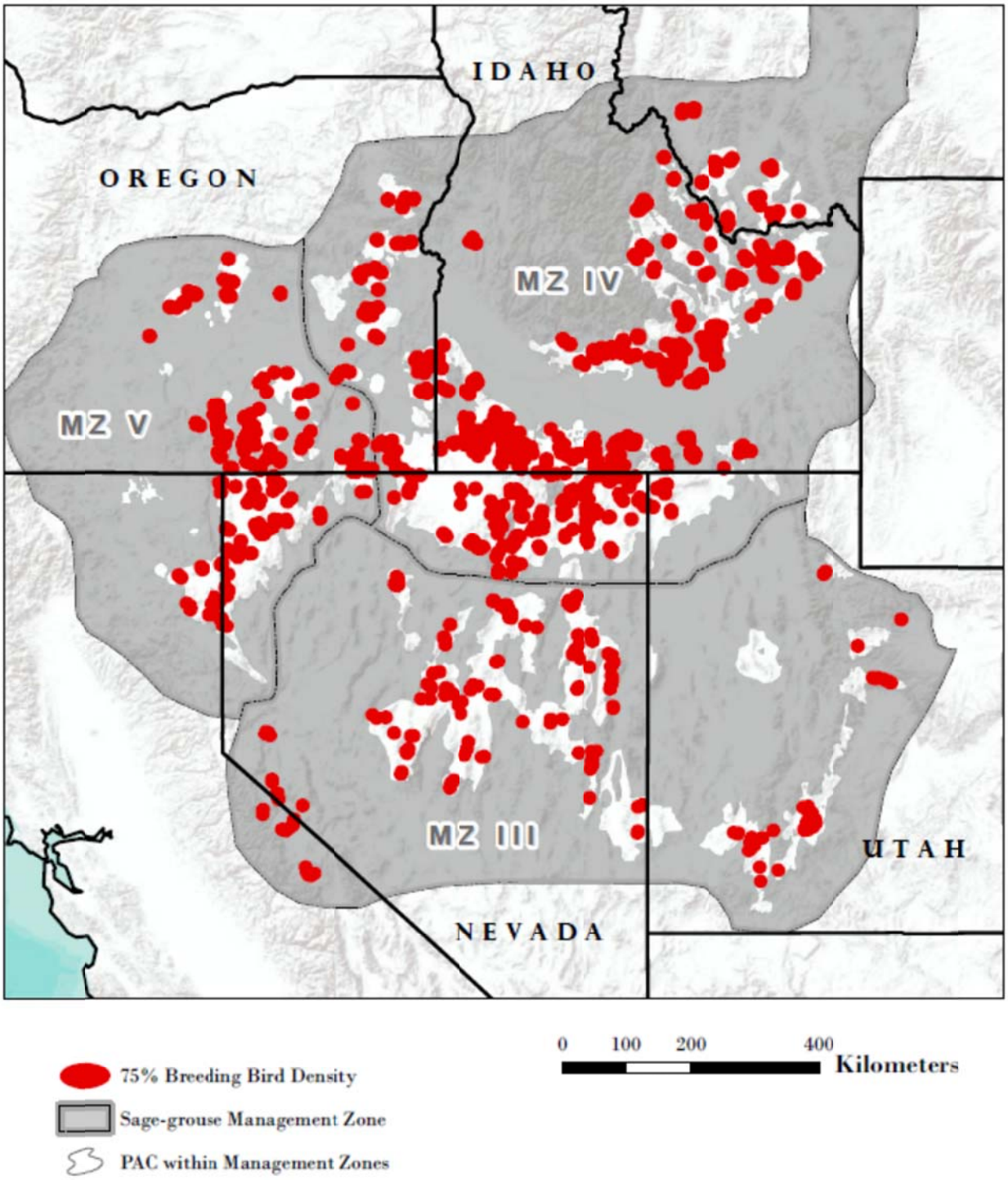


Figure 3, Sage-Grouse Breeding Bird Density Thresholds for 75% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is shown in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

Soil Temperature and Moisture Regimes

Invasive annual grasses and wildfires can be tied to management strategies through an understanding of resistance and resilience concepts. Invasive annual grasses has significantly reduced sage-grouse habitat throughout large portions of its range (Miller et al. 2011). While abandoned leks were linked to increased nonnative annual grass presence, active leks were associated with less annual grassland cover than in the surrounding landscape (Knick et al. 2013). Invasive annual grasses also increases fire frequency, which directly threatens sage-grouse habitat and further promotes the establishment of invasive annual grasses (Balch et al. 2013). This nonnative annual grass and fire feedback loop can result in conversion from sagebrush shrublands to annual grasslands (Davies 2011).

In cold desert shrublands, vegetation community resistance to invasive annual grasses and resilience following disturbance is strongly influenced by soil temperature and moisture regimes (Chambers et al. 2007; Meyer et al. 2001). Generally, colder soil temperature regimes and moister soil moisture regimes are associated with more resilient and resistant vegetation communities. While vegetation productivity and ability to compete and recover from disturbance increase along a moisture gradient, cooler temperatures limit invasive annual grass growth and reproduction (Chambers et al. 2007; Chambers et al. 2014). Conversely, warm and dry soil temperature and moisture regimes and to a lesser degree cool and dry soil temperature and moisture regimes, are linked to less resistant and resilient communities (see Figure 9 in Chambers et al. 2014). A continuum in resistance and resilience exists between the warm and dry and cool and dry soil temperature and moisture regimes that will need to be considered in Step 2 in developing implementation or activity plans. These relationships can be used to prioritize management actions within sage-grouse habitat using broadly available data.

To capture relative resistance and resilience to disturbance and invasive annual grasses across the landscape, soil temperature and moisture regime information (described in greater detail in Chambers et al. 2014) were obtained from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) data. Where gaps in this coverage existed, the NRCS US General Soil Map (STATSGO2) data was used (Soil Survey Staff 2014; see Appendix 1). The STATSGO2 database includes soils mapped at a 1:250,000-scale; the SSURGO database includes soils mapped at the 1:20,000 scale. Interpretations made from soil temperature and moisture regimes from the STATSGO2 database will not have the same level of accuracy as those made from the SSURGO database.

Areas characterized by warm and dry soil temperature and moisture regimes (low relative resistance and resilience) were intersected with sage-grouse breeding habitat and sagebrush landscape cover to identify candidate areas (emphasis areas) for potential management actions that mitigate threats from invasive annual grasses and wildfire (**Figure 4**, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V, and **Figure 5**, Intersection of High Density (75% BBD) Populations). These data layers provide the baseline information considered important in prioritizing areas where conservation and management actions could be developed to address invasive annual grasses in a scientifically defensible manner (see Table 4 in Chambers et al. 2014).

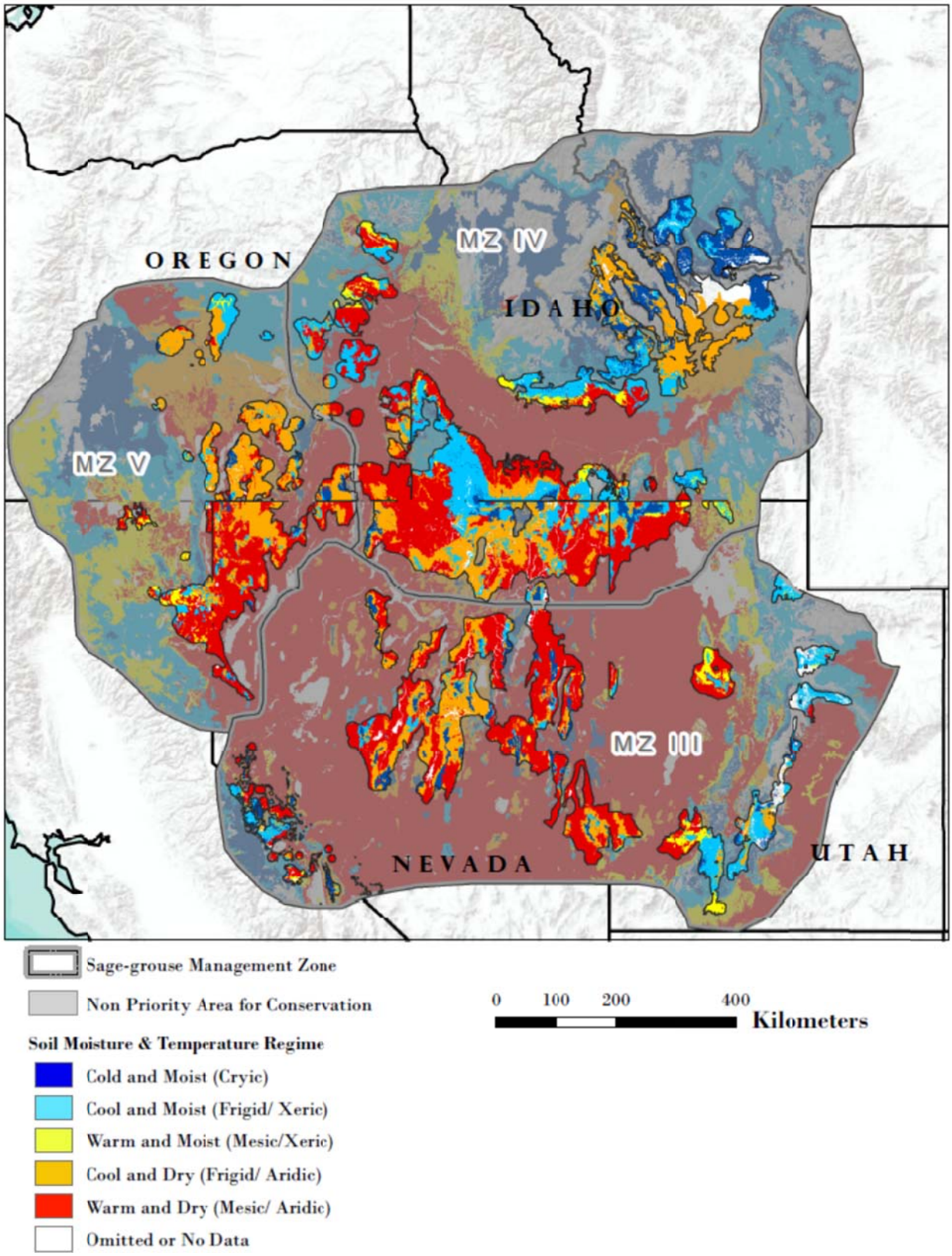


Figure 4, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V

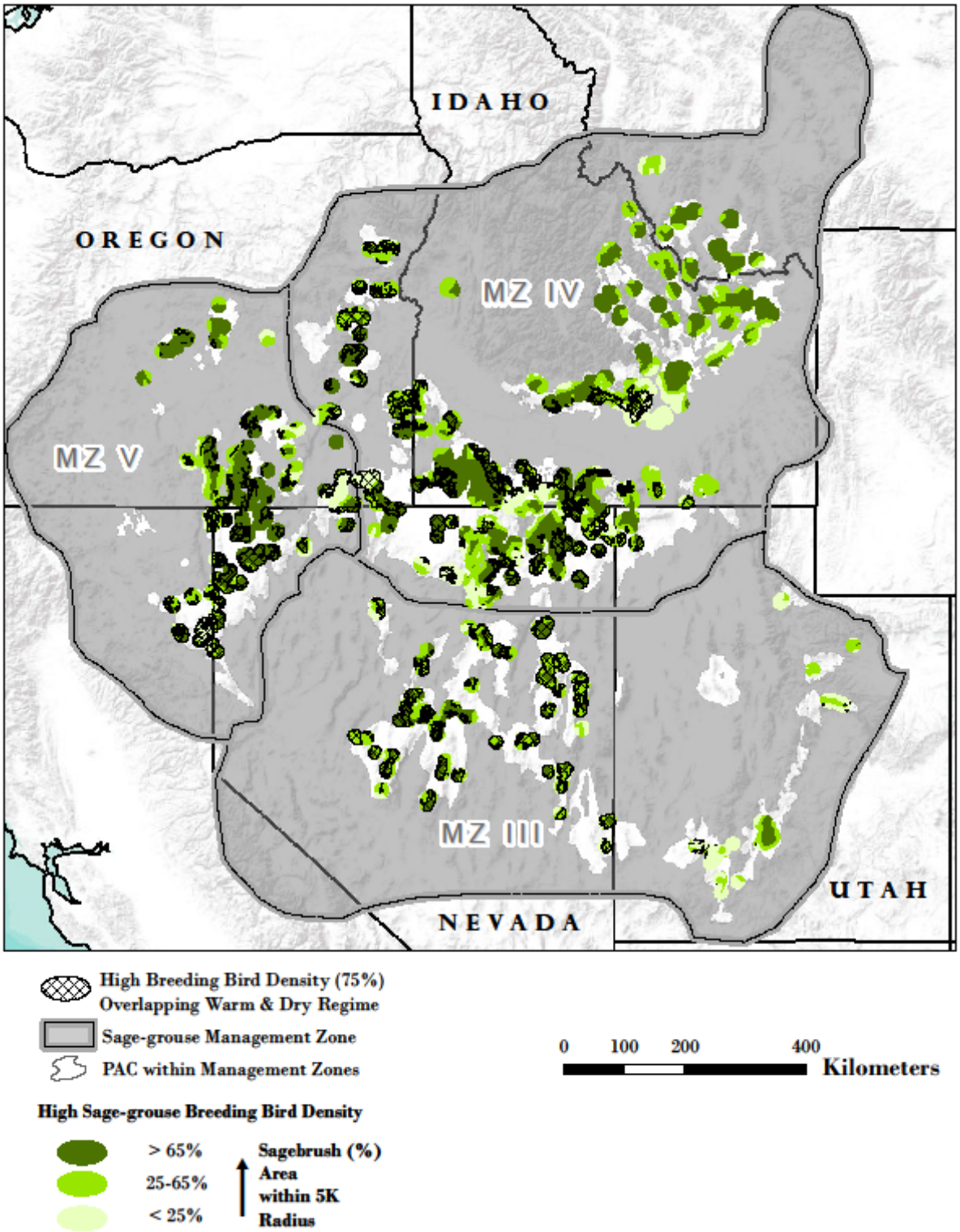


Figure 5, Intersection of High Density (75% BBD) Populations. The warm and dry sites and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin.

Sagebrush Landscape Cover

The amount of the landscape in sagebrush cover is closely related to the probability of maintaining active sage-grouse leks, and is used as one of the primary indicators of sage-grouse habitat potential at landscape scales (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). For purposes of prioritizing landscapes for sage-grouse habitat management, FIAT used less than or equal to 25 percent sagebrush landscape cover as a level below which there is a low probability of maintaining sage-grouse leks, and greater than or equal to 65 percent as the level above which there is a high probability of sustaining sage-grouse populations with further increases of landscape cover of sagebrush (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Increases in landscape cover of sagebrush have a constant positive relationship with sage-grouse lek probability at between about 25 percent and 65 percent landscape sagebrush cover (Knick et al. 2013). It is important to note that these data and interpretations relate only to persistence (i.e., whether or not a lek remains active), and it is likely that higher proportions of sagebrush cover may be required for population growth.

For the purposes of delineating sagebrush habitat relative to sage-grouse requirements for landscape cover of sagebrush, FIAT calculated the percentage of landscape sagebrush cover (Landfire 2013) within a 3-mile (5-kilometer) radius of each 98-foot by 98-foot (30 meter by 30 meter) pixel in Management Zones III, IV, and V (see Appendix 2 in Chambers et al. 2014) for how landscape sagebrush cover was calculated). FIAT then grouped the percentage of landscape sagebrush cover into each of the selected categories (0 to 25 percent, 25 to 65 percent, 65 to 100 percent; **Figure 6**, Sagebrush Landscape Cover and Fire Perimeters for the Analysis Area). Landfire data was based on 2000 satellite imagery so wildfire perimeters after that date were incorporated into this layer to better reflect landscape sagebrush cover. Burned areas were assumed to fall into the 0 to 25 percent landscape cover class.

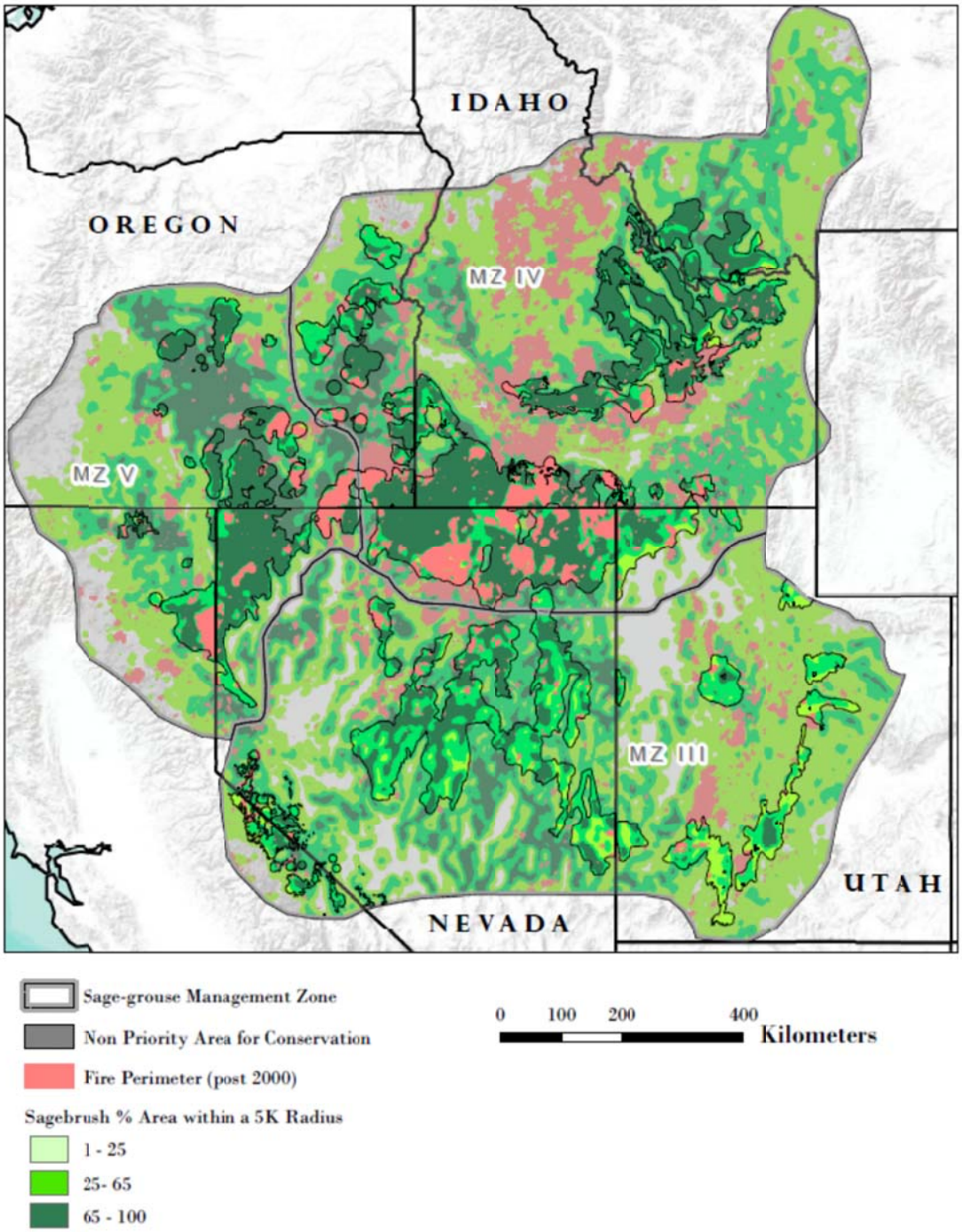


Figure 6, Sagebrush Landscape Cover and Fire Perimeters (post-2000) for the Analysis Area

Conifer Expansion

Conifer expansion into sagebrush landscapes also directly reduces sage-grouse habitat by displacing shrubs and herbaceous understory as well as by providing perches for avian predators. Conifer expansion also leads to larger, more severe fires in sagebrush systems by increasing woody fuel loads (Miller 2013). Sage-grouse populations have been shown to be impacted by even low levels of conifer expansion (Baruch-Mordo et al. 2013). Active sage-grouse leks persist in regions of relatively low conifer woodland and are threatened by conifer expansion (Baruch-Mordo et al. 2013; Knick et al. 2013).

To estimate where sage-grouse breeding habitat faces the largest threat of conifer expansion, FIAT used a risk model developed by Manier et al. (2013) that locates regions where sagebrush landscapes occur within 250 meters of conifer woodland (**Figure 7**, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD). Although the model is coarse, it is available for the entirety of the three sage-grouse management zones analyzed. FIAT encourages using more accurate conifer expansion data in Step 2.

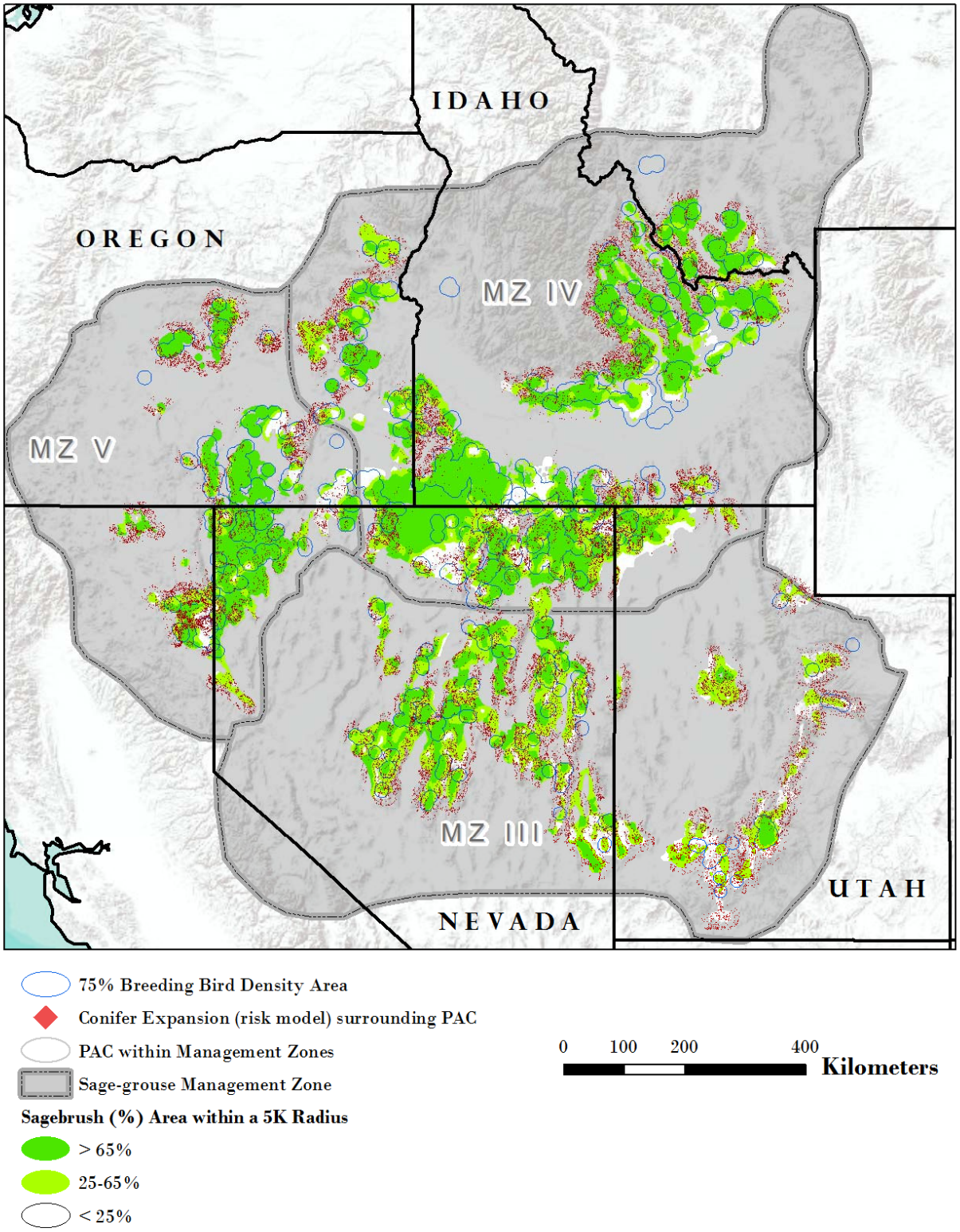


Figure 7, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD

Step 1a. Identifying PACs and focal habitats

A primary goal for the conservation of sage-grouse populations is the identification of important habitats needed to ensure the persistence and recovery of the species. Loss of habitat, and by inference populations, in these habitats would likely imperil the species in the Great Basin. The first objective is to protect and restore those habitats that provide assurances for retaining large well connected populations.

PACs and the 75 percent BBD maps were used to provide a first-tier stratification (e.g., focal habitats) for prioritizing areas where conservation actions could be especially important for sage-grouse populations. Although these areas are a subset of the larger sage-grouse habitats, they are readily identifiable and include habitats (e.g., breeding and nesting habitats that are considered critical for survival; Connelly et al. 2000; Holloran et al. 2005; Connelly et al. 2011) and necessary for the recovery of the species across its range.

The prioritization of habitats for conservation purposes was based on the several primary threats to remaining sage-grouse populations in the Great Basin including the loss of sagebrush habitats to wildfire and invasive annual grasses, and conifer expansion. The first, and probably the most urgent threat for sage-grouse, is the loss of sagebrush habitat due to wildfire and invasive annual species (e.g., cheatgrass; See Figure 11 in Chambers et al. 2014). Areas of highest concern are those with low resistance to cheatgrass and low resilience after disturbance (warm/dry and some cool/dry temperature and moisture regimes sites) that are either **within or in close proximity** to remaining high density populations of sage-grouse (Figure 5). Sagebrush habitats (greater than 25 percent sagebrush landscape cover) prone to conifer expansion, particularly pinyon pine and/or juniper, are also a management concern when within or adjacent to high density sage-grouse populations (Figure 7).

Because these two threats occur primarily at different points along an elevational gradient and are associated with different soil temperature and moisture regimes, separate approaches are used to select PACs and focal habitats for each.

High Density Populations at Highest Risk from <u>Wildfire and Invasive Annual Grasses</u>

PACs in Management Zones III, IV, and V. were evaluated on the basis of high density (75 percent) BBDs, sagebrush landscape cover, and soil temperature and moisture regimes to identify initial PACs that are a priority for assessments and associated focal habitats. **Figure 8**, High Priority PACs with High Density Sage-Grouse Populations (75% BBD), displays the results of the analysis focusing on the intersection of high density (75 percent BBD) populations, the warm and dry sites, and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin. **Table 1**, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes, displays quantitative outputs of this analysis. The table allows a comparison of these data, and assists in selecting five PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with warm and dry soil temperature and moisture regimes.

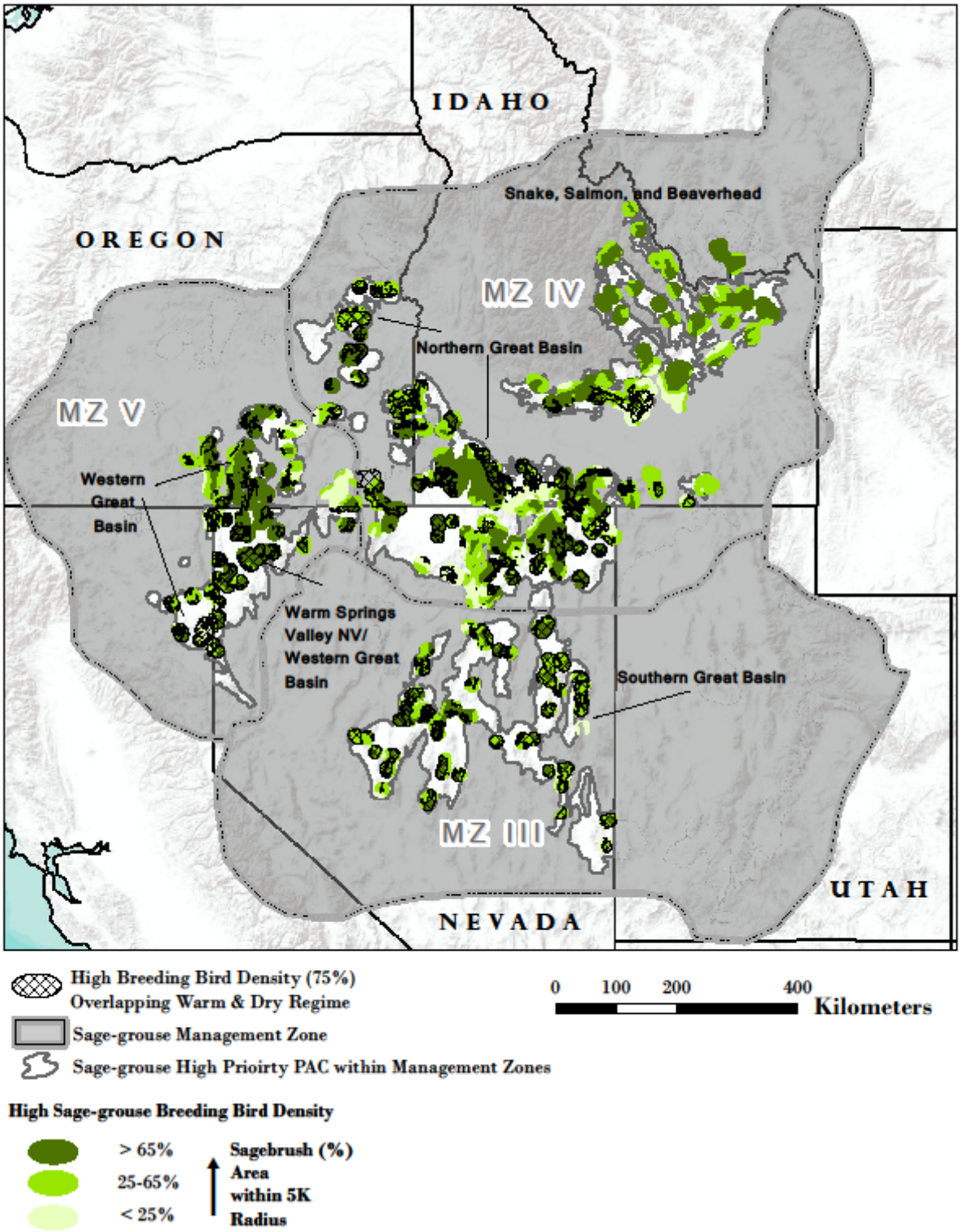


Figure 8, High Priority PACs with High Density Sage-Grouse Populations (75% BBD) sagebrush landscape cover classes, and areas with low resistance and resilience relative to wildfires and invasive annual species.

Table 1, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes

Sage-grouse Management Zone	Sage-grouse Priority Area for Conservation (PAC) Name	Total PAC Acres	Breeding Bird Density (75%) Acres	Percent of Breeding Bird Density (75%) Area within PAC	Warm and Dry Soil Moisture & Temperature Regime within Breeding Bird Density (75%) Acres*		
					0-25% Sagebrush Landscape Cover	25%-65% Sagebrush Landscape Cover	65%+ Sagebrush Landscape Cover
4	Northern Great Basin	13045515	7383442	57%	179551 (2%)	674554 (9%)	1745163 (24%)
3	Southern Great Basin	9461355	3146056	33%	42596 (1%)	792780 (25%)	1062091 (34%)
4	Snake, Salmon, and Beaverhead	5477014	2823205	52%	68107 (2%)	89146 (3%)	95970 (3%)
5	Western Great Basin	3177253	2084626	66%	149399 (7%)	140141 (7%)	202767 (10%)
5	Warm Springs Valley NV/Western Great Basin	3520937	1558166	44%	31458 (2%)	207365 (13%)	741353 (48%)
4	SW Montana	1369076	659475	48%	0 (0%)	0 (0%)	0 (0%)
4	Northern Great Basin/Western Great Basin	1065124	624581	59%	114222 (18%)	85258 (14%)	116513 (19%)
5	Central OR	813699	451755	56%	0 (0%)	6211 (1%)	16463 (4%)
3	Panguitch/Bald Hills	1135785	352258	31%	6883 (2%)	5821 (2%)	0 (0%)
3	Parker Mountain-Emery	1122491	308845	28%	0 (0%)	127 (0%)	0 (0%)
4	Box Elder	1519454	292658	19%	22 (0%)	43325 (15%)	23913 (8%)
4	Baker OR	336540	184813	55%	0 (0%)	46459 (25%)	36214 (20%)
3	NW-Interior NV	371557	108256	29%	576 (1%)	17117 (16%)	25173 (23%)
3	Carbon	355723	97734	27%	255 (0%)	180 (0%)	0 (0%)
3	Strawberry	323219	52635	16%	0 (0%)	0 (0%)	0 (0%)
3	Rich-Morgan-Summit	217033	37005	17%	0 (0%)	0 (0%)	0 (0%)
3	Hamlin Valley	341270	3244	1%	0 (0%)	139 (4%)	3105 (96%)
3	Ibapah	98574	0	0%	0 (NA)	0 (NA)	0 (NA)
3	Sheeprock Mountains	611374	0	0%	0 (NA)	0 (NA)	0 (NA)
5	Klamath OR/CA	162667	0	0%	0 (NA)	0 (NA)	0 (NA)

* Numbers in parenthesis indicate the percent of acres relative to total acres of breeding bird density (75%)

These five PACs comprise 90 percent and 95 percent of remaining PAC sagebrush landscape cover in the 25 to 65 percent and greater than or equal to 65 percent sagebrush landscape cover classes, respectively, of the 75 percent BBD associated with low resistance/resilience habitats. The 75 percent BBD habitats in the Northern, Southern Great Basin, and Warm Spring PACs appear particularly important for two reasons. They represent a significant part of the remaining habitats for the Great Basin metapopulation, and they have the greatest amount of low resiliency habitat remaining that still functions as sage-grouse habitat.

An examination of the 5 selected PACs shows that the sum of the 75 percent BBD within these PACs is 16,995,496 acres (**Table 2**, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class). These are the **focal habitats**. These five PACs constitute 84 percent of the 75 percent BBD low resiliency habitats for all Management Zones III, IV, and V PACs. Within and immediately around these focal habitats, 5,751,293 acres are in high BBD areas with landscape sagebrush cover in the 25-65 percent and ≥ 65 percent classes and in the warm and dry soil temperature and moisture regimes. These are the habitats in the most danger to loss due to their low resistance to invasive annual grasses and low resilience following wildfire. Within the focal habitats in the high priority PACs, low resistance and resilience areas (cross-hatched areas in Figure 8) are a high priority (emphasis area) for implementing management strategies. Applying management strategies outside the emphasis areas are appropriate if the application of fire operations and fuels management activities will be more effective in addressing wildfire threats.

Table 2, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class (see Figure 8)

PAC	PAC Acres	Acres of 75% BBD in PAC (**focal habitat**)	Proportion of 75% BBD within PACs	Warm & Dry Soils within 75% BBD by Sagebrush Landscape Cover Classes Greater Than 25%*	
				25-65%	>65%
Northern Great Basin	13,045,515	7,383,442	0.57	674,517(9%)	1,745,163(24%)
Southern Great Basin	9,461,355	3,146,056	0.33	792,780(25%)	1,062,091(34%)
Snake, Salmon, and Beaverhead	5,477,014	2,823,205	0.52	89,146(3%)	95,970(3%)
Warm Springs Valley NV/Western Great Basin	3,520,937	1,558,166	0.44	207,365(13%)	741,353(48%)
Western Great Basin	3,177,253	2,084,626	0.66	140,141(7%)	202,767(10%)
Total for 5 PACS	**34,682,074**	**16,995,496**	**0.49**	**1,903,949**	**3,847,344**

***** This category represents the emphasis areas for applying appropriate management strategies in or near the focal habitats due to the lower probability of recovery after disturbance and higher probability of invasive annual grasses and existing wildfire threats.

High Density Sage-Grouse Habitats at Risk from Conifer Expansion

PACs, sagebrush landscape cover, and the 75 percent BBD data were also used in conjunction with the conifer expansion data (Mainer et al. 2013) to provide an initial stratification to determine PACs where conifer removal would benefit important sagebrush habitats. Conifer expansion threats are primarily western juniper in the northern Great Basin and pinyon pine/Utah juniper in the southern Great Basin.

Figure 7 displays results of the analysis focusing on the intersection of the 75 percent BBD, and modeled conifer expansion areas within two sagebrush landscape cover classes by management zone and PACs within the Great Basin. To identify high density sage-grouse areas affected by conifer expansion, the amount and proportion of acres estimated to be affected were calculated by sagebrush cover class to assist in the identification of the focal habitats (**Table 3)**. **Table 4**, displays quantitative outputs of this analysis using the 25 to 65 percent and greater than 65 percent landscape sagebrush cover classes for the PACs. Thus, **focal habitats** for addressing conifer expansion are the areas within and near conifer expansion in sagebrush landscape cover classes of 25 to 65 percent and greater than 65 percent. Conifer expansion in these two sagebrush landscape cover classes in the 75 percent BBD areas constitutes an emphasis area for treatments to address conifer expansion. Landscapes with less than 25 percent sagebrush cover may require significant additional management actions to restore sagebrush on those landscapes and therefore were considered a lower priority for this analysis. Focal habitats are identified in Table 4 and displayed in **Figure 9**.

Table 3 assists in identifying those PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with modelled conifer expansion areas. Although there are uncertainties associated with the model, the results help managers identify specific geographic areas where treatments in conifer (pinyon and/or juniper) could benefit existing important sage-grouse populations.

The results of the screening revealed 5 PACs that contribute substantially to the 75 percent BBD habitats and are currently impacted most by conifer expansion (primarily pinyon pine and/or juniper; Table 4 and Figure 9). Four of the five PACs identified as high priority for conifer expansion treatments were also high priorities for wildfires and invasive annual grass threats. This is likely due to the size of the PACs and the relative importance of these PACs for maintaining the Great Basin sage-grouse meta-populations. As expected, the locations of high density sage-grouse habitats affected by conifer expansion differ spatially from those associated with low resilience habitats within and among the PACs, primarily due to differences in the biophysical settings (e.g., elevation and rainfall) that contribute to threats from invasive annual grasses and wildfires.

Three PACs (Snake/Salmon/Beaverhead, Southwest Montana, and Northern Great Basin/Western Great Basin) ranked high due to their relatively large proportion of high density breeding habitats (Table 3), but were not selected since the threat of conifer expansion was relatively low. One PAC, (Snake/Salmon/Beaverhead, was identified as a potential high priority area but was dismissed because results of the conifer expansion model likely overestimated impacts due to the adjacent conifer forests in this region. The COT Report also identified conifers as a “threat present but localized” in these areas, whereas, the top five PACs prioritized all have conifers identified as a widespread priority threat to address (USFWS 2013).

Table 3, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Modeled Conifer Expansion, and Percentage of Habitats in Sagebrush Landscape Cover Classes

Sage-grouse Management Zone	Sage-grouse Priority Area for Conservation (PAC) Name	PAC acres	Breeding Bird Density (75%) Acres	Relative Proportion of Breeding Bird Density Area within PAC	Conifer Expansion (Modeled) Acres*		
					0-25% Sagebrush Landscape Cover	25%-65% Sagebrush Landscape Cover	65%+ Sagebrush Landscape Cover
4	Northern Great Basin	13045515	7383442	0.57	188502 (1%)	512949 (4%)	442480 (3%)
3	Southern Great Basin	9461355	3146056	0.33	108657 (1%)	738624 (8%)	237828 (3%)
4	Snake, Salmon, and Beaverhead	5477014	2823205	0.52	4209 (0%)	92173 (2%)	216803 (4%)
5	Western Great Basin	3177253	2084626	0.66	87963 (3%)	184618 (6%)	126177 (4%)
5	Warm Springs Valley NV/Western Great I	3520937	1558166	0.44	37148 (1%)	107025 (3%)	217101 (6%)
4	SW Montana	1369076	659475	0.48	1428 (0%)	34765 (3%)	39215 (3%)
4	Northern Great Basin/Western Great Bas	1065124	624581	0.59	12101 (1%)	2247 (0%)	6161 (1%)
5	Central OR	813699	451755	0.56	3191 (0%)	44937 (6%)	59624 (7%)
3	Panguitch/Bald Hills	1135785	352258	0.31	89141 (8%)	75157 (7%)	2563 (0%)
3	Parker Mountain-Emery	1122491	308845	0.28	84719 (8%)	83441 (7%)	7469 (1%)
4	Box Elder	1519454	292658	0.19	8531 (1%)	114376 (8%)	57645 (4%)
4	Baker OR	336540	184813	0.55	945 (0%)	15263 (5%)	195 (0%)
3	NW-Interior NV	371557	108256	0.29	7929 (2%)	29440 (8%)	11813 (3%)
3	Carbon	355723	97734	0.27	15968 (4%)	34446 (10%)	283 (0%)
3	Strawberry	323219	52635	0.16	7916 (2%)	27340 (8%)	1075 (0%)
3	Rich-Morgan-Summit	217033	37005	0.17	11685 (5%)	14280 (7%)	238 (0%)
3	Hamlin Valley	341270	3244	0.01	11321 (3%)	29960 (9%)	6243 (2%)
3	Ibapah	98574	0	0.00	195 (0%)	6770 (7%)	1039 (1%)
5	Klamath OR/CA	162667	0	0.00	1 (0%)	1533 (1%)	15302 (9%)
3	Sheeprock Mountains	611374	0	0.00	16744 (3%)	78580 (13%)	11878 (2%)

* Numbers in parenthesis indicate the proportion of acres relative to total PAC acres

Table 4, PACS with the Highest Acres and Proportions of 75% BBD acres and Estimated Conifer Expansion within Sagebrush Landscape Cover Classes (25-65 percent and ≥65 percent; see Figure 9)

PAC	PAC Acres	Acres 75% BBD in PAC	Prop. 75% BBD within PACs	Conifer Expansion by Landscape Sagebrush Cover Classes 25-65% and ≥65%* Focal Habitat	
				25-65%	≥65%
Northern Great Basin	13,045,515	7,383,442	0.57	512,949 (4%)	442,480 (3%)
Southern Great Basin	9,461,355	3,146,056	0.33	738,624 (8%)	237,828 (3%)
Warm Springs Valley NV/Western Great Basin	3,520,937	1,558,166	0.44	107,025 (3%)	217,101 (6%)
Western Great Basin	3,177,253	2,084,626	0.66	184,618 (6%)	126,177 (4%)
Central Oregon	813,699	451,755	0.56	44,937 (6%)	59,624 (7%)
Total for 5 PACS	**30,018,759**	**14,624,045**	**0.49**	**1,588,153 (5%)**	**1,083,210 (4%)**

*Numbers in parenthesis represent the percent of total PAC acres for each class.

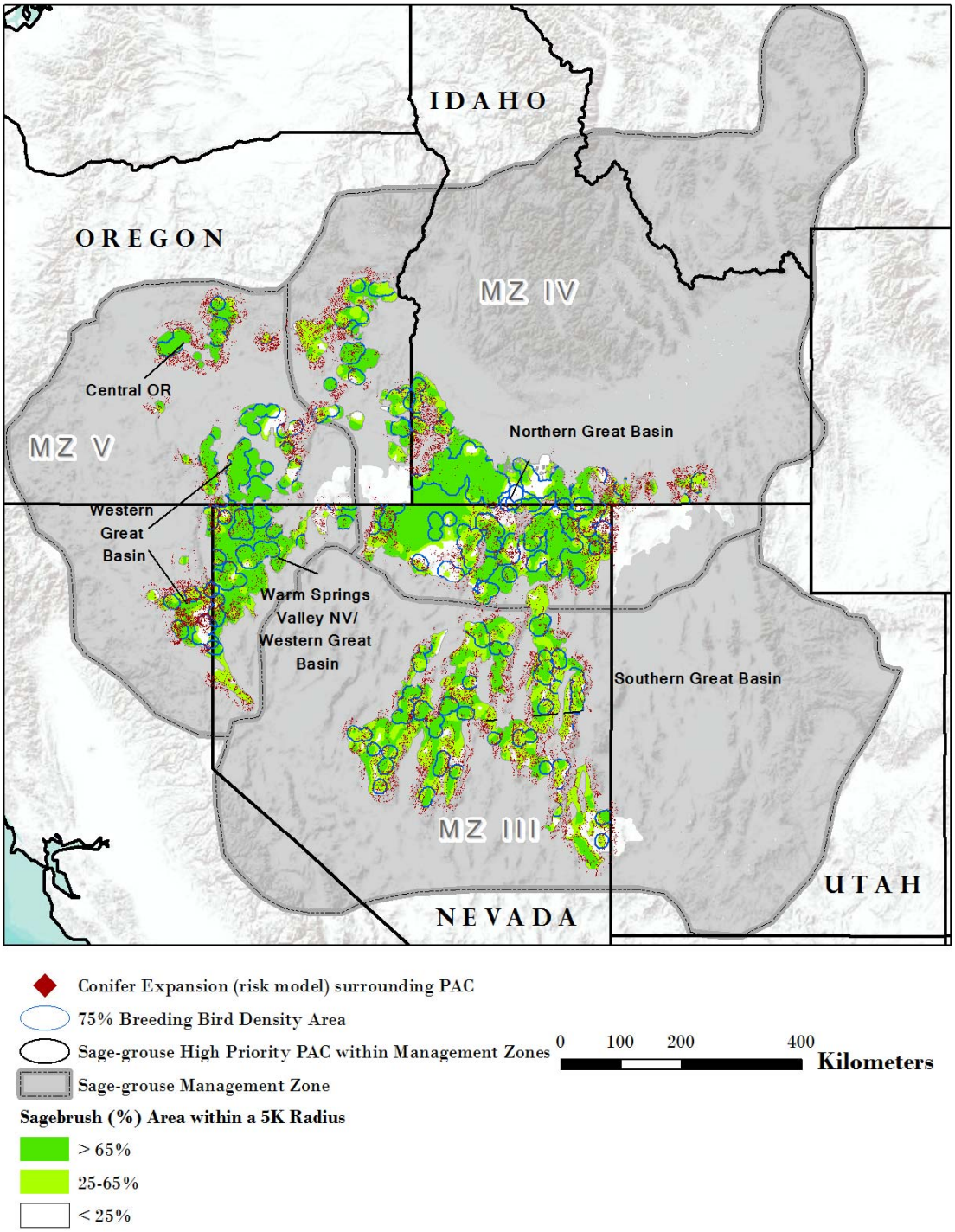


Figure 9, Five PACs Significantly Impacted by Conifer Expansion that contribute substantially to the 75% BBD and that have sagebrush landscape cover greater than 25%.

While the coarse-scale conifer expansion data used in this analysis likely over estimates the extent of the pinyon pine and/or juniper threat, results suggest that far fewer acres are currently affected by conifers than might be at risk from fire and invasive annual grasses impacts. Conifer expansion into sage-grouse habitats occurs at a slower rate, allowing more time for treatment, but early action may be needed to prevent population level impacts on sage-grouse (Baruch-Mordo et al. 2013). Furthermore, conifer expansion is primarily occurring on cooler and moister sites that are more resilient and where restoration is more likely to be effective (Miller et al. 2011), providing managers the opportunity to potentially offset at least some habitat loss expected to continue in less resilient ecosystems. While the available data set used to estimate conifer expansion provides only a coarse assessment of the problem, considerable efforts are currently underway to map conifers across sage-grouse range. These maps are expected to be available in the near future and should be used by land managers to better target project level conifer removal.

FIAT cautions against using the plotted locations of estimated conifer expansion for local management decisions due to the coarse-scale nature of this range-wide data set. Conifer expansion estimates are primarily provided here to aid in judging the relative scope of the threat in each PAC.

Step 1b. Potential Management Strategies

Potential management **strategies** (e.g., fuels management, habitat recovery/restoration, fire operations, post-fire rehabilitation) to conserve or restore Step 1 focal habitats are described below to assist local management units to initiate Step 2. These examples are illustrative and do not contain the full range of management strategies that may be required to address wildfires, invasive annual grasses, and conifer expansion within PACs and associated focal habitats. In general, the priority for applying management strategies is to first maintain or conserve intact habitat and second to strategically restore habitat (after a wildfire or proactively to reconnect habitat). Management strategies will differ when applying the protocol to:

Wildfire and Invasive Annual Grass. (See PACs identified in Table 2 and focal habitats shown in Figure 8). Focal habitats, as they relate to wildfires and invasive annual grasses, are defined as sage-grouse habitat in priority PACs within 75 percent BBD. Within these focal habitats, sagebrush communities with low resilience to disturbance and resistance to invasive annual grasses (warm and dry soil temperature and moisture regimes) are an emphasis area for management actions. Appendix 5 (A) in Chambers et al. 2014) includes a generalized state and transition model with an invasive annual grass component and warm and dry soil temperature and moisture regime associated with 8 to 12 inches of annual precipitation. This state and transition models is useful in developing management strategies to deal with annual grass issues as it contains useful restoration pathways.

Burn Probability is another tool that can be used to assist managers to identify the relative likelihood of large fire occurrence across the landscape within PACs and focal habitats. Burn probability raster data were generated by the Missoula Fire Lab using the large fire simulator - FSim - developed for use in the national Interagency **Fire Program Analysis (FPA)** project. FSim uses historical weather data and LANDFIRE fuel model data to simulate fires burning. Using these simulated fires, an overall burn probability is returned by FSim for each 270m pixel. The burn probability data was overlaid spatially with PACs, soil data, and shrub cover data. The majority of the high and very high burn probability acres lie within the top 5 PACs and are within areas with >25% sagebrush cover. Several of the other PACs have a greater overall percentage of the warm/dry soil regime with high/very high burn probability (northern great basin, baker, and NW interior NV) but the total acres are relatively few. Areas identified with high and very high burn probability are most likely to experience large fires given fire history, fuels, weather and topography. Results are displayed in the table 5 and Figure 10.

Table 5, Percentages of sage-grouse PAC areas with high and very high burn probability, 75% BBD within PAC, 75% BBD and warm dry/temperature regime, and 75% BBD and warm dry/temperature and warm dry/temperature with high and very high burn probability.

Sage Grouse Mangement Zone	*Sage-grouse Priority Area for Conservation (PAC) Name*	*Total PAC Acres*	*High, very high burn probability (percent of PAC acres)*	*75% BBD within PAC (percent PAC acres)*	*75% BBD and warm and dry soil/temperature regime ~~acres~~ (percent PAC acres)*	*75% BBD and warm and dry soil/temperature regime with high, very high burn probability (percent PAC acres)*
4	*Northern Great basin*	*13,045,415*	*86%*	*57%*	*19%*	*17%*
3	*Southern Great Basin*	*9,461,355*	*48%*	*33%*	*20%*	*9%*
4	*Snake, Salmon, and Beaverhead*	*5,477,014*	*68%*	*52%*	*5%*	*4%*
5	*Western Great Basin*	*3,177,253*	*61%*	*66%*	*15%*	*12%*
5	*Warm Springs Valley /Western Great Basin*	*3,520,937*	*30%*	*44%*	*28%*	*9%*
4	*SW Montana*	*1,369,076*	*1%*	*48%*	*0%*	*0%*
4	*Northern Great Basin/Western Great Basin*	*1,065,124*	*82%*	*59%*	*30%*	*22%*
5	*Central Oregon*	*813,699*	*71%*	*56%*	*3%*	*2%*
3	*Panguitch/Bald Hills*	*1,135,785*	*70%*	*31%*	*1%*	*1%*
3	*Parker Mountain-Emery*	*1,122,491*	*28%*	*28%*	*0%*	*0%*
4	*Box Elder*	*1,519,454*	*61%*	*19%*	*4%*	*2%*
4	*Baker Oregon*	*336,540*	*74%*	*55%*	*25%*	*21%*
3	*NW-Interior NV*	*371,557*	*99%*	*29%*	*12%*	*11%*
3	*Carbon*	*355,723*	*22%*	*27%*	*0%*	*0%*
3	*Strawberry*	*323,219*	*26%*	*16%*	*0%*	*0%*
3	*Rich-Morgan-Summit*	*217,033*	*79%*	*17%*	*0%*	*0%*
3	*Hamlin Valley*	*341,270*	*60%*	*1%*	*1%*	*0%*
3	*Ibapah*	*98,574*	*0%*	*0%*	*0%*	*0%*
3	*Sheeprock Mountains*	*611,374*	*98%*	*0%*	*0%*	*0%*
5	*Klamath OR/CA*	*162,667*	*98%*	*0%*	*0%*	*0%*

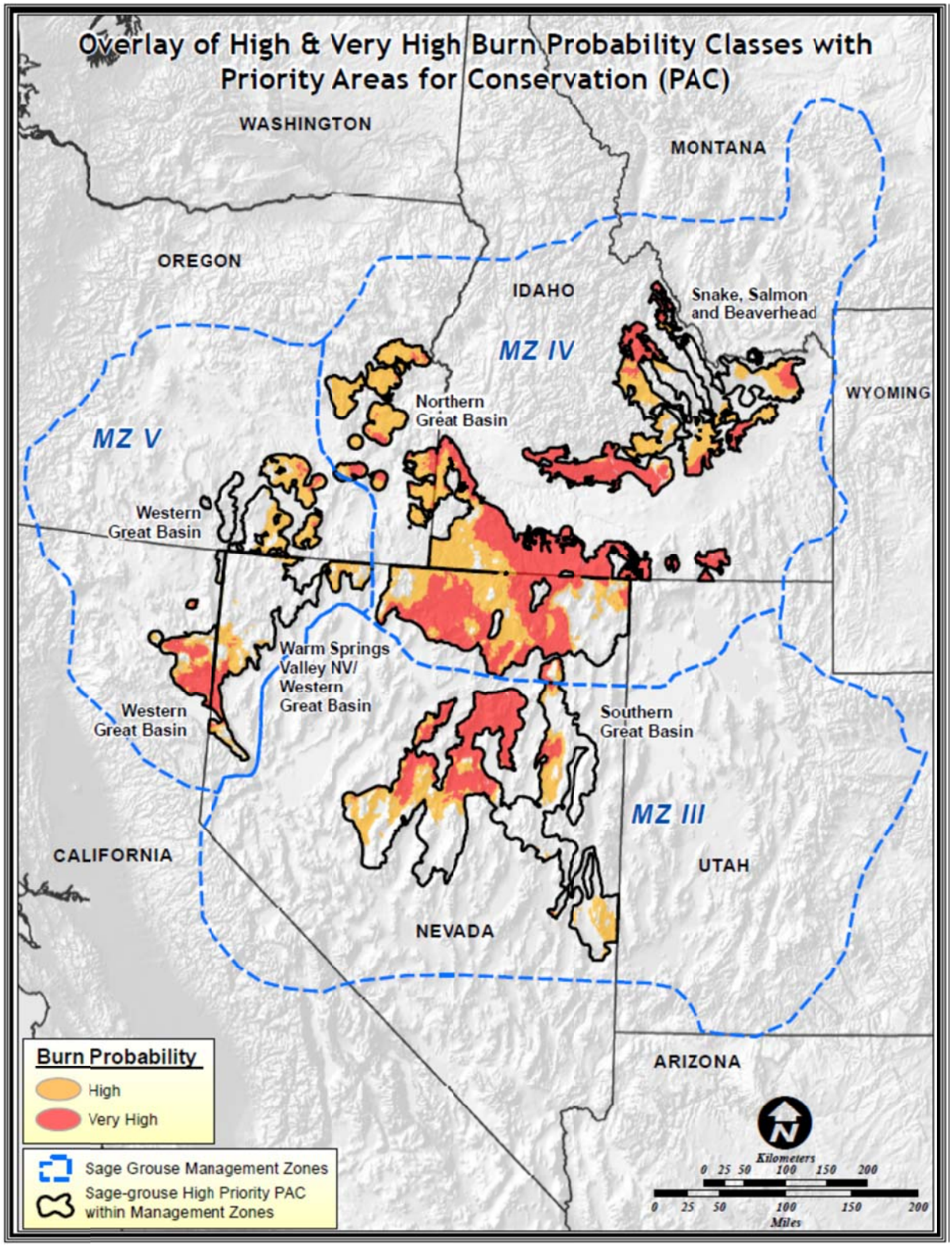


Figure 10, Burn Probability (high and very high) in priority invasive annual grass and wildfire PACs. .

Conifer Expansion. (See priority PACs for assessment identified in Table 4 and focal habitats shown in Figure 9). Focal habitats, as they relate to conifer expansion, are defined as sage-grouse habitat in a priority PAC with sagebrush landscape cover between 25 and 100 percent that is either near or in a conifer expansion area. The relationship between conifer expansion and resilience to disturbance and resistance to expansion is not documented to the same degree as with invasive annual grasses. However, Appendix 5 (D. and E.) in Chambers et al. 2014) includes two generalized state and transition models for conifer expansion with warm to cool and soil temperature regimes associated with precipitation ranges from 12 to 14 or more inches of annual precipitation. These state and transition models are useful in developing management strategies to deal with conifer expansion as they contain useful restoration pathways.

Chambers et al. 2014) is recommended for review at this point for information on applying resistance and resilience concepts along with sage-grouse habitat characteristics to develop management strategies to address wildfires, invasive annual grasses, and conifer expansion. The following tables are recommended for use in developing management strategies in or near focal habitats:

Table 1. Soil temperature and moisture regimes relationship to vegetation types and resistance and resilience.
Table 2. Sage-grouse habitat matrix showing the relationship between landscape sagebrush cover and resistance and resilience.
Table 3. Potential management strategies based on sage-grouse habitat requirements and resistance and resilience.
Table 4. Management strategies (fire suppression, fuels management, post-fire rehabilitation, and habitat restoration) associated with each cell in the sage-grouse habitat matrix (Table 2).

The "Putting it all together" section of the Chambers et al. 2014) also contains a case study from Northeast Nevada illustrating applications of management strategies to address the conservation, protection, and restoration of sage-grouse habitat.

To further assist in understanding Step 1b, examples of general priorities for management strategies are provided below and illustrated in Appendix 3 and 4:

1. Fuels Management: Projects that are designed to change vegetation composition and/or structure to modify potential fire behavior for the purpose of improving fire suppression effectiveness and limiting fire spread and intensity.
    a. Identify priorities and potential measures to reduce the threats to sage-grouse habitat resulting from changes in invasive annual grasses (primary focus on exotic annual grasses and conifer encroachment) and wildland fires. Place high priority on areas dominated by invasive annual grasses that are near or adjacent to low resistance and resilience habitats that are still intact.
    b. Areas on or near perimeter of successful post-fire rehabilitation and habitat restoration projects where threats of subsequent fire are present are important for consideration.

c. Fuels management can be a high priority in large tracts of intact sagebrush if impacts on sage-grouse populations are minimal and outweighed by the potential benefits of reduced wildfire impacts in area being protected.

2. Habitat Recovery/Restoration Recovery (passive restoration) is a high priority in intact sagebrush stands to improve resistance and resilience before a disturbance. For example, where understory perennial herbaceous species are limited, improved livestock grazing practices can increase the abundance of these species and promote increased resistance to annual grasses.
    a. Habitat restoration is important where habitat connectivity issues are present within focal habitats.
    b. Pinyon pine and/or juniper removal in Phase I and II stands adjacent to large, contiguous areas of sagebrush (greater than 25 percent sagebrush landscape cover) is a priority.

3. Fire Operations (includes preparedness, prevention and suppression activities).
    a. Higher priority should be placed on areas with greater than 65 percent cover than on areas with 25 to 65 percent cover, followed by 0 to 25 percent cover (these categories are continuums not discrete thresholds).
    b. Higher priority should be placed on lower resistance/resilience habitats compared with higher resistance/resilience habitats.
    c. Fire operations in areas restored or post-fire rehabilitation treatment where subsequent wildfires can have detrimental effect on investment and recovery of habitat are important for consideration.
    d. Fire operations (suppression) are especially important in low elevation winter sagebrush habitat with low resistance and resiliency.
4. Post-Fire Rehabilitation
    a. High priority should be placed on supporting short-term natural recovery and long-term persistence in higher resistance and resiliency habitats (with appropriate management applied).
    b. High priority should be placed on reseeding in moderate to low resistance and resiliency habitats, but only if competition from invasive annual grasses, if present, can be controlled prior to seeding.

Step 2

Step 2 is carried out by local management units using the Step 1 geospatial data, focal habitats, and the associated management strategies. Step 2 includes evaluating the availability and accuracy of local information and geospatial data used to develop local management strategies in or near focal habitats (Step 2a).

It also involves developing focal habitat activity/implementation plans that include prioritized management tactics and treatments to implement effective fuels management, habitat

recovery/restoration, fire operations, and post-fire rehabilitation (Step 2b). These activity/implementation plans will serve as the basis for NEPA analysis of site-specific projects.

Step 2a- Review of Step 1 Data and Incorporation of Local Information

Evaluate the accuracy and utility of Step 1 geospatial layers for focal habitats by incorporating more accurate or locally relevant:

- Vegetation maps (especially sagebrush cover)
- Updated or higher resolution conifer expansion layers (if applicable)
- Soil survey and ecological site descriptions
- Weather station, including Remote Automatic Weather Stations, data
- PACs, focal habitats, winter habitats, sage-grouse population distributions (i.e., more recent BBD surveys)
- Maps of cheatgrass and other invasive annual grasses that degrade sage-grouse habitat
- Wildfire polygons including perimeters and unburned islands within burn polygons
- Treatment locations and success (consult US Geological Survey Land Treatment Digital Library at http://ltdl.wr.usgs.gov/). The Land Treatment Digital Library allows the user to search on treatment results on an ecological site basis.
- Models and tools to help inform management strategies. For example, data which characterizes wildfire potential can help identify risk to focal habitats and help plan fire suppression and fuels management strategies to address these risks.
- Rapid Ecoregional Assessments
- Land Use Plans
- Appropriate monitoring or inventory information
- Any other geospatial data or models that could improve the accuracy of the assessment process

It is essential that subregional or local information and geospatial data be subjected to a quality control assessment to ensure that it is appropriate to use in developing Step 2b activity and implementation plans. Since PACs and focal habitats usually transcend multiple administrative boundaries, a collaborative approach is highly recommended for Step 2a.

A series of questions tied to the management strategies described in the Introduction section follows to assist managers in developing the framework to complete Step 2b (development of activity/implementation plans). The questions that follow apply to the focal habitats (and buffer areas around focal areas where management strategies may be more effectively applied) and will help in developing coordinated implementation/activity plans. These questions should not limit the scope of the assessment and additional questions relative to local situations are encouraged. These questions portray the minimum degree of specificity for focal habitats in order for offices to complete Step 2a.

Fuels Management

1. Where are the priority fuels management areas (spatially defined treatment opportunity areas that consider fire risk, fuels conditions, and focal habitats [including areas adjacent to focal habitats])?
2. Based on fire risk to focal habitats, what types of fuels treatments should be implemented to reduce this threat (for example, linear features that can be used as anchors during suppression operations)?
3. Considering resistance/resilience concepts and the landscape context from Step 1, where should treatments be applied in and around focal habitats to:
   a. Constrain fire spread?
   b. Reduce the extent of conifer expansion?
   c. Augment future suppression efforts by creating fuel breaks or anchors for suppression?
4. Based on opportunities for fire to improve/restore focal habitats, what types of fuels treatments should be implemented to compliment managed wildfire by modifying fire behavior and effects?
5. Are there opportunities to utilize a coordinated fuels management approach across jurisdictional boundaries?
6. What fuel reduction techniques will be most effective that are within acceptable impact ranges of local sage-grouse populations, including but not limited to grazing, prescribed fire, chemical, and biological and mechanical treatments? Will combinations of these techniques improve effectiveness (e.g., using livestock to graze fine fuels in a mowed fuel break in sagebrush)?

Habitat Recovery/Restoration

1. Are there opportunities for habitat restoration treatments to protect, enhance or maintain sage-grouse focal habitat especially to restore connectivity of focal area habitat?
2. Considering the resistance and resilience GIS data layer (Figure 4) and the Sage-Grouse Habitat Matrix (Chambers et al. 2014; Table 2), where and why would passive or active restoration treatments be used?
3. What are the risks and opportunities of restoring habitat with low resistance and resilience including the warm/dry and cool/dry soil moisture/temperature regime areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to effectively complete habitat restoration in focal habitats?

Fire Operations

1. Where are priority fire management areas (spatially defined polygons having the highest need for preparedness and suppression action)?

2. Where are the greatest wildfire risks to focal habitats considering trends in fire occurrence and fuel conditions (see Figure 10)?
3. Where do opportunities exist that could enhance or improve suppression capability in and around focal habitats?
    a) For example, increased water availability through installation of helicopter refill wells or water storage tanks.
    b) Decreased response time through pre-positioned resources or staffing remote stations.
4. Should wildfire be managed (per land use plan objectives) for improving focal habitat (e.g., reducing conifer expansion), and if so where, and under what conditions?
5. How can fire management be coordinated across jurisdictional boundaries to reduce risk or to improve focal habitats?

Post-fire Rehabilitation

1. Where are areas that are a high priority for post-fire rehabilitation to improve habitat connectivity if a wildfire occurs?
2. Which areas are more conducive (higher resistance and/or resilience) to recovery and may not need reseeding after a wildfire?
3. What opportunities to build in fire resistant fuel breaks to reduce the likelihood of future wildfires impacts on seeded or recovering areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to implement rehabilitation practices?

The outcome of Step 2a is the assembly of the pertinent information and GIS layers to assist managers in developing implementation or activity plans to address wildfires, invasive annual grasses, and conifer expansion in focal habitats. Activity plans generally refer to plans where management of a resource is changed (livestock grazing plans) whereas implementation plans are generally associated with treatments.

Step 2b- Preparation of Activity/Implementation Plans

Activity/implementation plans are prepared to implement the appropriate management strategies within and adjacent to focal habitats. Since focal habitats cross jurisdictional boundaries, it is especially important that a collaborative approach be used to develop implementation/activity plans. The process of identifying partners and creating collaborative teams to develop these plans is a function of state, regional, and local managers and is not addressed as part of this step.

Implementation/activity plans are required to:

1. Address issues in and around focal habitats related to wildfires, invasive annual grasses, and conifer expansion

2. Use resistance to invasive annual grasses and resilience after disturbance (where appropriate) as part of the selection process for implementing management strategies
3. Emphasize application of management strategies within or near focal habitats with low resistance and resilience (warm/dry and cool/dry soil moisture/temperature regimes) invasive annual grasses and wildfires
4. Use the best available local information to inform the assessment process
5. Encourage collaboration and coordination with focal habitats across jurisdictional boundaries
6. Be adaptive to changing conditions, disturbances, and modifications of PAC boundaries

FIAT recommends considering other factors, such as adaptive management for climate change, local sagebrush mortality due to aroga moth or other pests, and cheatgrass die-off areas in developing activity/implementation plans. The latter two factors could influence where and what kind of management strategies may be needed to address the loss of habitat or changes in fuel characteristics (e.g., load and flammability) associated with these mortality events.

The following recommendations are provided to assist in the preparation of activity/implementation plans:

Fuels Management

1. Spatially delineate priority areas for fuel management treatments per Step 2a information considering:
    a. Linear fuel breaks along roads
    b. Other linear fuel breaks to create anchor points
    c. Prescribed burning which would meet objectives identified in the Fish and Wildlife Service's Conservation Objectives Team (COT) report
    d. Mechanical (e.g., treatment of conifer expansion into sagebrush communities)
    e. Other mechanical, biological, or chemical treatments
    f. If they exist, spatially delineated areas where fuel treatments would increase the ability to use fire to improve/enhance focal habitats.
2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of fuels treatments.
3. Quantify a projected level of treatment within or near focal habitats.
    a. Identify treatments (projects) to be planned within or near focal habitats.
    b. Include a priority and proposed work plan for proposed treatments.

Habitat Recovery/Restoration

1. Spatially delineate priority areas for restoration, using criteria established in Step 2a. Priority areas for restoration should be delineated by treatment methods:
    a. Seeding priority areas
    b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological, combination)

    c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding).
    d. Include tables, maps or appropriate info.
2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of restoration treatments.
3. Include a priority or implementation schedule for proposed restoration treatment

Fire Operations

1. Spatially delineate priority areas for fire suppression, based upon criteria established in Step 2a. Priority areas for fire operations should be delineated by type, such as:
    a. Initial attack priority areas
    b. Resource pre-positioning and staging priority areas
2. Spatially delineate areas where opportunities exist to enhance or improve suppression capability.
3. Spatially delineate areas where wildfire can be managed to achieve land use plan and COT objectives.

Post-Fire Rehabilitation

1. Spatially delineate priority areas for post-fire rehabilitation using criteria in Step 2a.
2. Priority areas for post-fire rehabilitation should be based on resistance and resiliency and pre-fire landscape sagebrush cover and include consideration of:
    a. Seeding priority areas
    b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological (herbivory or seeding),
    c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding)
3. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of post-fire rehabilitation treatments.

This completes the assessment process and sets the stage for more detailed project planning and NEPA associated with implementing on-the-ground treatments and management changes.

Members of the FIAT Development and Review teams are listed in Appendix 5.

Literature Cited:

Aldridge, C. L.; Nielsen, S. E.; Beyer, H. L.; Boyce, M. S.; Connelly, J. W.; Knick, S. T.; Schroeder, M. A. 2008. Range-wide patterns of greater sage-grouse persistence. Diversity and Distributions 14:983–994.

Balch, J. K.; Bradley, B. A.; D'Antonio, C. M.; Gomez-Dans, J. 2012. Introduced annual grass increases regional fire activity across the arid western USA (1980–2009). Global Change Biology 19:173-183.

Baruch-Mordo, S.; Evans, J. S., Severson, J. P.; Naugle D.E.; Maestas, J. D.; Kiesecker, J. M.; Falkowski, M. J.; Christian A. Hagen, C. A.; Reese, K. P. 2013. Saving sage-grouse from the trees: a proactive solution to reducing a key threat to a candidate species. Biological Conservation 167:233-241.

Chambers, J.C.; Miller, R. F.; Board, D. I.; Grace, J. B.; Pyke, D. A.; Roundy, B. A.; Schupp, E. W.; Tausch, R. J. 2014. Resilience and resistance of sagebrush ecosystems: implications for state and transition models and management treatments. Rangeland Ecology and Management. 67: 440-454.

Chambers, J. C.; Miller, R. F.; Grace, J. B.; Pyke, D. A.; Bradley, B.; Hardegree, S.; D'Antonio, C. 2014. Resilience to stress and disturbance, and resistance to Bromus tectorum L. invasion in the cold desert shrublands of western North America. Ecosystems 17: 360-375.

Chambers, J. C.; Pyke, D. A.; Maestas, J. D.; Pellant, M.; Boyd, C. S.; Campbell, S.; Espinosa, S.; Havlina, D.; Mayer, K. E.; and Wuenschel, A. 2014. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and sage-grouse – a strategic multi-scale approach. Fort Collins, CO, USA: U.S. Department of Agriculture, Forest Service, RMRS-GTR-326. 73p.

Chambers, J. C.; Roundy, B. A.; Blank, R. R.; Meyer, S. E.; Whittaker, A. 2007. What makes Great Basin sagebrush ecosystems invasible by Bromus tectorum? Ecological Monographs 77:117-145.

Connelly, J. W.; Rinkes, E. T.; Braun, C. E. 2011. Characteristics of Greater Sage-Grouse habitats: a landscape species at micro- and macroscales. In: Knick, S. T.; Connelly, J. W. Eds. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in avian biology. Berkeley, CA, USA: University of California Press. 38:69–83.

Connelly, J. W.; Schroeder, M. A.; Sands, A. R.; Braun, C. E. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967–985.

Davies, K. W.; Boyd, C. S.; Beck, J. L.; Bates, J. D.; Svejcar, T. J.; Gregg, M. A. 2011. Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities. Biological Conservation 144:2573–2584.

Doherty, K.E.; Tack, J. D.; Evans, J. S.; Naugle, D. E. 2010. Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning. BLM completion report: Agreement # L10PG00911.

Holloran, M. J.; Heath, B. J.; Lyon, A. G.; Slater, S. J.; Kuipers, J. L.; Anderson, S. H. 2005. Greater Sage-Grouse nesting habitat selection and success in Wyoming. Journal of Wildlife Management 69:638–649.

Knick, S. T.; Hanser, S. E.; Preston, K. L. 2013. Modeling ecological minimum requirements for distribution of greater sage-grouse leks: implications for population connectivity across their western range, U.S.A. Ecology and Evolution 3(6):1539–1551.

Manier, D.J., D.J.A. Wood, Z.H. Bowen, R.M. Donovan, M.J. Holloran, L.M. Juliusson, K.S. Mayne, S.J. Oyler-McCance, F.R. Quamen, D.J. Saher, and A.J. Titolo. 2013. Summary of science, activities, programs, and policies that influence the rangewide conservation of Greater Sage-Grouse (Centrocercus urophasianus): U.S. Geological Survey Open-File Report 2013–1098, 170 p., http://pubs.usgs.gov/of/2013/1098/.

Meyer S. E.; Garvin, S. C.; Beckstead, J. 2001. Factors mediating cheatgrass invasion of intact salt desert shrubland. In: McArthur, D. E.; Fairbanks, D. J. Comp. Shrubland ecosystem genetics and biodiversity: proceedings. Ogden UT: U.S. Department of Agriculture, Forest Service. RMRS-P-21. p. 224-232.

Miller, R. F.; Chambers, J. C.; Pyke, D. A.; Pierson, F. B.; Williams, C. J. 2013. A review of fire effects on vegetation and soils in the Great Basin Region: response and ecological site characteristics. Fort Collins, CO: USA: Department of Agriculture, Forest Service. RMRS-GTR-308. 136 p.

Miller R. F.; Knick, S. T.; Pyke, D. A.; Meinke, C. W.; Hanser, S. E.; Wisdom, M. J.; Hild, A. L. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. In: Knick S. T.; Connelly, J. W. Eds. Greater sage-grouse – ecology and conservation of a landscape species and its habitats. Studies in avian biology No. 38. Berkeley, CA, USA: University of California Press. 38:145-185.

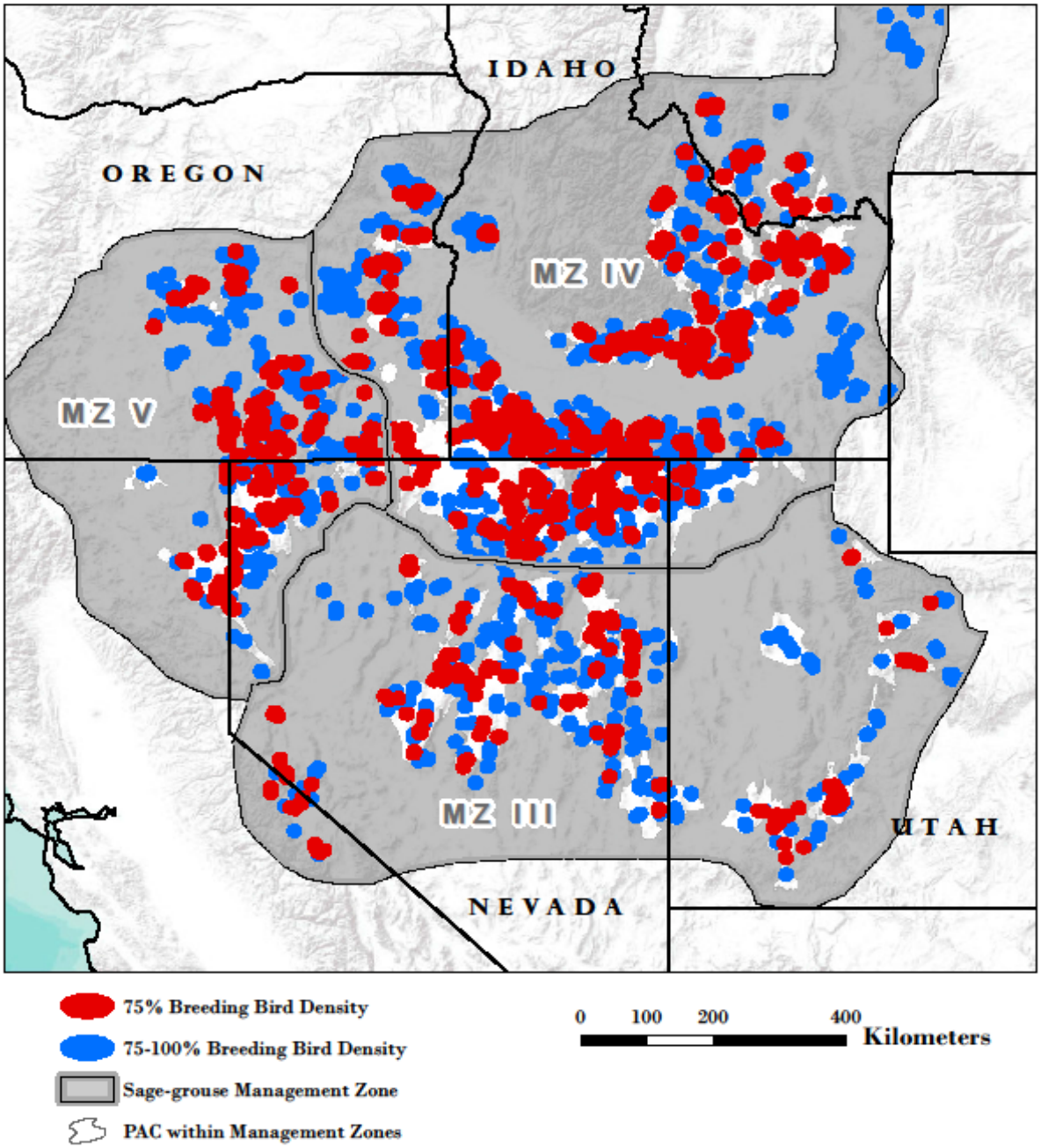
Pyke, D. A. 2011. Restoring and rehabilitating sagebrush habitats. In: Knick, S. T.; Connelly, J. W. Eds. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in avian biology. Berkeley, CA, USA: University of California Press. 38:531-548.

U.S. Fish and Wildlife Service [USFWS]. 2013. Greater Sage-Grouse (Centrocercus urophasianus) Conservation Objectives: Final Report. U.S. Fish and Wildlife Service, Denver, CO. February 2013.

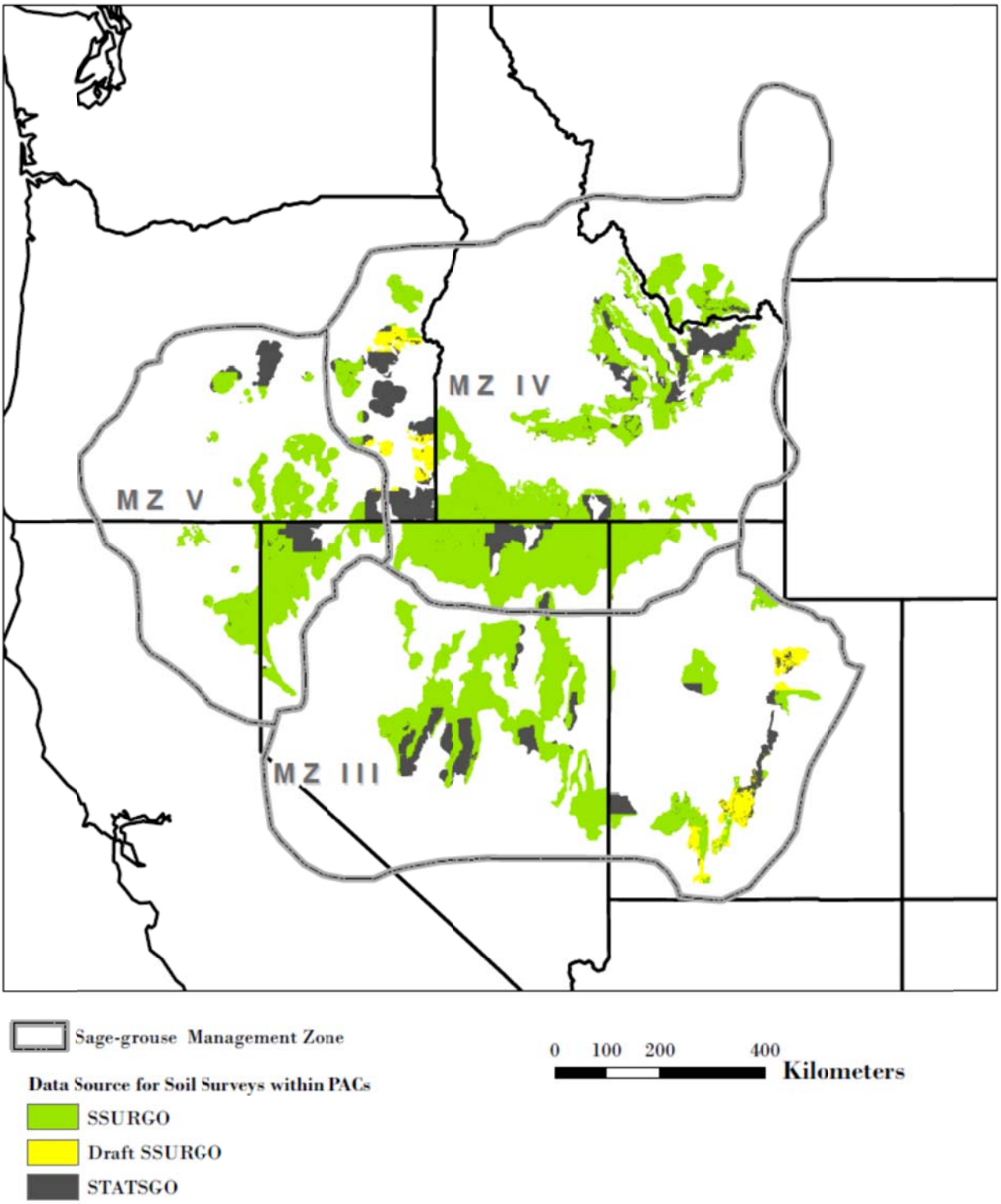
Wisdom, M. J., Meinke, C. W.; Knick, S. T.; Schroeder, M. A. 2011. Factors associated with extirpation of

Sage-Grouse. In: Knick, S. T.; Connelly, J. W. Eds. Greater sage-grouse: ecology and conservation of a landscape species and its habitats. Studies in avian biology. Berkeley, CA, USA: University of California Press. 38:451–472.

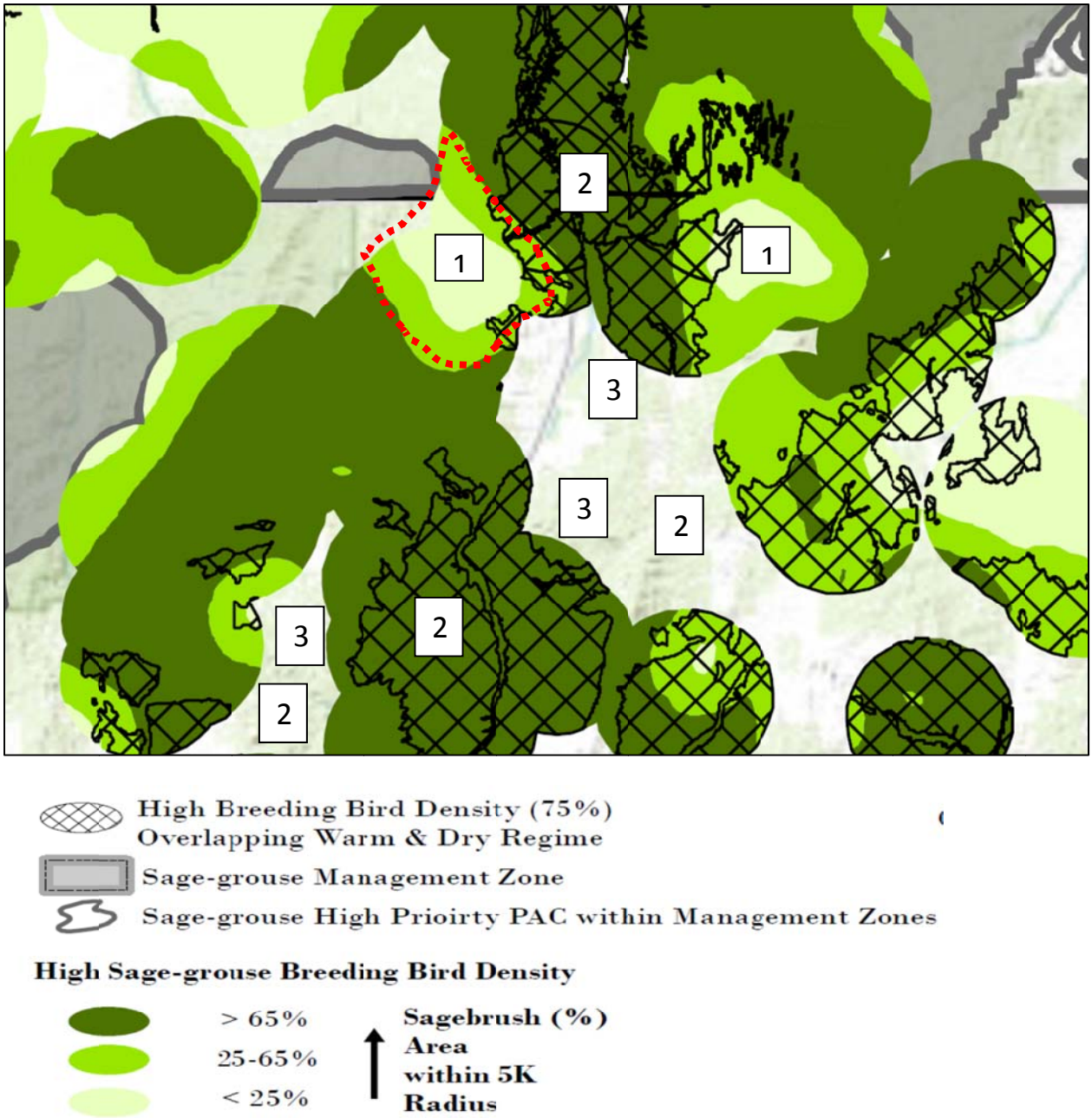
Appendix 1. Sage-grouse breeding bird density thresholds for 75% and 100% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is included in this figure to provide context for local management units when making decisions concerning connectivity between populations and PACs.



Appendix 2. Gaps in SSURGO soil survey data in Management Zones III, IV, and V. STATSGO2 soil survey data used to fill these gaps.



Appendix 3. Example of potential management strategies applied to Wildfire/Invasive Annual Grass Scenario.

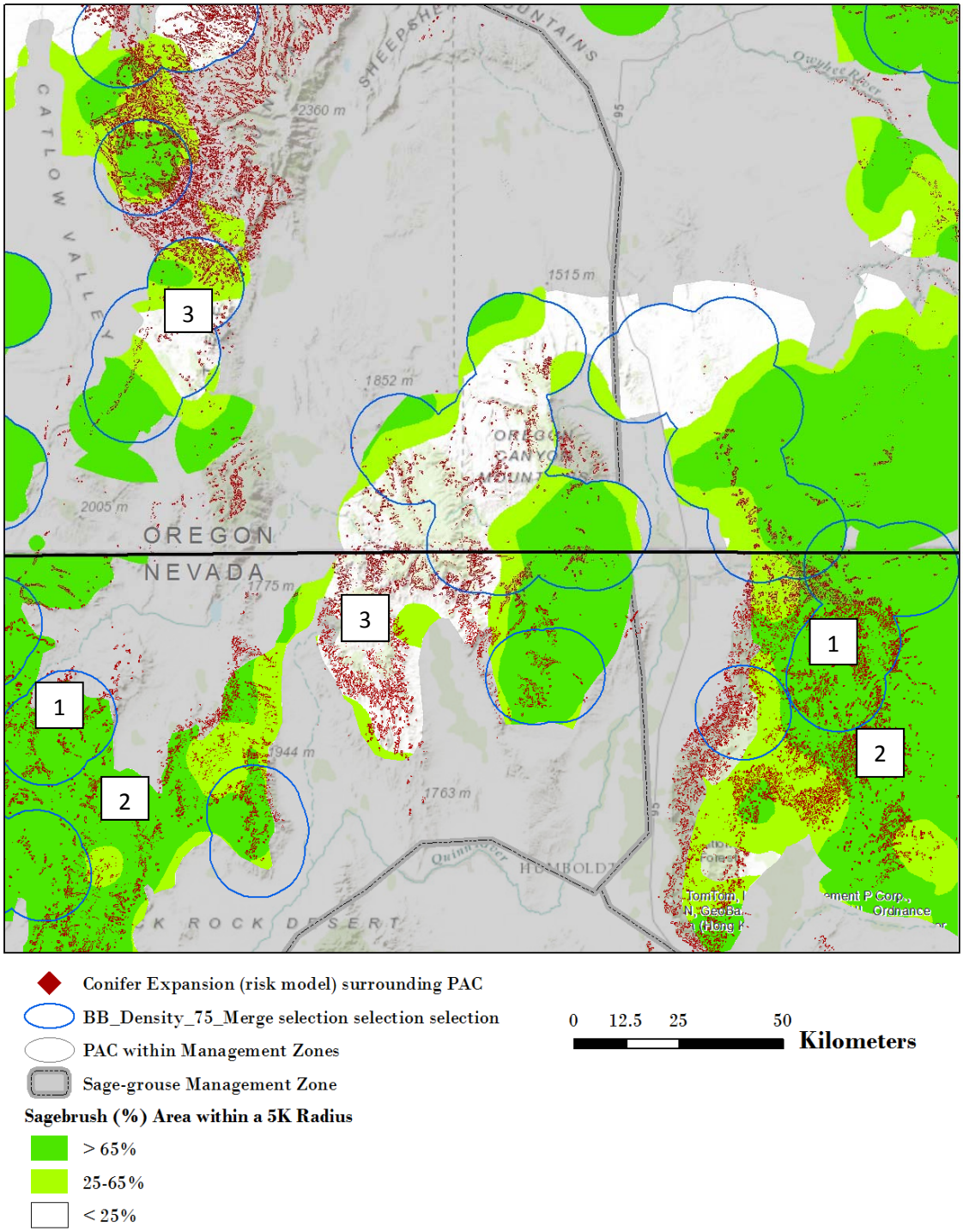


1 High priority for habitat restoration and post-fire rehabilitation to restore connectivity.

2 High priority for fire suppression within and around area given >65% sagebrush landscape cover and low resistance/resilience.

3 **High priority for fuels management to reduce likelihood of wildfires in low resistance/resilience habitat** with >65% landscape cover.

Appendix 4. Management strategy example for Western Juniper expansion.



1	High priority (emphasis area) for juniper control (>25% landscape sagebrush cover & 75% BBD)
2	Moderate priority (emphasis area) for juniper control (>25% landscape sagebrush cover)
3	Very low priority (<25% landscape sagebrush cover)

Appendix 5. Members of FIAT Development and Review Team

Development Team

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Appendix J

Areas of Critical Environmental Concern Evaluation

APPENDIX J
AREAS OF CRITICAL ENVIRONMENTAL CONCERN EVALUATION

INTRODUCTION

During the scoping process for this RMPA/EIS the BLM invited the public to nominate or recommend areas on public lands for GRSG and their habitat to be considered as Areas of Critical Environmental Concern (ACECs). In response the BLM received ACEC nominations from a number of interested organizations. Section 103 of the Federal Land Policy and Management Act (FLPMA) defines ACECs as public lands for which special management attention is required (when such areas are developed or used or when no development is required) and to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources; or other natural systems or processes or to protect life and safety from natural hazards. Section 202(c)(3) requires that priority be given to the designation and protection of ACECs in land use plans. Other factors set forth in FLPMA include consideration of the "relative scarcity of the values involved and the availability of alternative means and sites for realization of those values"; and the weighing of "long term benefits to the public against short-term benefits" (Sec. 202(c)).

Research Natural Areas (RNAs) are managed under the ACEC authority as areas with valuable ecological resources and representative cells for plant communities. These areas are protected and maintained in natural conditions, for the purposes of conserving biological diversity, conducting non-manipulative research and monitoring, and fostering education. The identification and establishment of a national network of RNAs was congressionally mandated for the US Forest Service in the National Forest Management Act (NFMA) (36 CFR Sec. 219.25; 36 CFR 251.23), and the BLM and National Park Service have been cooperators in this program for over 30 years. The Department of the Interior and the Department of Agriculture, Pacific Northwest Research Station

developed an Interagency Strategy for the Pacific Northwest Natural Areas Network in July 2009 (General Technical Report PNW-GTR-798).

The identification of potential ACECs and the designation of ACECs will be done though the planning process in accordance with the BLM's procedures for preparing, approving, and revising Resource Management Plans. FLPMA also states that ACEC identification "shall not, of itself, change or prevent change of management or use of public lands" (Sec. 201 (a)). Thus, there may be locations where an environmental resource has been identified as a potential ACEC that, nevertheless, will not be protected through ACEC designation. The designation and development of special management attention for a potential ACEC is a management decision done through the RMP process.

ACEC Nominations

During the scoping process for this RMPA/EIS the BLM received ACEC comments/potential ACEC nominations from Western Watersheds Project (WWP). In response, all GRSG PPH was identified as a single huge ACEC, with the intent to protect all breeding, brooding, winter, and other critical sagebrush and occupied sage-grouse habitat. The boundaries of this citizen potential ACEC were developed by following the designated PPH boundaries on 4,547,043 acres. In addition, in response to citizen ACEC comments from WildEarth Guardians (WEG), the BLM identified 17 potential ACECs for Oregon following an interdisciplinary process on 4,041,905 acres. The ACEC boundaries were created by merging all active GRSG leks and occupied habitat, sage-grouse brooding, transitional and winter habitat, and high quality sagebrush habitat. Many potential ACECs included large blocks of sagebrush habitats in PPH and PGH at higher elevation (> 5,000 feet) with the intent that with vegetation changes because of climate change, many sagebrush habitats will be moving upslope through time and could serve as refugia for the birds in the future (i.e., future suitable habitat). Attention was paid to connectivity between the 17 ACECs and to existing ACECs and RNAs and isolated leks, with an attempt to provide for movement corridors. All ACECs were also designed to follow BLM ownership and livestock grazing allotment boundary or pasture fences, resulting in both PPH and PGH habitat being included. Using the abovementioned criteria, 17 ACECs were identified on 4,041,905 acres within the four districts.

ACEC Evaluation Process

Based on the two proposals from the public, the "all PPH ACEC", and the "17 ACEC" potential ACEC proposal, the areas were evaluated using an interdisciplinary process as identified in BLM Manual 1613 - Areas of Critical Environmental Concern, to decide if these areas should be carried forward for further evaluation in the land use planning process under various alternatives. The ACEC evaluations were conducted by a subgroup of the BLM's GRSG core team, which included federal and state wildlife biologists, a botanist, a range and fire ecologist, GIS support, and land use planners assigned to the project. Additional input was provided by specialists from each Field and District Office

as needed. The BLM core team evaluated the two external ACEC nominations, to determine relevance and importance. Sage-grouse habitat and existing vegetation information was evaluated for the areas. Draft GIS maps and attributes were created and reviewed and adjustments were made based on local understanding and knowledge of sage-grouse and habitat in the mapped areas.

RELEVANCE AND IMPORTANCE CRITERIA

As mentioned in the introduction, to be considered for designation as an ACEC, an area must meet the requirements of relevance and importance as described in the Code of Federal Regulations (43 CFR 1610.7.2). The definitions for relevance and importance are as follows:

Relevance

An area is considered relevant if it contains one or more of the following:

1. A significant historic, cultural, or scenic value (for example, rare or sensitive archaeological resources and religious or cultural resources important to Native American Indians).
2. A fish and wildlife resource (for example, habitat for endangered, threatened, or sensitive species or habitat essential for maintaining species diversity).
3. A natural process or system (for example, endangered, threatened or sensitive plant species; rare, endemic, or relict plants or plant communities; and rare geologic features).
4. A natural hazard (for example, areas of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action could meet the relevance criteria if it is determined through the resource management planning process that it has become part of the natural process.

Importance

An area is considered important if the value, resource, system, process, or hazard described has substantial significance to satisfy the importance criteria, which generally means it is characterized by one or more of the following:

1. Has more than locally significant qualities that give it special worth, consequence, has meaning, distinctiveness, or cause for concern, especially compared with any similar resource.
2. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to change.
3. Has been recognized as warranting protection to order to satisfy national priority concerns or to carry out the mandates of FLPMA.

Special Management Attention

Following BLM Manual 1613, to be designated as an ACEC, an area must require special management attention to protect the relevant and important values. Special management attention refers to management prescriptions developed during preparation of an RMP or amendment to protect the important and relevant values of an area from the potential effects of actions permitted by the RMP.

Potential ACECs

A. For the "All PPH ACEC" proposal (Alternative C) as nominated by WWP, the following meets the relevance test necessary for ACEC designation as:

1. Sage-grouse are a wildlife resource that are a candidate for Federal listing and are a BLM Special Status Species.
2. The proposed ACEC contains key natural processes and natural systems (high quality sagebrush plant communities), that are critical for the survival of sage-grouse, as identified as potential priority habitat (PPH).

The following "All PPH" potential ACEC also meets the Importance test necessary for ACEC designation as:

1. This ACEC has more than locally significant qualities that gives it special worth and cause for concern. These PPH areas have been identified as priority habitat for sage-grouse by the state and contain the higher-density lekking sites that are known in Oregon and that have been identified as key sage-grouse habitats. These areas link to PPH habitat in Nevada and Idaho, and include higher elevation habitats that the birds are likely to move into in the future as temperature regimes continue to increase and push big sagebrush plant communities and sage-grouse higher in elevation.
2. The proposed ACECs have qualities that make them unique and rare–areas of intact sagebrush plant communities supporting sage-grouse–that are vulnerable to change. Areas in southeast Oregon have been nationally recognized as having some of the higher sage-grouse densities and more high quality intact sagebrush habitat within the Great Basin.
3. The sage-grouse has also been recognized as needing protection at a multi-state, Great Basin scale and is a national priority. These ACECs that are made up of all PPH contain the best of the habitats as designated by the state.

Special Management Attention. Alternative C, "All PHMA ACEC Proposal"

The special management attention that was developed is the same as the objectives and actions developed for PHMA in Alternative C found in Tables 2-12 and 2-13.

B. For the ACEC proposal as nominated by WEG (Alternative F), 17 potential ACECs were nominated, and were found to meet the relevance test necessary for ACEC designation as:

1. Sage-grouse are a wildlife resource that are a candidate for Federal listing and are a BLM Special Status Species.
2. The potential ACECs also contain key natural processes and natural systems (high quality sagebrush plant communities) that are critical for sage-grouse.

The following "17 ACEC" proposal also meets the Importance test necessary for ACEC designation as:

1. These ACECs have more than locally significant qualities that give them special worth and cause for concern. These proposed areas contain the higher-density lekking sites that are known in Oregon and that are some of the highest densities in the Great Basin. These areas serve as refugia for the bird, are spatially arrayed to connect to existing ACECs and RNAs and to other potential ACECs and priority and key sage-grouse habitats in Nevada and Idaho. They also include habitats that the birds are likely to move into in the future as temperature regimes continue to increase and push big sagebrush and sage-grouse higher in elevation.
2. The potential ACECs have qualities that make them unique and rare–areas of relatively intact sagebrush plant communities supporting sage-grouse–that are vulnerable to change. Areas in southeast Oregon have been nationally recognized as having some of the higher sage-grouse densities and more high quality intact sagebrush habitat within the Great Basin.
3. The sage-grouse has also been recognized as needing protection at a multi-state, Great Basin scale and is a national priority. These potential ACECs contain the some of the best of the 'Core' habitats as designated by the state.

The following areas were identified as potential ACECs under the "17 ACEC" proposal.

#1 Diablo Peak - Acres: 345,250
Values: Core sage-grouse leks, nesting and brooding habitat, connectivity between proposed East Warner ACEC and existing ACECs in PPH, contains suitable habitat at higher elevation.

#2 East Warner – Acres: 313,182
Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat, connectivity between proposed Diablo peak and proposed ACECs in Nevada, existing ACECs and RNAs in PPH, contains suitable habitat at higher elevation.

#3 Hill - Acres: 74,778
Values: Core sage-grouse leks, nesting and brooding habitat, connectivity with proposed ACECs in Nevada and between existing ACECs and Hart Mountain. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#4 Beaty Butte - Acres: 507,050
Values: Core sage-grouse leks, nesting, brooding, and wintering habitat; connectivity with USFWS Sheldon Refuge and Hart Mountain. The ACEC contains suitable sage-grouse habitat at the higher elevations. Contains important habitat for other wildlife (pronghorn antelope).

#5 Jackass - Acres: 428,057
Values: Core sage-grouse leks, nesting, brooding and wintering habitat; connectivity to the south with Hart Mountain. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#6 Lone Mountain - Acres: 244,797
Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity to the south with Hart Mountain and existing ACECs. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#7 Trout Creek - Acres: 675,218
Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity to proposed ACECs in Nevada, and across southeastern Oregon east to west, and existing ACECs and RNAs. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#8 Corner – Acres: 355,598
Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity with key sage grouse habitat in Idaho and proposed ACECs in Nevada, existing ACECs and RNAs, and habitat in the Fort McDermitt Shoshone Paiute Indian Reservation. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#9 Antelope – Acres: 117,076

Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity with key sage grouse habitat in Idaho and to proposed ACECs to the north and south. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#10 Cow Creek – Acres: 42,776

Values: Core sage-grouse leks, nesting, brooding and wintering habitat; connectivity with key sage grouse habitat in Idaho and to proposed ACECs to the north and south. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#11 Star Mountain – Acres: 102,858

Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity with Red Hills and Cow Creek. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#12 Red Hills – Acres: 83,849

Values: High density of sage-grouse leks in core, nesting, brooding and wintering habitat; connectivity with Star Mountain and Cow Creek. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#13 Willow – Acres: 53,803

Values: Core sage-grouse leks, nesting and brooding habitat; connectivity to virtue flat and red hills and existing ACEC and RNA. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#14 Virtue Flat – Acres: 21,938

Values: High density of sage-grouse leks in core, nesting, brooding habitat; ongoing long term research sites, northern most populations, connectivity across Snake River with key habitats in Idaho.

#15 Goose – Acres: 4,785

Values: Sage-grouse leks in core, nesting, and brooding habitat; connectivity with adjacent proposed ACECs.

#16 Buck Creek – Acres: 143,151

Values: High density of sage-grouse leks in isolated core habitat, nesting, brooding and wintering habitat; connectivity with Frederick Butte. The ACEC contains suitable sage-grouse habitat at the higher elevations.

#17 Frederick Butte – Acres: 527,739

Values: High density of sage-grouse leks in isolated core habitat, nesting, brooding and wintering habitat; connectivity with Buck Creek. The most northwest population of sage-grouse in Oregon. The ACEC contains suitable sage-grouse habitat at the higher elevations.

Special Management Attention. Alternative F, "17 ACEC Proposal"

The special management attention that was developed is the same as the objectives and actions developed for PHMA and GMA in Alternative F found in Tables 2-12 and 2-13.

PREFERRED ALTERNATIVE AND PROPOSED PLAN

Under the preferred alternative and the proposed plan, the developed management actions will provide for the conservation of GRSG and habitat within the areas proposed as ACECs in Alternatives C and F. These areas were identified as meeting the ACEC relevance and importance criteria and were determined to need special management attention as ACECs in Alternative C and Alternative F. The management actions developed for those alternatives provide for that protection. However, additional special management attention is not necessary to protect the identified values following the objectives and actions proposed under the preferred alternative and proposed plan. The relevant and important values will be maintained or improved under the preferred alternative and proposed plan, and the designation of ACECs under the preferred alternative is not needed.

Appendix K

Special Status Species: Vascular Plants

APPENDIX K
SPECIAL STATUS SPECIES: VASCULAR PLANTS

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
American pillwort	*Pilularia americana*	BLM S	Shallow vernal pools	X			
Annual dropseed	*Muhlenbergia minutissima*	BLM S	Sandy and gravelly drainages, rocky slopes, flats, road cuts, and open sites; usually found in ponderosa pine and oak-pine forests, juniper woodlands, thorn-scrub forests, and grasslands; 1,200 to 3,000 meters				X
Arrowleaf thelypody	*Thelypodium eucosmum*	BLM S	Moist seepy areas on ashy-clay soils in juniper/shrublands	X			
Awned sedge	*Carex atherodes*	BLM STR	Wet meadows, seeps, and pond edges; less than 1,400 meters		X	X	

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Barren Valley collomia	*Collomia renacta*	BLM S	Relatively undisturbed rocky sites with poorly developed soils on scablands or lithic soils in grey rabbitbrush and sandberg bluegrass communities				X
Bartonberry	*Rubus bartonianus*	BLM S	Rocky riparian zones along tributaries of the Snake River and on steep, talus, and scree slopes in side canyons; 1,100 to 4,600 feet				X
Bastard milkvetch	*Astragalus tegetarioides*	BLM S	Primarily in cracks of welder tuffaceous rock outcrops or sandy soils, in dry pine forests and sagebrush communities; 1,350 to 1,650 meters			X	
Beautiful penstemon	*Penstemon perpulcher*	BLM STR	Western juniper – big sagebrush, bluebunch wheatgrass, and Idaho fescue grasslands; less than 1,500 meters				X
Bellard's kobresia	*Kobresia myosuroides*	BLM S	Moist meadows and wetlands		X		
Biennial stanleya	*Stanleya confertifolia*	BLM S	Barren clay slopes in sagebrush communities, heavy clay flats, loose soil mounds, dry sandy grounds, alkaline meadows, and flats; 600 to 1,500 meters				X
Bogg's lake hedge-hyssop	*Gratiola heterosepala*	BLM S	Shallow water, mud, or damp soil at edges of lakes and vernal pools			X	
Bolander's spikerush	*Eleocharis bolanderi*	BLM S	Fresh, often summer-dry meadows, springs, seeps, and stream margins; 1,000 to 3,400 meters			X	X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Broad fleabane	*Erigeron latus*	BLM S	Dry, open places, level to moderate slope, commonly with sagebrush, usually undisturbed, sometimes grazed or burned sites; 200 to 400 meters				X
Broad-keeled milk-vetch	*Astragalus platytropis*	BLM S	Stony crests, screes, talus, gravely hilltops, and barren ridges in sagebrush communities on strongly calciphile soils; 1,650 to 3,530 meters				X
Broad-toothed monkeyflower	*Mimulus latidens*	BLM S	Vernally wet depressions, drainages; less than 1,700 meters			X	
Bupleurum	*Bupleurum americanum*	BLM S	Rocky outcrops in forest openings or in open grasslands or dry meadows				X
Capitate sedge	*Carex capitata*	BLM S	Wet or seasonally wet meadows		X		
Chambers' twinpod	*Physaria chambersii*	BLM S	Clay hillsides, limestone gravel, dolomite ridges, road edges, loose gravel, reddish clay, sagebrush, and juniper areas; 1,500 to 3,200 meters				X
Chromato - chlamys lichen	*Thelenella muscorum* var. *octospora*	BLM STR	Soil crusts in big sagebrush steppe, bluebunch wheatgrass, and Idaho fescue grasslands; less than 1,200 meters	X			
Colonial luina	*Luina serpentina*	BLM S	Serpentine outcrops	X			
Columbia cress	*Rorippa columbiae*	BLM S	Vernally wet meadows and lake playas with mostly clay soils			X	
Cooper's goldflower	*Hymenoxys lemmonii*	BLM S	Roadsides, open areas, meadows, on slopes, along drainages, and streams; 1,400 to 2,200 meters			X	X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Cordilleran sedge	*Carex cordillerana*	BLM S	Rocky slopes with sagebrush and juniper		X		X
Crater Lake grapefern	*Botrychium pumicola*	BLM S	Pumice soils with lodgepole pine; 1,500 to 2,500 meters	X			
Crenulate moonwort	*Botrychium crenulatum*	BLM S	Moist meadows, streambanks, shrub-dominated wetlands, continuous springs, and wet roadside areas; 1,500 to 2,500 meters			X	
Cronquist's stickseed	*Hackelia cronquistii*	BLM S	Big sagebrush – antelope bitterbrush / bluebunch wheatgrass – Idaho fescue communities; slopes, typically north facing; 600 to 750 meters				X
Crosby's buckwheat	*Eriogonum crosbyae*	BLM S	Grows on slopes composed of light-tan to white volcanic ash deposits, sandstone, or altered tuffaceous material stratified with rhyolite in sparse sagebrush/rabbitbrush communities; 1,500 to 1,800 meters			X	
Cusick's buckwheat	*Eriogonum cusickii*	BLM S	Prefers barren, rocky areas with dry gravelly volcanic soil in open flats in sagebrush communities, or very exposed areas along subalpine ridges; 1,450 to 3,000 meters			X	
Cusick's giant-hyssop	*Agastache cusickii*	BLM S	In rocky places on margins of playas and dry stream beds, and on talus slopes, at mid to high elevations			X	
Cusick's lupine	*Lupinus lepidis* var. *cusickii*	BLM S	Wyoming big sagebrush – Idaho fescue grasslands; 800 to 1,100 meters				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Dark alpine sedge	*Carex subnigricans*	BLM S	Moist rocky slopes and meadows; Steens Mountains		X		
Darkthroat shootingstar	*Dodecatheon pulchellum* var. *shoshonense*	BLM S	Moist, alkali, inland, meadow communities; 700 to 2,400 meters				X
Davidson's rockcress	*Arabis davidsonii*	BLM STR	Rock outcrops; 1,500 to 3,500 meters				X
Davis' peppergrass	*Lepidium davisii*	BLM S	Clay playas in sagebrush communities, vernal ponds; 800 to 1,600 meters				X
Desert allocarya	*Plagiobothrys salsus*	BLM S	Alkaline playas, sinks at low elevations			X	
Desert chaenactis	*Chaenactis xantiana*	BLM S	Open, deep loose, sandy (rarely gravelly) soils, arid and semiarid shrublands, and chaparral; 300 to 2,500 meters			X	X
Desert needlegrass	*Achnatherum speciosum*	BLM S	Dry sagebrush communities; 600 to 1,500 meters		X		
Desert prenanthella	*Prenanthella exigua*	BLM S	Sandy, gravelly, or clay soils; desert sashes and open slopes to sagebrush-juniper steppes; 20 to 1,900 meters				X
Disappearing monkeyflower	*Mimulus evanescens*	BLM S	Vernally wet gravelly, rocky areas, and low, wet fields, in sagebrush-juniper zones; 1,200 to 1,700 meters			X	X
Dwarf suncup	*Camissonia pygmaea*	BLM S	Dry, gravelly washes	X			
Etter's senecio	*Senecio ertterae*	BLM S	Talus slopes on greenish yellow ash tuff; 900 to 1,200 meters				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Flathead larkspur	*Delphinium bicolor*	BLM S	Grasslands, sagebrush steppe, ponderosa pine forests, and subalpine screes				X
Fringed desert-parsley	*Lomatium feonicaulaceum* ssp. *fimbriatum*	BLM S	Dry open slopes, from valleys and plains to middle or sometimes high elevation in mountains				X
Geyer's milk-vetch	*Astragalus geyeri* var. *geyeri*	BLM S	Depressions in mobile or stabilized dunes, sandy flats, and valley floors, along draws in gullied hills, and on margins of alkaline sandy playas; below 1,850 to 2,150 meters				X
Geyer's onion	*Allium geyeri* var.*geyeri*	BLM S	Moist open slopes, meadows, or stream banks; 200 to 4,000 meters			X	
Golden buckwheat	*Eriogonum chrysops*	BLM S	Gravelly basaltic or rhyolitic slopes and outcrops, in low sagebrush – sandberg bluegrass communities; 1,200 to 1,400 meters				X
Greeley's cymopterus	*Cymopterus acaulis* var. *greeleyorum*	BLM S	Heavy clay, sand, or volcanic ash. Sandy soil and brown and white volcanic ash in Wyoming sagebrush, desert shrub and Indian ricegrass zones				X
Greenbanded mariposa lily (sagebrush mariposa)	*Calochortus macrocarpus* var. *macrocarpus*	BLM S	Grasslands in sagebrush steppe; often found on basalt substrates on hillside grasslands and rock outcrops with ponderosa pine, balsamroot, bluebunch wheatgrass, Idaho fescue and Sandberg's bluegrass; 300 to 1,370 meters				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Green buckwheat	*Eriogonum umbellatum* var. *glaberrimum*	BLM S	Sandy to gravelly slopes in big sagebrush communities			X	
Greentinge Indian paintbrush	*Castilleja chlorotica*	BLM S	Mid-elevation open forest to subalpine slopes, associated with Juniper/big sagebrush, ponderosa/bitterbrush, and mountain mahogany stands	X			
Grimy ivesia	*Ivesia rhypara* var. *rhypara*	BLM S	Soils ranging from reddish tuff to loose light-colored volcanic ash, shallow on gravelly, light-colored soil derived from vitric ash flow pumice with antelope bitterbrush; 1,300 to 1,600 meters			X	X
Hairlike sedge	*Carex capillaris*	BLM S	In moss mats in moist areas, bogs, marshes, streambanks, wet meadows, sometimes on limestone substrates		X		
Henderson's ricegrass	*Achnatherum hendersonii*	BLM S	Rocky ridgeline grasslands in big sagebrush	X			
Hooker's wild buckwheat	*Eriogonum hookeri*	BLM S	Sandy washes, flats, and slopes, saltbush, greasewood, sagebrush, and mountain mahogany communities, juniper woodlands; 1,300 to 2,500 meters				X
Ibapah wavewing	*Cymopterus ibapensis*	BLM S	Open places, variously in sandy, gravelly, rocky, loam, or clay soil, often with sagebrush or juniper; 1,350 to 2,700 meters				X
Iodine bush	*Allenrolfea occidentalis*	BLM S	Alkaline playas and clay flats, wetland pools		X		X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
King's rattleweed	*Astragalus calycosus*	BLM S	Dry stony or otherwise barren places, from the valley floor to lower foothills in sagebrush or juniper-pinyon forest, strongly but not obligatory calciphine soils; 1,300 to 3,950 meters				X
Lahontan sagebrush	*Artemisia arbuscula* ssp. *longicaulis*	BLM S	Dry plains and hills, commonly in shallower soil or less favorable sites than *A. tridentata*; lowlands to 3,300 meters				X
Leiberg's clover	*Trifolium leibergii*	BLM S	Barren tuffaceous hillsides, bare shaley crests and talus, and reddish ash-flow; 1,200 to 2,400 meters			X	X
Lesser panicle sedge	*Carex diandra*	BLM S	Bogs and fens, lakeshores, and springs and seeps			X	
Longbeard mariposa lily	*Calochortus longebarbatus* var. *peckii*	BLM S	Vernally moist draws, streambeds, and meadow basins	X			
Long-flowered snowberry	*Symphoricarpos longiflorus*	BLM S	Open, rocky slopes and washes in the sagebrush and juniper zones, sometimes extending upwards into the ponderosa pine zone; up to 2,200 meters			X	X
Lyrate malacothrix	*Malacothrix sonchoides*	BLM S	Usually on dunes or in deep, fine sand in arroyos and on plains in Joshua tree woodlands, grasslands; 300 to 2,100 meters			X	X
Mackenzie's phacelia	*Phacelia lutea* var. *mackenzieorum*	BLM S	Unweathered tuff talus				X
Malheur stylocline	*Stylocline psilocarphooides*	BLM STR	Sandy – gravelly soils in sagebrush; less than 1,800 meters				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Malheur Valley fiddleneck	*Amsinckia carinata*	BLM S	Sandy loam soils and yellow ash tuff on north-facing slopes; 1,100 meters				X
Malheur wirelettuce	*Stephanomeria malheurensis*	FE	Known only from the top of a dry, broad hill on volcanic soil intermixed with layers of limestone in sagebrush		X		
Moonwort	*Botrichium lunaria*	BLM S	Damp turf and gravel, hillside seeps, carex meadow		X		
Moss gentian	*Gentiana prostrata*	BLM S	Sub-alpine wet meadows, moss mats, seeps, springs; 2,600 meters		X		
Mucronleaf tortula moss	*Tortula mucronifolia*		On soil, tree roots, and sheltered ledges and crevices of rock outcrops and cliffs in riparian forest composed of western birch, quaking aspen, and black cottonwood		X		
Mulford's milk-vetch	*Astragalus mulfordiae*	BLM S	Sandy bluffs and dune-like or sometimes shaley talus of river terraces; 650 to 950 meters				X
Native sedge	*Carex vernacular*	BLM S	Subalpine wet meadows, rocky slopes, stream edges, and lakeshores		X		
Nevada lupine	*Lupinus nevadensis*	BLM S	Hillsides and valley floors, in dry sandy or gravelly soils among sagebrush			X	
Duskyseed sedge	*Carex pelocarpa*	BLM S	Subalpine to alpine slopes, ridges, boulder fields, talus, and rocky streamsides		X		
Obscure buttercup	*Ranunculus triternatus*	BLM S	Vernally moist grasslands, cliff faces	X			

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Ochoco desert parsley	*Lomatium ochocense*	BLM S	Rocky rideelines and grasslands with big sagebrush and stiff sagebrush; 1,300 to 1,450 meters	X			
Oregon semaphore grass	*Pleuropogon oregonus*	BLM S	Wet meadows and streambanks, where water flows year around			X	
Orthotrichum moss	*Orthotrichum euryphyllum*	BLM STR	Basalt rock outcrops and outcrops at seeps and springs, in big sagebrush, ponderosa pine, and juniper woodlands		X		
Owyhee clover	*Trifolium owyheense*	BLM S	Steep barren slopes, ridges, and playa-margins, in Wyoming big sagebrush on shallow blue-gray diatomaceous or yellow green tuff soils; 1,300 to 1,500 meters				X
Owyhee sagebrush	*Artemisia papposa*	BLM S	Rocky swales, dry meadows, and alkaline mud flats; 1,400 to 2,100 meters				X
Packard's desert-parsley	*Lomatium packardiae*	BLM STR	Dry, open, rocky soils of rhyolite or volcanic ash in sagebrush; 1,200 to 2,300 meters				X
Packard's mentzelia	*Mentzelia packardiae*	BLM STR	Talus slopes, volcanic ash soils, in big sagebrush communities; 800 to 1,600 meters				X
Palmer's evening-primrose	*Camissonia palmeri*	BLM STR	Dry, open sagebrush scrub; less than 1,200 meters				X
Peck's milkvetch	*Astragalus peckii*	BLM S	Loose pumice/ash soils in open lodgepole pine and juniper forests with big sagebrush – bitterbrush flats; 800 to 1,100 meters	X			

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Playa buckwheat	*Eriogonum salicornioides*	BLM S	Clayey flats and slopes, saltbush, greasewood and sagebrush communities, and juniper woodlands; 700 to 1,300 meters				X
Playa yellow phacelia	*Phacelia inundata*	BLM S	Mostly on alkali flats and on or around the margins of playas, sinks, and fluctuating lakes, in places that are likely to be submerged for part of the year, only seldom on slopes			X	X
Prickly poppy	*Argemone munita*	BLM S	Sandy loam in big sagebrush and greasewood		X		X
Profuse-flowered pogogyne	*Pogogyne floribunda*	BLM S	Restricted to summer-dry playa lake beds and ephemeral channels in Great Basin silver sagebrush communities			X	X
Prostrate buckwheat	*Eriogonum prociduum*	BLM S	Barren, dry volcanic gravelly slopes in sagebrush communities; 1,400 to 2,400 meters			X	X
Purple cymopterus	*Cympoterus purpurascens*	BLM S	Dry rocky, big sagebrush communities, desert scrub, ash soils; 1,400 meters		X		
Rafinesque's pondweed	*Potamogeton diversifolius*	BLM S	Shallow lakes, ponds, and pools		X		
Rock olive	*Peltula euploca*	BLM STR	Basalt rock outcrops in juniper woodlands and sagebrush			X	
Rough pyrrocoma	*Pyrrocoma scaberula*	BLM S	Snake river canyon grasslands				X
Rose's desert parsley	*Lomatium roseanum*	BLM S	Rock soils and crevices in big sagebrush / sandberg blue grass and rabbitbrush communities				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Rosy pussypaws	*Cistanthe rosea*	BLM S	Gravelly soils; 1,500 to 3,800 meters				X
Rural paintbrush	*Castilleja flava* var. *rustica*	BLM S	Open big sagebrush – bunchgrass, open pine forests				X
Seaside heliotrope	*Heliotropium curassavicum* var. *obovatum*	BLM S	Saline places, on or around the margins of alkaline lakes and playas in mid-elevation valleys		X	X	X
Shelly's ivesia	*Ivesia rhypara* var. *shellyi*	BLM S	Pockets in boulders and outcrops of pumiceous welded ash-flow tuff along walls of canyons in bunchgrass-sagebrush hills			X	
Shockley's ivesia	*Ivesia shockleyi*	BLM S	Andesite rocky outcrops in low sagebrush, and sandberg blue grass / Idaho fescue communities				X
Short-flowered eriogonum	*Eriogonum brachyanthum*	BLM S	Sandy soils, dunes with greasewood and saltbush		X		
Short-seeded waterwort	*Elatine brachysperma*	BLM S	Mud or shallow water on the banks of streams and at the edges of ponds and reservoirs; 1,200 to 1,500 meters			X	X
Slender gentian	*Gentianella tenella* ssp. *tenella*	BLM S	Wet meadows at high elevation		X		
Slender sedge	*Carex lasiocarpa* var. *americana*	BLM S	Fens, bogs, lakeshores, wet meadows, and floating mats in deep soils with moderate nutrient levels			X	
Slender wild cabbage	*Caulanthus major* var. *nevadensis*	BLM S	Margin of montane forests, sagebrush, and juniper woodlands; 1,500 to 3,200 meters				X
Smooth mentzelia	*Mentzelia mollis*	BLM S	Barren heavy clay slopes and bluffs derived from volcanic ash; 800 to 1,465 meters				X

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Smooth wild cabbage	*Caulanthus crassicaulis* var. *glaber*	BLM S	Sagebrush scrub, juniper woodland; 1,200 to 2,900 meters				X
Snake River goldenweed	*Pyrrocoma radiata*	BLM S	Dry hillsides, alkaline slopes in big sagebrush / bluebunch wheatgrass communities; 600 to 2,400 meters				X
Snowline cymopterus	*Cymopterus nivalis*	BLM S	Ash flow soils or open rocky places in juniper/sagebrush/bunchgrass communities with varying slopes and elevations, often associated with *Eriogonum prociduum, E. cusickii*			X	
Soleri's pygmy-weed	*Crassula solierii*	BLM STR	Mudflats, vernal pools, and wetland edges; less than 2,000 meters		X		X
South fork John Day milkvetch	*Astragalus diaphanus var. diurnus*	BLM STR	Dry, barren, gravelly slopes in juniper woodlands and sagebrush; 760 to 1,100 meters	X			
Spalding's catchfly	*Silene spaldingii*	FT	Grasslands with Idaho fescue, bluebunch wheatgrass, snowberry or sagebrush; 470 to 1,160 meters				X
Spiny fameflower	*Phemeranthus spinescens*	BLM S	Basalt outcrops in sagebrush steppe	X			
St. Jacob's wovenspore lichen	*Texosporium sancti-jacobi*	BLM S	Grasslands in big sagebrush communities	X			
Sterile milk-vetch	*Astragalus cusickii* var. *sterilis*	BLM S	Rocky hillsides, bluffs, talus-slopes, and barren hilltops; below 1,500 meters				X
Suksdorf's desertparsley	*Lomatium suksdorfii*	BLM S	Open gravelly, rocky slopes in grasslands and woodlands	X			

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Three-color monkeyflower	*Mimulus tricolor*	BLM S	Vernally wet depressions, wet clay soil, especially desiccated vernal pools			X	
Three forks stickseed	*Hackelia ophiobia*	BLM S	Talus and rock-crevices. Talus at the base of rhyolitic cliffs and rock crevices on shady north face of canyons				X
Tioga pass sedge	*Carex tiogana*	BLM S	In moss mats in moist areas, bogs, marshes, streambanks, wet meadows, sometimes on limestone substrates, (Steen's Mountains, see *Carex capillaris*)		X		
Transmontane abronia	*Abronia turbinata*	BLM S	Sandy soils, desert scrub; 900 to 2,500 meters				X
Tygh Valley milkvetch	*Astragalus tyghensis*	BLM S	Open juniper and pine woodlands; dry, rocky, clay soils; canyon walls; big sagebrush grasslands; 400 to 550 meters	X			
United blazingstar	*Mentzelia congesta*	BLM S	Open dry places, often in sandy soils, usually where the sand shifts and in sites disturbed by humans; 1,200 to 2,550 meters				X
Variable hot-rock penstemon	*Penstemon deustus var. variabilis*	BLM STR	Dry foothills and grasslands on thin soils; 500 to 800 meters	X			
Verrucose sea-purslane	*Sesuvium verrucosum*	BLM S	Saline or alkaline soil on or around margins of interior seasonal lakes, often with *Heliotropium curassavicum* var. *obovatum* and black greasewood			X	

Table K-1
Special Status Vascular Plants

Common Name	Scientific Name	Status[1]	General Habitat	Prineville District	Burns District	Lakeview District	Vale District
Warner Mt. bedstraw	*Galium serpenticum* var. *warnerense*	BLM S	Steep slopes, rocky scree areas and talus slopes, at bases or rock outcrops, along road cuts; 1,450 to 2,750 meters			X	
Watson's desertparsley	*Lomatium watsonii*	BLM S	Dry open, rocky slopes in sagebrush, grasslands	X			
Wedge-leaf saxifrage	*Saxifraga adscendens* spp. *oregonensis*	BLM S	Moist meadows, rocky slopes at high elevation		X		
Wheeler's skeleton-weed	*Chaetadelpha wheeleri*	BLM S	Dunes, sandy soils and alkali flats in creosote bush scrub; 800 to 1,800 meters				X
White locoweed	*Oxytropis sericea* var. *sericea*	BLM S	Prairies, plains, foot-hills, especially in open dry grasses and rocky habitats below 2,200 meters; bur ascending to mountain balds and through open pine forest to timberline near 3,300 meters				X
Whitebark pine	*Pinus albicaulis*	BLM S	High elevation – subalpine forests				X

Sources: BLM species files; Oregon Plant Atlas 2012; ORBIC 2012; Flora of North America 2013; Intermountain Flora
[1] FE – Federally endangered, FT – Federally threatened, BLM S – BLM Sensitive, BLM STR – BLM Strategic

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Appendix L

Special Status Species: Other Taxa

APPENDIX L
SPECIAL STATUS SPECIES: OTHER TAXA

Table L-1 lists the special status species documented (D) as occurring or suspected (S) to occur on BLM-administered lands within the planning area. Status codes are S = BLM Sensitive, FT = Federally Threatened, and FE = Federally Endangered.

Table L-1
Special Status Species Documented (D) as Occurring or Suspected (S) to Occur on BLM-administered Lands Within the Planning Area

			Occurrence Status			
Scientific Name	**Common Name**	**Status**	**Burns**	**Lakeview**	**Prineville**	**Vale**
Bird						
Agelaius tricolor	Tricolored blackbird	S		D	D	
Ammodramus savannarum	Grasshopper sparrow	S	D		D	D
Anser albifrons elgasi	Tule white-fronted goose	S		S		
Bartramia longicauda	Upland sandpiper	S			S	
Bucephala albeola	Bufflehead	S			D	
Centrocercus urophasianus	Greater sage-grouse	S	D	D	D	D
Charadrius alexandrinus nivosus	Western snowy plover	S	D	D		
Coccyzus americanus	Yellow-billed cuckoo	S	D	S	S	D
Coturnicops noveboracensis	Yellow rail	S		D	D	
Cygnus buccinator	Trumpeter swan	S	D	S	D	D
Cypseloides niger	Black swift	S			S	
Dolichonyx oryzivorus	Bobolink	S	D		S	D
Egretta thula	Snowy egret	S	D	D		
Eremophila alpestris strigata	Streaked horned lark	S				D
Falco peregrinus anatum	American peregrine falcon	S	D	D	D	D

Table L-1
Special Status Species Documented (D) as Occurring or Suspected (S) to Occur on BLM-administered Lands Within the Planning Area

			Occurrence Status			
Scientific Name	**Common Name**	**Status**	**Burns**	**Lakeview**	**Prineville**	**Vale**
Haliaeetus leucocephalus	Bald eagle	S	D	D	D	D
Larus pipixcan	Franklin's gull	S	D	D		D
Leucosticte atrata	Black rosy finch	S	D			
Leucosticte tephrocotis wallowa	Wallowa rosy finch	S				S
Melanerpes lewis	Lewis' woodpecker	S	S		D	D
Pelecanus erythrorhynchos	American white pelican	S	D	D		D
Picoides albolarvatus	White-headed woodpecker	S	D	D	D	D
Podiceps auritus	Horned grebe	S	D	D		D
Podiceps grisegena	Red-necked grebe	S		S		
Progne subis	Purple martin	S				D
Seiurus noveboracensis	Northern waterthrush	S			S	
Tympanuchus phasianellus columbianus	Columbian sharp-tailed grouse	S				S
Fish						
Oncorhynchus mykiss	Steelhead	FT			D	D
Oncorhynchus mykiss (snake river basin)	Steelhead	FT				D
Oncorhynchus tshawytscha	Chinook salmon	FT				D
Oncorhynchus tshawytscha (snake river fall runs)	Chinook salmon	FT				D
Catostomus microps	Modoc sucker	FE		S		
Catostomus tahoensis	Tahoe sucker	S				D
Catostomus warnerensis	Warner sucker	FT		D		
Cottus pitensis	Pit sculpin	S		S		
Gila alvordensis	Alvord chub	S	D			
Gila bicolor eurysoma	Sheldon tui chub	S		D		
Gila bicolor oregonensis	Oregon lakes tui chub	S		D		
Gila bicolor ssp.	Catlow tui chub	S	D			
Gila bicolor ssp.	Hutton tui chub	FT		D		
Gila bicolor ssp.	Summer basin tui chub	S		D		
Gila bicolor thalassina	Goose lake tui chub	S		S		
Gila boraxobius	Borax lake chub	FE	D			
Lampetra tridentata	Goose lake lamprey	S		D		
Lavinia symmetricus mitrulus	Pit roach	S		S		
Oncorhynchus clarkii henshawi	Lahontan cutthroat trout	FT	D			D
Oncorhynchus clarkii lewisi	Westslope cutthroat trout	S			D	
Oncorhynchus mykiss	Redband trout	S	D	D		D

Table L-1
Special Status Species Documented (D) as Occurring or Suspected (S) to Occur on BLM-administered Lands Within the Planning Area

			Occurrence Status			
Scientific Name	**Common Name**	**Status**	**Burns**	**Lakeview**	**Prineville**	**Vale**
Oncorhynchus mykiss (Malheur Lakes)	Redband trout	S	D			
Oncorhynchus mykiss (Oregon Great Basin)	Redband trout	S	D	D		D
Oncorhynchus mykiss (Warner Valley/Warner Lakes)	Redband trout	S		D		
Rhinichthys osculus	Foskett speckled dace	FT		D		
Richardsonius egregius	Lahontan redside shiner	S				D
Salvelinus confluentus	Bull trout	FT	D		D	D
Amphibian						
Anaxyrus woodhousii	Woodhouse's toad	S				D
Ascaphus montanus	Rocky mountain tailed frog	S				D
Dicamptodon copei	Cope's giant salamander	S			D	
Lithobates pipiens	Northern leopard frog	S		S		D
Rana luteiventris	Columbia spotted frog	S	D	D	D	D
Rana luteiventris (Outside Great Basin)	Columbia spotted frog	S			D	
Rana pretiosa	Oregon spotted frog	S		S	D	
Reptiles						
Actinemys marmorata	Pacific pond turtle	S		D		
Chrysemys picta	Painted turtle	S				D
Mammals						
Antrozous pallidus	Pallid bat	S	D	D	D	D
Brachylagus idahoensis	Pygmy rabbit	S	D	D	D	D
Canis lupus	Gray wolf	FE				D
Canis lupus (northern Rocky Mtn.)	Gray wolf	S				D
Corynorhinus townsendii	Townsend's big-eared bat	S	D	D	D	D
Euderma maculatum	Spotted bat	S	D	S	D	D
Gulo gulo luscus	North american wolverine	S	D		S	S
Lynx canadensis	Canada lynx	FT	D		S	S
Myotis thysanodes	Fringed myotis	S	D	D	D	D
Spermophilus washingtoni	Washington ground squirrel	S			D	D
Vulpes macrotis	Kit fox	S	D	D		D
Fungus						
Rhizopogon brunneifibrillosus	Fungus	S			S	

Table L-1
Special Status Species Documented (D) as Occurring or Suspected (S) to Occur on BLM-administered Lands Within the Planning Area

			Occurrence Status			
Scientific Name	**Common Name**	**Status**	**Burns**	**Lakeview**	**Prineville**	**Vale**
Non-Vascular Plant						
Anthelia julacea	Liverwort	S	S			S
Barbilophozia lycopodioides	Liverwort	S				S
Jungermannia polaris	Liverwort	S	S			S
Lophozia gillmanii	Liverwort	S	S			S
Peltolepis quadrata	Liverwort	S				S
Preissia quadrata	Liverwort	S	S		S	S
Ptilidium pulcherrimum	Liverwort	S				S
Schistidium cinclidodonteum	Moss	S	S			S
Tortula mucronifolia	Moss	S	D	S	S	
Texosporium sancti-jacobi	Lichen	S	S	S	D	S
Invertebrate Animal						
Gonidea angulata	Western ridged mussel	S	D	S	D	D
Colligyrus depressus	Harney basin duskysnail	S	S			
Cryptomastix populi	Hells canyon land snail	S				D
Fisherola nuttalli	Shortface lanx	S			D	
Fluminicola fuscus	Columbia pebblesnail	S			S	
Fluminicola insolitus	Donner und blitzen pebblesnail	S	D			
Helisoma newberryi newberryi	Great basin Ramshorn	S		D		
Juga hemphilli dallesensis	Dalles juga	S			D	
Juga hemphilli hemphilli	Barren juga	S			S	
Juga hemphilli maupinensis	Purple-lipped juga	S			D	
Juga newberryi	A freshwater snail	S			D	
Monadenia fidelis ssp. *nov. (deschutes)*	Deschutes sideband	S			D	
Monadenia fidelis ssp. Nov. (Modoc Rim)	Modoc rim sideband	S		D		
Pyrgulopsis fresti	Owyhee hot springsnail	S				D
Pyrgulopsis intermedia	Crooked creek springsnail	S	S	S		D
Pyrgulopsis owyheensis	A springsnail	S				D
Pyrgulopsis robusta	Jackson lake springsnail	S	S	S	S	D
Micracanthia fennica	Harney hot spring shore bug	S	D			
Vanduzeeina borealis californica	California shield-backed bug	S		S		
Bombus occidentalis	Western bumblebee	S		S		
Boloria selene	Silver-bordered fritillary	S			D	S

Appendix M

Standards for Rangeland Health and Guidelines for Livestock Grazing

STANDARDS FOR RANGELAND HEALTH

AND

GUIDELINES FOR LIVESTOCK GRAZING MANAGEMENT

FOR

PUBLIC LANDS ADMINISTERED BY THE BUREAU OF LAND MANAGEMENT IN THE STATES OF OREGON AND WASHINGTON

AUGUST 12, 1997

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Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington

Introduction

These Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington were developed in consultation with Resource Advisory Councils and Provincial Advisory Committees, tribes and others. These standards and guidelines meet the requirements and intent of 43 Code of Federal Regulations, Subpart 4180 (Rangeland Health) and are to be used as presented, in their entirety. These standards and guidelines are intended to provide a clear statement of agency policy and direction for those who use public lands for livestock grazing, and for those who are responsible for their management and accountable for their condition. Nothing in this document should be interpreted as an abrogation of Federal trust responsibilities in protection of treaty rights of Indian tribes or any other statutory responsibilities including, but not limited to, the Taylor Grazing Act, the Clean Water Act, and the Endangered Species Act.

Fundamentals of Rangeland Health

The objectives of the rangeland health regulations referred to above are: "to promote healthy sustainable rangeland ecosystems; to accelerate restoration and improvement of public rangelands to properly functioning conditions; . . . and to provide for the sustainability of the western livestock industry and communities that are dependent upon productive, healthy public rangelands."

To help meet these objectives, the regulations on rangeland health identify fundamental principles providing direction to the States, districts, and on-the-ground public land managers and users in the management and use of rangeland ecosystems.

A hierarchy, or order, of ecological function and process exists within each ecosystem. The rangeland ecosystem consists of four primary, interactive components: a physical component, a biological component, a social component, and an economic component. This perspective implies that the physical function of an ecosystem supports the biological health, diversity and productivity of that system. In turn, the interaction of the physical and biological components of the ecosystem provides the basic needs of society and supports economic use and potential.

The Fundamentals of Rangeland Health stated in 43 CFR 4180 are:

1. Watersheds are in, or are making significant progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components; soil and plant conditions support infiltration, soil moisture storage and the release of water that are in balance with climate and landform and maintain or improve water quality, water quantity and the timing and duration of flow.

2. Ecological processes, including the hydrologic cycle, nutrient cycle and energy flow, are maintained, or there is significant progress toward their attainment, in order to support healthy biotic populations and communities.

3. Water quality complies with State water quality standards and achieves, or is making significant progress toward achieving, established Bureau of Land Management objectives such as meeting wildlife needs.

4. Habitats are, or are making significant progress toward being, restored or maintained for Federal threatened and endangered species, Federal Proposed, Category 1 and 2 Federal candidate and other special status species.

The fundamentals of rangeland health combine the basic precepts of physical function and biological health with elements of law relating to water quality, and plant and animal populations and communities. They provide direction in the development and implementation of the standards for rangeland health.

Standards for Rangeland Health

The standards for rangeland health (standards), based on the above fundamentals, are expressions of the physical and biological condition or degree of function necessary to sustain healthy rangeland ecosystems. Although the focus of these standards is on domestic livestock grazing on Bureau of Land Management lands, on-the-ground decisions must consider the effects and impacts of all uses.

Standards that address the physical components of rangeland ecosystems focus on the roles and interactions of geology and landform, soil, climate and water as they govern watershed function and soil stability. The biological components addressed in the standards focus on the roles and interactions of plants, animals and microbes (producers, consumers and decomposers), and their habitats in the ecosystem. The biological component of rangeland ecosystems is supported by physical function of the system, and it is recognized that biological activity also influences and supports many of the ecosystem's physical functions.

Guidance contained in 43 CFR 4180 of the regulations directs management toward the maintenance or restoration of the physical function and biological health of rangeland ecosystems. Focusing on the basic ecological health and function of rangelands is expected to provide for the maintenance, enhancement, or creation of future social and economic options.

The standards are based upon the ecological potential and capability of each site. In assessing a site's condition or degree of function, it must be understood that the evaluation compares each site to its own potential or capability. Potential and capability are defined as follows:

Potential-The highest level of condition or degree of function a site can attain given no political, social or economic constraints.

Capability-The highest level of condition or degree of function a site can attain given certain political, social or economic constraints. For example, these constraints might include riparian areas permanently occupied by a highway or railroad bed that prevent the stream's full access to its original flood plain. If such constraints are removed, the site may be able to move toward its potential.

In designing and implementing management strategies to meet the standards of rangeland health, the potential of the site must be identified, and any constraints recognized, in order that plan goals and objectives are realistic and physically and economically achievable.

Standards and Guidelines in Relation to the Planning Process

The standards apply to the goals of land use plans, activity plans, and project plans (Allotment Management Plans, Annual Operating Plans, Habitat Management Plans, etc.). They establish the physical and biological conditions or degree of function toward which management of publicly-owned rangeland is to be directed. In the development of a plan, direction provided by the standards and the social and economic needs expressed by local communities and individuals are brought together in formulating the goal(s) of that plan.

When the standards and the social and economic goals of the planning participants are woven together in the plan goal(s), the quantifiable, time specific objective(s) of the plan are then developed. Objectives describe and quantify the desired future conditions to be achieved within a specified time frame. Each plan objective should address the physical, biological, social and economic elements identified in the plan goal.

Standards apply to all ecological sites and land forms on public rangelands throughout Oregon and Washington. The standards require site-specific information for full on-ground usability. For each standard, a set of indicators is identified for use in tailoring the standards to site-specific situations. These indicators are used for rangeland ecosystem assessments and monitoring and for developing terms and conditions for permits and leases that achieve the plan goal.

Guidelines for livestock grazing management offer guidance in achieving the plan goal and objectives. The guidelines outline practices, methods, techniques and considerations used to ensure that progress is achieved in a way, and at a rate, that meets the plan goal and objectives.

Indicators of Rangeland Health

The condition or degree of function of a site in relation to the standards and its trend toward or away from any standard is determined through the use of reliable and scientifically sound indicators. The consistent application of such indicators can provide an objective view of the condition and trend of a site when used by trained observers.

For example, the amount and distribution of ground cover can be used to indicate that infiltration at the soil surface can take place as described in the standard relating to upland watershed function. In applying this indicator, the specific levels of plant cover necessary to support infiltration in a particular soil should be identified using currently available information from reference areas, if they exist; from technical sources like soil survey reports, Ecological Site Inventories, and Ecological Site Descriptions, or from other existing reference materials. Reference areas are lands that best represent the potential of a specific ecological site in both physical function and biological health. In many instances potential reference areas are identified in Ecological Site Descriptions and are referred to as "type locations." In the absence of suitable reference areas, the selection of indicators to be used in measuring or judging condition or function should be made by an interdisciplinary team of experienced professionals and other trained individuals.

Not all indicators identified for each standard are expected to be employed in every situation. Criteria for selecting appropriate indicators and methods of measurement and observation include, but are not limited to: 1. the relationship between the attribute(s) being measured or observed and the desired outcome; 2. the relationship between the activity (e.g., livestock grazing) and the attribute(s) being measured or observed; and 3. funds and workforce available to conduct the measurements or observations.

Assessments and Monitoring

The standards are the basis for assessing and monitoring rangeland condition and trend. Carrying out well-designed assessment and monitoring is critical to restoring or maintaining healthy rangelands and determining trends and conditions.

Assessments are a cursory form of evaluation based on the standards that can be used at different landscape scales. Assessments, conducted by qualified interdisciplinary teams (which may include but are not limited to physical, biological and social specialists, and interagency personnel) with participation from permittees and other interested parties, are appropriate at the watershed and sub-watershed levels, at the allotment and pasture levels and on individual ecological sites or groups of sites. Assessments identify the condition or degree of function within the rangeland ecosystem and indicate resource problems and issues that should be monitored or studied in more detail. The results of assessments are a valuable tool for managers in assigning priorities within an administrative area and the subsequent allocation of personnel, money and time in resource monitoring and treatment. The results of assessments may also be used in making management decisions where an obvious problem exists.

Monitoring, which is the well documented and orderly collection, analysis and interpretation of resource data, serves as the basis for determining trends in the condition or degree of function of rangeland resources and for making management decisions. Monitoring should be designed and carried out to identify trends in resource conditions, to point out resource problems, to help indicate the cause of such problems, to point out solutions, and/or to contribute to adaptive management decisions. In cases where monitoring data do not exist, professional judgement, supported by interdisciplinary team recommendation, may be relied upon by the authorized officer in order to take necessary action. Review and evaluation of new information must be an ongoing activity.

To be effective, monitoring must be consistent over time, throughout administrative areas, and in the methods of measurement and observation of selected indicators. Those doing the monitoring must have the knowledge and skill required by the level or intensity of the monitoring being done, as well as the experience to properly interpret the results. Technical support for training must be made available.

Measurability

It is recognized that not every area will immediately meet the standards and that it will sometimes be a long-term process to restore some rangelands to properly functioning condition. It is intended that in cases where standards are not being met, measurable progress should be made toward achieving those standards, and significant progress should be made toward fulfilling the fundamentals of rangeland health. Measurability is defined on a case-specific basis based upon the stated planning objectives (i.e., quantifiable, time specific), taking into account economic and social goals along with the biological and ecological capability of the area. To the extent that a rate of recovery

conforms with the planning objectives, the area is allowed the time to meet the standard under the selected management regime.

Implementation

The material contained in this document will be incorporated into existing Land Use Plans and used in the development of new Land Use Plans. According to 43 CFR 4130.3-1, permits and leases shall incorporate terms and conditions that ensure conformance with 43 CFR 4180. Terms and conditions of existing permits and leases will be modified to reflect standards and guidelines at the earliest possible date with priority for modification being at the discretion of the authorized officer. Terms and conditions of new permits and leases will reflect standards and guidelines in their development.

Indicators identified in this document will serve as a focus of interpretation of existing monitoring data and will provide the basis of design for monitoring and assessment techniques, and in the development of monitoring and assessment plans.

The authorized officer shall take appropriate action as soon as practicable but not later than the start of the next grazing year upon determining, through assessment or monitoring by experienced professionals and interdisciplinary teams, that a standard is not being achieved and that livestock are a significant contributing factor to the failure to achieve the standards and conform with the guidelines.

Standards for Rangeland Health

Standard 1 Watershed Function - Uplands

Upland soils exhibit infiltration and permeability rates, moisture storage and stability that are appropriate to soil, climate and landform.

Rationale and Intent

This standard focuses on the basic physical functions of upland soils that support plant growth, the maintenance or development of plant populations and communities, and promote dependable flows of quality water from the watershed.

To achieve and sustain rangeland health, watersheds must function properly. Watersheds consist of three principle components: the uplands, riparian/wetland areas and the aquatic zone. This standard addresses the upland component of the watershed. When functioning properly, within its potential, a watershed captures, stores and safely releases the moisture associated with normal precipitation events (equal to or less than the 25 year, 5 hour event) that falls within its boundaries. Uplands make up the largest part of the

watershed and are where most of the moisture received during precipitation events is captured and stored.

While all watersheds consist of similar components and processes, each is unique in its individual makeup. Each watershed displays its own pattern of landform and soil, its unique climate and weather patterns, and its own history of use and current condition. In directing management toward achieving this standard, it is essential to treat each unit of the landscape (soil, ecological site, and watershed) according to its own capability and how it fits with both smaller and larger units of the landscape.

A set of potential indicators has been identified for which site-specific criteria will be used to determine if this standard is being met. The appropriate indicators to be used in determining attainment of the standard should be drawn from the following list.

Potential Indicators

Protection of the soil surface from raindrop impact; detention of overland flow; maintenance of infiltration and permeability, and protection of the soil surface from erosion, consistent with the potential/capability of the site, as evidenced by the:

- amount and distribution of plant cover (including forest canopy cover);
- amount and distribution of plant litter;
- accumulation/incorporation of organic matter;
- amount and distribution of bare ground;
- amount and distribution of rock, stone, and gravel;
- plant composition and community structure;
- thickness and continuity of A horizon;
- character of microrelief;
- presence and integrity of biotic crusts;
- root occupancy of the soil profile;
- biological activity (plant, animal, and insect); and
- absence of accelerated erosion and overland flow.

Soil and plant conditions promote moisture storage as evidenced by:

- amount and distribution of plant cover (including forest canopy cover);
- amount and distribution of plant litter;
- plant composition and community structure; and
- accumulation/incorporation of organic matter.

Standard 2 Watershed Function - Riparian/Wetland Areas

Riparian-wetland areas are in properly functioning physical condition appropriate to soil, climate, and landform.

Rationale and Intent

Riparian-wetland areas are grouped into two major categories: 1. lentic, or standing water systems such as lakes, ponds, seeps, bogs, and meadows; and 2. lotic, or moving water systems such as rivers, streams, and springs. Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and which under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Riparian areas commonly occupy the transition zone between the uplands and surface water bodies (the aquatic zone) or permanently saturated wetlands.

Properly functioning condition of riparian and wetland areas describes the degree of physical function of these components of the watershed. Their functionality is important to water quality in the capture and retention of sediment and debris, the detention and detoxification of pollutants, and in moderating seasonal extremes of water temperature. Properly functioning riparian areas and wetlands enhance the timing and duration of streamflow through dissipation of flood energy, improved bank storage, and ground water recharge. Properly functioning condition should not be confused with the Desired Plant Community (DPC) or the Desired Future Condition (DFC) since, in most cases, it is the precursor to these levels of resource condition and is required for their attainment.

A set of indicators has been identified for which site-specific criteria will be used to determine if this standard is being met. The criteria are based upon the potential (or upon the capability where potential cannot be achieved) of individual sites or land forms.

Potential Indicators

Hydrologic, vegetative, and erosional/depositional processes interact in supporting physical function, consistent with the potential or capability of the site, as evidenced by:

- frequency of floodplain/wetland inundation;
- plant composition, age class distribution, and community structure;
- root mass;
- point bars revegetating;
- streambank/shoreline stability;
- riparian area width;
- sediment deposition;
- active/stable beaver dams;
- coarse/large woody debris;
- upland watershed conditions;
- frequency/duration of soil saturation; and
- water table fluctuation.

Stream channel characteristics are appropriate for landscape position as evidenced by:

- channel width/depth ratio;

- channel sinuosity;
- gradient;
- rocks and coarse and/or large woody debris;
- overhanging banks;
- pool/riffle ratio;
- pool size and frequency; and
- stream embeddedness.

Standard 3 Ecological Processes

Healthy, productive and diverse plant and animal populations and communities appropriate to soil, climate and landform are supported by ecological processes of nutrient cycling, energy flow and the hydrologic cycle.

Rationale and Intent

This standard addresses the ecological processes of energy flow and nutrient cycling as influenced by existing and desired plant and animal communities without establishing the kinds, amounts or proportions of plant and animal community compositions. While emphasis may be on native species, an ecological site may be capable of supporting a number of different native and introduced plant and animal populations and communities while meeting this standard. This standard also addresses the hydrologic cycle which is essential for plant growth and appropriate levels of energy flow and nutrient cycling. Standards 1 and 2 address the watershed aspects of the hydrologic cycle.

With few exceptions, all life on earth is supported by the energy supplied by the sun and captured by plants in the process of photosynthesis. This energy enters the food chain when plants are consumed by insects and herbivores and passes upward through the food chain to the carnivores. Eventually, the energy reaches the decomposers and is released as the thermal output of decomposition or through oxidation.

The ability of plants to capture sunlight energy, to grow and develop, to play a role in soil development and watershed function, to provide habitat for wildlife and to support economic uses depends on the availability of nutrients and moisture. Nutrients necessary for plant growth are made available to plants through the decomposition and metabolization of organic matter by insects, bacteria and fungi, the weathering of rocks and extraction from the atmosphere. Nutrients are transported through the soil by plant uptake, leaching and by rodent, insect and microbial activity. They follow cyclical patterns as they are used and reused by living organisms.

The ability of rangelands to supply resources and satisfy social and economic needs depends on the buildup and cycling of nutrients over time. Interrupting or slowing

nutrient cycling can lead to site degradation, as these lands become increasingly deficient in the nutrients plants require.

Some plant communities, because of past use, frequent fire or other histories of extreme or continued disturbance, are incapable of meeting this standard. For example, shallow-rooted winter-annual grasses that completely dominate some sites do not fully occupy the potential rooting depth of some soils, thereby reducing nutrient cycling well below optimum levels. In addition, these plants have a relatively short growth period and thus capture less sunlight than more diverse plant communities. Plant communities like those cited in this example are considered to have crossed the threshold of recovery and often require great expense to be recovered. The cost of recovery must be weighed against the site's potential ecological/economic value in establishing treatment priorities.

The role of fire in natural ecosystems should be considered, whether it acts as a primary driver or only as one of many factors. It may play a significant role in both nutrient cycling and energy flows.

A set of indicators has been identified for which site-specific criteria will be used to determine if this standard is being met.

Potential Indicators

Photosynthesis is effectively occurring throughout the potential growing season, consistent with the potential/capability of the site, as evidenced by plant composition and community structure.

Nutrient cycling is occurring effectively, consistent with the potential/capability of the site, as evidenced by:

- plant composition and community structure;
- accumulation, distribution, incorporation of plant litter and organic matter into the soil;
- animal community structure and composition;
- root occupancy in the soil profile; and
- biological activity including plant growth, herbivory, and rodent, insect and microbial activity.

Standard 4 Water Quality

Surface water and groundwater quality, influenced by agency actions, complies with State water quality standards.

Rationale and Intent

The quality of the water yielded by a watershed is determined by the physical and chemical properties of the geology and soils unique to the watershed, the prevailing climate and weather patterns, current resource conditions, the uses to which the land is put and the quality of the management of those uses. Standards 1, 2 and 3 contribute to attaining this standard.

States are legally required to establish water quality standards and Federal land management agencies are to comply with those standards. In mixed ownership watersheds, agencies, like any other land owners, have limited influence on the quality of the water yielded by the watershed. The actions taken by the agency will contribute to meeting State water quality standards during the period that water crosses agency administered holdings.

Potential Indicators

Water quality meets applicable water quality standards as evidenced by:

- water temperature;
- dissolved oxygen;
- fecal coliform;
- turbidity;
- pH;
- populations of aquatic organisms; and
- effects on beneficial uses (i.e., effects of management activities on beneficial uses as defined under the Clean Water Act and State implementing regulations).

Standard 5 Native, T&E, and Locally Important Species

Habitats support healthy, productive and diverse populations and communities of native plants and animals (including special status species and species of local importance) appropriate to soil, climate and landform.

Rationale and Intent

Federal agencies are mandated to protect threatened and endangered species and will take appropriate action to avoid the listing of any species. This standard focuses on retaining and restoring native plant and animal (including fish) species, populations and communities (including threatened, endangered and other special status species and species of local importance). In meeting the standard, native plant communities and animal habitats would be spatially distributed across the landscape with a density and frequency of species suitable to ensure reproductive capability and sustainability. Plant populations and communities would exhibit a range of age classes necessary to sustain recruitment and mortality fluctuations.

Potential Indicators

Essential habitat elements for species, populations and communities are present and available, consistent with the potential/capability of the landscape, as evidenced by:

- plant community composition, age class distribution, productivity;
- animal community composition, productivity;
- habitat elements;
- spatial distribution of habitat;
- habitat connectivity; and
- population stability/resilience.

Guidelines for Livestock Grazing Management

Guidelines for livestock grazing management offer guidance in achieving plan goals, meeting standards for rangeland health and fulfilling the fundamentals of rangeland health. Guidelines are applied in accordance with the capabilities of the resource in consultation, cooperation, and coordination with permittees/lessees and the interested public. Guidelines enable managers to adjust grazing management on public lands to meet current and anticipated climatic and biological conditions.

General Guidelines

1. Involve diverse interests in rangeland assessment, planning and monitoring.

2. Assessment and monitoring are essential to the management of rangelands, especially in areas where resource problems exist or issues arise. Monitoring should proceed using a qualitative method of assessment to identify critical, site-specific problems or issues using interdisciplinary teams of specialists, managers, and knowledgeable land users.

Once identified, critical, site-specific problems or issues should be targeted for more intensive, quantitative monitoring or investigation. Priority for monitoring and treatment should be given to those areas that are ecologically at-risk where benefits can be maximized given existing budgets and other resources.

Livestock Grazing Management

1. The season, timing, frequency, duration and intensity of livestock grazing use should be based on the physical and biological characteristics of the site and the management unit in order to:

    a. provide adequate cover (live plants, plant litter and residue) to promote

infiltration, conserve soil moisture and to maintain soil stability in upland areas;

b. provide adequate cover and plant community structure to promote streambank stability, debris and sediment capture, and floodwater energy dissipation in riparian areas.

c. promote soil surface conditions that support infiltration;

d. avoid sub-surface soil compaction that retards the movement of water in the soil profile;

e. help prevent the increase and spread of noxious weeds;

f. maintain or restore diverse plant populations and communities that fully occupy the potential rooting volume of the soil;

g. maintain or restore plant communities to promote photosynthesis throughout the potential growing season;

h. promote soil and site conditions that provide the opportunity for the establishment of desirable plants;

i. protect or restore water quality; and

j. provide for the life cycle requirements, and maintain or restore the habitat elements of native (including T&E, special status, and locally important species) and desired plants and animals.

2. Grazing management plans should be tailored to site-specific conditions and plan objectives. Livestock grazing should be coordinated with the timing of precipitation, plant growth and plant form. Soil moisture, plant growth stage and the timing of peak stream flows are key factors in determining when to graze. Response to different grazing strategies varies with differing ecological sites.

3. Grazing management systems should consider nutritional and herd health requirements of the livestock.

4. Integrate grazing management systems into the year-round management strategy and resources of the permittee(s) or lessee(s). Consider the use of collaborative approaches (e.g., Coordinated Resource Management, Working Groups) in this integration.

5. Consider competition for forage and browse among livestock, big game animals, and wild horses in designing and implementing a grazing plan.

6. Provide periodic rest from grazing for rangeland vegetation during critical growth periods to promote plant vigor, reproduction and productivity.

7. Range improvement practices should be prioritized to promote rehabilitation and resolve grazing concerns on transitory grazing land.

8. Consider the potential for conflict between grazing use on public land and adjoining land uses in the design and implementation of a grazing management plan.

Facilitating the Management of Livestock Grazing

1. The use of practices to facilitate the implementation of grazing systems should consider the kind and class of animals managed, indigenous wildlife, wild horses, the terrain and the availability of water. Practices such as fencing, herding, water development, and the placement of salt and supplements (where authorized) are used where appropriate to:

    a. promote livestock distribution;

    b. encourage a uniform level of proper grazing use throughout the grazing unit;

    c. avoid unwanted or damaging concentrations of livestock on streambanks, in riparian areas and other sensitive areas such as highly erodible soils, unique wildlife habitats and plant communities; and

    d. protect water quality.

2. Roads and trails used to facilitate livestock grazing are constructed and maintained in a manner that minimizes the effects on landscape hydrology; concentration of overland flow, erosion and sediment transport are prevented; and subsurface flows are retained.

Accelerating Rangeland Recovery

1. Upland treatments that alter the vegetative composition of a site, like prescribed burning, juniper management and seedings or plantings must be based on the potential of the site and should:

    a. retain or promote infiltration, permeability, and soil moisture storage;

    b. contribute to nutrient cycling and energy flow;

    c. protect water quality;

d. help prevent the increase and spread of noxious weeds;

e. contribute to the diversity of plant communities, and plant community composition and structure;

f. support the conservation of T&E, other special status species and species of local importance; and

g. be followed up with grazing management and other treatments that extend the life of the treatment and address the cause of the original treatment need.

2. Seedings and plantings of non-native vegetation should only be used in those cases where native species are not available in sufficient quantities; where native species are incapable of maintaining or achieving the standards; or where non-native species are essential to the functional integrity of the site.

3. Structural and vegetative treatments and animal introductions in riparian and wetland areas must be compatible with the capability of the site, including the system's hydrologic regime, and contribute to the maintenance or restoration of properly functioning condition.

Glossary

Appropriate action-implementing actions pursuant to subparts 4110, 4120, 4130 and 4160 of the regulations that will result in significant progress toward fulfillment of the standards and significant progress toward conformance with the guidelines. (see **Significant progress**)

Assessment-a form of evaluation based on the standards of rangeland health, conducted by an interdisciplinary team at the appropriate landscape scale (pasture, allotment, sub-watershed, watershed, etc.) to determine conditions relative to standards.

Compaction layer-a layer within the soil profile in which the soil particles have been rearranged to decrease void space, thereby increasing soil bulk density and often reducing permeability.

Crust, Abiotic-(physical crust) a surface layer on soils, ranging in thickness from a few millimeters to a few centimeters, that is much more compact, hard and brittle, when dry, than the material immediately beneath it.

Crust, Biotic-(microbiotic or cryptogamic crust) a layer of living organisms (mosses, lichens, liverworts, algae, fungi, bacteria, and/or cyanobacteria) occurring on, or near the soil surface.

Degree of function-a level of physical function relative to properly functioning condition commonly expressed as: properly functioning, functioning-at-risk, or non-functional.

Diversity-the aggregate of species assemblages (communities), individual species, and the genetic variation within species and the processes by which these components interact within and among themselves. The elements of diversity are: 1. community diversity (habitat, ecosystem), 2. species diversity; and 3. genetic diversity within a species; all three of which change over time.

Energy flow-the processes in which solar energy is converted to chemical energy through photosynthesis and passed through the food chain until it is eventually dispersed through respiration and decomposition.

Ground water-water in the ground that is in the zone of saturation; water in the ground that exists at, or below the water table.

Guideline-practices, methods, techniques and considerations used to ensure that progress is made in a way and at a rate that achieves the standard(s).

Gully-a channel resulting from erosion and caused by the concentrated but intermittent flow of water usually during and immediately following heavy rains.

Hydrologic cycle-the process in which water enters the atmosphere through evaporation, transpiration, or sublimation from the oceans, other surface water bodies, or from the land and vegetation, and through condensation and precipitation returns to the earth's surface. The precipitation then occurring as overland flow, stream flow, or percolating underground flow to the oceans or other surface water bodies or to other sites of evapo-transpiration and recirculation to the atmosphere.

Indicators-parameters of ecosystem function that are observed, assessed, measured, or monitored to directly or indirectly determine attainment of a standard(s).

Infiltration-the downward entry of water into the soil.

Infiltration rate-the rate at which water enters the soil.

Nutrient cycling-the movement of essential elements and inorganic compounds between the reservoir pool (soil, for example) and the cycling pool (organisms) in the rapid exchange (i.e., moving back and forth) between organisms and their immediate environment.

Organic matter-plant and animal residues accumulated or deposited at the soil surface; the organic fraction of the soil that includes plant and animal residues at various stages of decomposition; cells and tissues of soil organisms, and the substances synthesized by the soil population.

Permeability-the ease with which gases, liquids or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

Properly functioning condition-Riparian-wetland: adequate vegetation, landform, or large (coarse) woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid in flood plain development; improve flood-water retention and ground water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse channel and ponding characteristics to provide the habitat and water depth, duration and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The result of interaction among geology, soil, water, and vegetation.

Uplands: soil and plant conditions support the physical processes of infiltration and moisture storage and promote soil stability (as appropriate to site potential); includes the production of plant cover and the accumulation of plant residue that protect the soil surface from raindrop impact, moderate soil temperature in minimizing frozen soil conditions (frequency, depth, and duration), and the loss of soil moisture to evaporation; root growth and development in the support of permeability and soil aeration. The result of interaction among geology, climate, landform, soil, and organisms.

Proper grazing use-grazing that, through the control of timing, frequency, intensity and duration of use, meets the physiological needs of the desirable vegetation, provides for the establishment of desirable plants and is in accord with the physical function and stability of soil and landform (properly functioning condition).

Reference area-sites that, because of their condition and degree of function, represent the ecological potential or capability of similar sites in an area or region (ecological province); serve as a benchmark in determining the ecological potential of sites with similar soil, climatic, and landscape characteristics.

Rill-a small, intermittent water course with steep sides; usually only a few inches deep.

Riparian area-a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and stream, glacial potholes, and shores of lakes and reservoirs with stable water levels area typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil. Includes, but is not limited to, jurisdictional wetlands.

Significant progress-when used in reference to achieving a standard: (actions), the necessary land treatments, practices and/or changes to management have been applied or are in effect; (rate), a rate of progress that is consistent with the anticipated recovery rate described in plan objectives, with due recognition of the effects of climatic extremes (drought, flooding, etc.), fire, and other unforeseen naturally occurring events or disturbances. Monitoring reference areas that are ungrazed and properly grazed may provide evidence of appropriate recovery rates. (See Proper Grazing Use)

Soil density-(bulk density)-the mass of dry soil per unit bulk volume.

Soil moisture-water contained in the soil; commonly used to describe water in the soil above the water table.

Special status species-species proposed for listing, officially listed (T/E), or candidates for listing as threatened or endangered by the Secretary of the Interior under the provisions of the Endangered Species Act; those listed or proposed for listing by the State in a category implying potential endangerment or extinction; those designated by each Bureau of Land Management State Director as sensitive.

Species of local importance-species of significant importance to Native American populations (e.g., medicinal and food plants).

Standard-an expression of the physical and biological condition or degree of function necessary to sustain healthy rangeland ecosystems.

Uplands-lands that exist above the riparian/wetland area, or active flood plains of rivers and streams; those lands not influenced by the water table or by free or unbound water; commonly represented by toe slopes, alluvial fans, and side slopes, shoulders and ridges of mountains and hills.

Watershed-an area of land that contributes to the surface flow of water past a given point. The watershed dimensions are determined by the point past, or through which, runoff flows.

Watershed function-the principal functions of a watershed include the capture of moisture contributed by precipitation; the storage of moisture within the soil profile, and the release of moisture through subsurface flow, deep percolation to groundwater, evaporation from the soil, and transpiration by live vegetation.

Wetland-areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and which under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

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Appendix N

Rangeland Health Standards Summary

Rangeland Health Standards by Grazing Allotment, PPH/PGH, District, Planning Area, and BLM Ownership

Jeanne DeBenedetti Keyes 9/19/2012

Note 1: Allotment categories such as ALLOTMENT NUMBER, ALLOTMENT NAME, TOTAL ALLOTMENT AUMS, MANAGEMENT CATEGORY, STD1 etc. will be duplicated because these attributes come from the RAS table and are not actually split by Sage Grouse Habitat boundaries.

Note 2: The information presented below is for BLM owned land only.

Note 3: This spreadsheet includes Priority, General and areas of no habitat. If the record is blank for habitat, then this area is outside of Priority or General Habitat.

Note 4: Not met by livestock could include other factors as well.

Note 5: If an allotment contains both PPH and PGH, only the habitat with the most acres is provided.

Data 1998 to 2012

Standard:

* = met, x = not met due to factors other than livestock, xl = not met livestock, na = standard not present ; blank = has not been assessed

"Standard (Std)" is Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public lands administered by the Bureau of Land Management in the States of Oregon and Washington, August 12, 1997.

Selective Management Category:

I = Improve category allotments are managd to resolve high-level resource conflicts and concerns and receive highest priority for funding and management actions.

M = Maintain category allotments are managed to maintain curretly satisfactory resource conditons and will be actively managed to ensure that resource values do not decline.

C = Custodial allotments are manged custodial to protect resource values.

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Burns District	Three Rivers Resource Area RMP 1992	PGH	05536	ALDER CREEK	2584	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06012	ALVORD ALLOTMENT	7355	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06042	BASQUE HILLS	1047	I	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05604	BURNT FLAT	3863	I	*	*	x	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	02246	CAMP CURREY FFR	8	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07062	CAPEHART LAKE	1500	I	xl	*	*	*	xl
Burns District	Andrews Management Unit RMP 2005	PGH	06027	CARLSON CR ALLOT.	688	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07010	CLAW CREEK	2861	I	*	xl	*	xl	xl

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Burns District	Three Rivers Resource Area RMP 1992	PPH	05514	COAL MINE CREEK	452	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05106	COW CREEK	230	I	*	xl	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05524	DAWSON BUTTE	614	I	xl	*	xl	x	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	05223	EAST DAVIES	128	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06010	EAST RIDGE	720	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07024	EAST SAGEHEN	2510	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07041	EAST SILVIES	594	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07003	EAST WAGONTIRE	6667	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	07001	EAST WARM SPRINGS	7594	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06028	FIELDS	1910	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06035	FIELDS BASIN	3506	I	x	x	*	xl	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07049	FORKS OF POISON CR	648	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06006	FRAZIER FIELD	1906	I	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07025	GOULDIN	567	I	x	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05601	HAMILTON	270	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06023	HAMMOND	473	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07007	HAT BUTTE	2312	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07031	HAY CREEK	585	I	*	*	*	x	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07036	HAYES	431	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07026	HORTON MILL	450	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05558	J&G F.F.R.	33	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06029	KEG SPRINGS	1791	I	*	na	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06008	KRUMBO ALLOTMENT	4150	I	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05571	LAMB RANCH	246	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07040	LANDING CREEK	740	I	*	*	*	*	*

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Burns District	Andrews Management Unit RMP 2005	PGH	06031	LAVOY TABLES	1653	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07043	LONE PINE	2147	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06044	LOWER ANTELOPE	500	I	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05534	MAHON CREEK	273	I	x	*	x	*	x
Burns District	Andrews Management Unit RMP 2005	PGH	06026	MANN LAKE ALLOT.	3670	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05535	MILLER CANYON	450	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05511	MOFFET TABLE	1885	I	*	*	*	*	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	05532	MOUNTAIN	3248	I	*	xl	*	x	*
Burns District	Andrews Management Unit RMP 2005	PPH	06005	MUD CREEK ALLOT	590	I	*	*	x	*	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	07058	NARROWS	300	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06121	NEUSCHWANDER FFR	43	I	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06001	NORTH CATLOW	4424	I	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05517	OTIS MOUNTAIN	1738	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07012	PACKSADDLE	250	I		*	na	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07019	PALOMINO BUTTES	2806	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05503	PINE CREEK	2410	I	*	xl	*	xl	xl
Burns District	Andrews Management Unit RMP 2005	PGH	06011	POLLOCK ALLOTMENT	4107	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06020	PUEBLO LONE MTN	15305	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06043	PUEBLO SLOUGH	1612	I	*	na	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06030	REICKEN'S CORNER	688	I	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05310	RIDDLE MOUNTAIN	3095	I	*	*	*	x	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	07006	RIMROCK LAKE	1775	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05530	RIVER	1649	I	*	xl	*	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	07063	ROUNDTOP BUTTE	3092	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07009	RYEGRASS	2851	I	*	xl	*	xl	xl

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Burns District	Three Rivers Resource Area RMP 1992	PGH	07015	SECOND FLAT	638	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06019	SERRANO PT ALLOT.	500	I	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07008	SHEEP LAKE-SHIELDS	1710	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05513	SHELLY	600	I	*	xl	*	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	04143	SILVIES	2500	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07033	SILVIES RIVER	699	I	*	xl	*	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	07030	SKULL CREEK	1959	I	*	*	*	x	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	05331	SMYTH-KIGER	2295	I	*	xl	*	*	xl
Burns District	Andrews Management Unit RMP 2005	PGH	06002	SOUTH STEENS ALLOT.	21197	I	*	xl	*	xl	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05531	STINKINGWATER	2857	I	*	xl	*	xl	xl
Burns District	Andrews Management Unit RMP 2005	PGH	06040	STONEHOUSE	1772	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05566	TEXACO BASIN	2351	I	x	*	x	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	04097	TROUT CREEK	420	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06015	TROUT CR MOUNTAIN	8352	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05523	TUB SPRINGS-HART	1002	I	*	*	*	*	x
Burns District	Andrews Management Unit RMP 2005	PGH	06018	TULE SPRINGS	5504	I	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05565	UPTON MOUNTAIN	1615	I	*	xl	*	*	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	05594	VENATOR	320	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07021	WEAVER LAKE	1396	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05221	WEST DAVIES	143	I	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07004	WEST WAGONTIRE	4959	I	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	05329	RIDDLE/COYOTE	1563	I					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05515	MULE CREEK	938	I					
Burns District	Three Rivers Resource Area RMP 1992	PGH	07023	WEST SAGEHEN	1911	I					
Burns District	Andrews Management Unit RMP 2005	PGH	00032	SOUTH CATLOW	2069	I					

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Burns District	Andrews Management Unit RMP 2005	PGH	06010	EAST RIDGE	720	I					
Burns District	Andrews Management Unit RMP 2005	PGH	06032	KRUMBO MOUNTAIN	1059	I					
Burns District	Three Rivers Resource Area RMP 1992	PGH	07002	WEST WARM SPRINGS	11006	I	*	xl	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07014	BADGER SPRING	1048	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05508	BAKER KNOWLES	58	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05600	BEAVER CREEK	1018	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05516	BIRCH CREEK	243	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05533	BUCHANAN	152	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05537	BUCK MOUNTAIN	1515	M	*	*	*	*	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	05105	CAMP HARNEY	946	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07039	CAVE GULCH	209	M					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05526	CHALK HILLS	936	M	*	*	*	*	x
Burns District	Andrews Management Unit RMP 2005	PGH	06033	CHIMNEY	2015	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07017	CLUSTER	548	M	*	*	x	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05592	COLEMAN CREEK	424	M					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05528	COOLER	530	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05522	COTTONWOOD CREEK	996	M	*	xl	*	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	05597	CRANE	183	M					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05101	DEVINE RIDGE	1307	M	*	x	*	x	x
Burns District	Three Rivers Resource Area RMP 1992	PPH	02252	DIETRICH FIELD FFR	7	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07022	DOG MOUNTAIN	175	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07056	DOUBLE O	592	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05303	DRY LAKE	5000	M	*	xl	*	xl	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05501	EAST COW CREEK	809	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	04098	EAST CREEK-PINE HILL	374	M	*	xl	*	xl	xl

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Burns District	Andrews Management Unit RMP 2005	PGH	06017	GRASSY BASIN	942	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05309	HAPPY VALLEY	2107	M	xl	*	xl	x	x
Burns District	Steens Mountain Cooperative Management	PGH	06025	HARDIE SUMMER	408	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05529	HOUSE BUTTE	2085	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05202	HUNTER	453	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05510	JONES DRIPP SPRINGS	120	M	*	xl	*	xl	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07016	JUNIPER RIDGE	2076	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05320	KEGLER FFR	16	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05505	LITTLE MUDDY CREEK	286	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05576	LOWER PINE	376	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05599	MAHON RANCH	329	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05525	MILL GULCH	525	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05506	MUDDY CREEK	504	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05102	PRATHER CREEK	41	M	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05301	PRINCETON	2532	M	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05538	RIVERSIDE	2045	M	xl	xl	xl	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PGH	05527	RIVERSIDE F.F.R.	49	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05502	ROCK CREEK	526	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05521	ROCKY BASIN	467	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05306	ROCKY FORD	941	M	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06007	RUBY SPRINGS	1950	M	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06016	SANDHILLS	2294	M	*	x	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07051	SAWTOOTH-MNF	32	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05575	SCHOOL HOUSE	303	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07018	SILVER LAKE	1755	M	*	*	*	*	*

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Burns District	Three Rivers Resource Area RMP 1992	PGH	07053	SILVIES CANYON	68	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07035	SILVIES MEADOWS	159	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05593	SLOCUM FIELD	300	M					
Burns District	Andrews Management Unit RMP 2005	PPH	06024	SOUTH FORK	40	M	*	x	*	x	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	5504	STATE FIELD	98	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07028	STINGER CREEK	4	M	xl	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06014	TUM TUM	688	M	*	*	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05316	VIRGINIA VALLEY	3645	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05564	WHEELER BASIN	618	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05509	WILLIAMS DRIPP SGS	176	M	*	xl	xl	xl	xl
Burns District	Three Rivers Resource Area RMP 1992	PPH	05130	LIME KILN 7 SEC 30	224	M					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05104	SOLIDER CREEK	200	M					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05595	COYOTE CREEK	124	M					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05596	EMMERSON	258	M					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05507	WOLF CREEK	135	M	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	07020	SAND HOLLOW	532	M					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05563	ARNOLD F.F.R.	23	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07046	BAKER HILL FIELD	20	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05573	BEAVER FFR	39	C					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05598	BECKLEY HOME	113	C					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05218	BENNETT F.F.R.	18	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05519	BIG UPSON FIELD	40	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07061	BULGER	63	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05578	C & D FFR	7	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06109	CASEY FFR	63	C	*	na	*	na	*

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Burns District	Three Rivers Resource Area RMP 1992	PGH	05203	CATTERSON F.F.R.	125	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05512	CLARKS RIVER	40	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05323	CLEMENS F.F.R.	78	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06126	CM OTLEY FFR	173	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07054	CRICKET CREEK	40	C					
Burns District	Andrews Management Unit RMP 2005	PGH	06107	CRUMP/CALD FFR	12	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06104	DEFENBAUGH FFR	60	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05543	DEVINE FLAT FIELD	118	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06115	DIXON FFR	22	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	07042	DOLE SMITH	25	C	*	na	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05546	DRUIT FIELD	23	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06111	DUNBAR FFR	68	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	00040	EAST VICKERS FFR	79	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05328	FISHER F.F.R.	46	C	*	*	*	*	x
Burns District	Three Rivers Resource Area RMP 1992	PPH	05548	GRIFFIN	56	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	02249	HAMILTON FFR	20	C	x	*	x	*	x
Burns District	Three Rivers Resource Area RMP 1992	PGH	05317	HATT BUTTE	103	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06108	HENRICKS FFR	30	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	04096	HI DESERT	80	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	07032	HOTCHKISS INDV	26	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05554	J FRANCIS MILLER FFR	15	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05327	JENKINS B.FLAT F.F.R	280	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06128	KONEK FFR	10	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06127	KUENY RANCH FFR	36	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05520	LITTLE UPSON	24	C	*	*	*	*	*

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Burns District	Three Rivers Resource Area RMP 1992	PGH	07052	LONE PINE FIELD	6	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06112	LONG HOLLOW FFR	103	C					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05540	LUCE FIELD	26	C	*	*	*	*	x
Burns District	Andrews Management Unit RMP 2005	PPH	06118	LUPHER FFR	21	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06120	MANN LAKE FFR	22	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05587	MANNING FIELD	10	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05325	Marshall Dia FFR	14	C	*	*	X	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05542	MARSHALL F.F.R.	13	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05567	MILER F.F.R.	16	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05552	MILLER F.F.R. A	20	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05574	MUDDY CREEK FFR	25	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05518	NEWELL FIELD	155	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06116	NORTHRUP FFR	40	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06102	OREGON END FFR	138	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06106	ORLANDO FFR	320	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06133	OTLEY BROS. FFR	24	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05555	OTT F.F.R.	5	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07047	PEABODY	36	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05556	PINE CRK. F.F.R.	180	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06119	POLLOCK FFR	19	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05602	QUIER F.F.R.	5	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05588	REED F.F.R.	18	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05570	RIVER F.F.R.	60	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06125	ROARING SP FFR	374	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06114	ROCK CREEK FFR	148	C	*	na	*	na	*

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Burns District	Three Rivers Resource Area RMP 1992	PPH	07034	SCAT FIELD	96	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06130	SCHARFF FFR	68	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07005	SECOND FLAT FFR	55	C	*	xl	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05590	SMITH F.F.R.	15	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06131	SOUTH POCKET FFR	11	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07029	SPRING CREEK	51	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PPH	06122	STARR FFR	9	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06110	STILL FFR	68	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05206	STOCKADE F.F.R.	63	C	*	x	*	x	x
Burns District	Three Rivers Resource Area RMP 1992	PPH	05545	SUNSHINE FIELD	53	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05559	SWORD'S F.F.R.	32	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05589	TEMPLE'S F.F.R.	28	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05217	THOMPSON F.F.R.	77	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07048	VARIEN CANYON	14	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	05539	W. & C. BLAYLOCK FR	30	C	*	*	*	*	x
Burns District	Andrews Management Unit RMP 2005	PGH	06101	WALDKIRCH FFR	12	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	04138	WHITE	10	C					
Burns District	Three Rivers Resource Area RMP 1992	PGH	07045	WHITING FFR	48	C	*	*	*	*	*
Burns District	Andrews Management Unit RMP 2005	PGH	06103	WILEY FFR	9	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06124	WINDMILL FFR	15	C	*	na	*	na	*
Burns District	Andrews Management Unit RMP 2005	PGH	06105	WRENCH RANCH FFR	51	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PGH	07013	ZOGLMANN	160	C					
Burns District	Andrews Management Unit RMP 2005	PPH	06038	ALVORD PEAK ALLOT.	628	C	*	na	*	na	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	05557	J&G KANE F.F.R.	5	C	*	*	*	*	*
Burns District	Three Rivers Resource Area RMP 1992	PPH	00046	EAST WAGONTIRE FFR	505	C					

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Burns District	Three Rivers Resource Area RMP 1992	PPH	02425	PURDY FFR	15	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05314	BAKER F.F.R	24	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05324	RIDDLE F.F.R	5	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05541	HOME RANCH ENCLOS	100	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05553	MILLER F.F.R.B.	5	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05560	WEST VICKERS FFR	112	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	05561	WILBER F.F.R	125	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	07037	COAL PIT SPRINGS	110	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	07082	HINES FIELD	45	C					
Burns District	Three Rivers Resource Area RMP 1992	PPH	07088	SUNSET VALLEY	16	C					
Burns District	Andrews Management Unit RMP 2005	PPH	02690	TURKEY FFR	25	C					
Burns District	Andrews Management Unit RMP 2005	PPH	06116	NORTHRUP FFR	40	C					
Burns District	Andrews Management Unit RMP 2005	PPH	06117	KASER FFR	5	C					
Burns District	Andrews Management Unit RMP 2005	PPH	06100	HAMMOND FFR	32	C					
Burns District	Andrews Management Unit RMP 2005	PPH	06129	ALVORD FFR	1	C					
Burns District	Three Rivers Resource Area RMP 1992	PGH	05584	POISON CREEK	248	C	*	na	*	na	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00600	BEATY BUTTE	26121	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00514	CORN LAKE	2663	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00509	COX BUTTE	1196	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00517	COYOTE-COLVIN	5091	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	10102	CRACK-IN-THE-	298	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00204	CRUMP INDIVIDUAL	92	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00519	FISH CREEK	575	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00426	FIVE MILE BUTTE	1021	1	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00206	LANE PLAN II	450	1	*	*	*	*	*

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Lakeview	Lakeview Resource Area RMP 2003	PGH	01000	LITTLE JUNIPER SPRINGS	5417	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00520	LYNCH-FLYNN	881	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00710	MURDOCK	403	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00512	NORTH BLUE JOINT	289	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00511	NORTHEAST WARNER	6152	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00705	OATMAN FLAT	2082	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00216	O'KEEFFE INDIVIDUAL	4808	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00510	ORIJANA RIM	1423	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00212	RAHILLY-GRAVELLY	1781	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00435	SHALE ROCK	1220	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00428	SHEEPROCK	3967	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00700	SILVER-BRIDGE CREEK	303	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00711	SOUTH HAYES BUTTE	88	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00201	VINYARD INDIVIDUAL	460	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00523	WARNER LAKES	1114	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00427	XL	4220	I	x	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	01000	LITTLE JUNIPER SPRINGS	5417	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	10103	ZX-CHRISTMAS LAKE	31069	I	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00522	ABERT SEEDING	2619	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	01001	ALKALI WINTER	6223	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00903	BEASLEY LAKE	232	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00712	BRIDGE WELL SEEDING	188	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00213	BURRO SPRING	279	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00909	BUTTON SPRING	1068	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00214	CHUKAR SPRING	52	M	*	*	*	*	*

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Lakeview	Lakeview Resource Area RMP 2003	PGH	00902	CINDER BUTTE	891	M	*	*	x	*	x
Lakeview	Lakeview Resource Area RMP 2003	PGH	00518	CLOVER CREEK	435	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00407	CLOVER FLAT	200	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00400	COGLAN HILLS	117	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00432	COLEMAN SEEDING	920	M	x	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00908	COUGAR MOUNTAIN	616	M	*	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00217	COX INDIVIDUAL	74	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00709	DEAD INDIAN-DUNCAN	425	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	10101	EAST GREEN	980	M	*	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00433	EAST JUG MOUNTAIN	2236	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00530	EAST RABBIT HILLS	1198	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00420	EGLI RIM	1056	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00412	FIR TIMBER BUTTE	58	M	*	x	*	x	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00222	FISHER LAKE	781	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00900	FREMONT	1970	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00205	GREASER DRIFT	356	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00202	HICKEY INDIVIDUAL	519	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00904	HIGHWAY	118	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00215	HILL CAMP	3932	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00910	HOGBACK BUTTE	680	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00905	HOMESTEAD	685	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00515	JUNIPER MOUNTAIN	3621	M	*	xl	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00207	LANE PLAN I	1942	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00431	NARROWS	275	M	*	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00531	NORTH RABBIT HILLS	1317	M	*	*	*	*	*

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Lakeview	Lakeview Resource Area RMP 2003	PGH	00906	NORTH WEBSTER	112	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00422	PAISLEY FLAT	585	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00100	PETER CREEK	329	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00521	PRIDAY RESERVOIR	65	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00516	RABBIT BASIN	1846	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00210	RIM	39	M	*	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00421	ROSEBUD	158	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00211	ROUND MOUNTAIN	1102	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00208	SAGEHEN	266	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00218	SANDY SEEDING	600	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00713	SILVER CREEK	200	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00430	SOUTH POVERTY	4202	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00529	SOUTH RABBIT HILLS	1266	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00915	SQUAW BUTTE	1000	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00418	SQUAW LAKE	834	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00419	ST. PATRICK'S	750	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00707	TUFF BUTTE	536	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00429	TWIN LAKES	2345	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00911	VALLEY	613	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00901	WASTINA	419	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00406	WEST CLOVER FLAT	15	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00914	WEST GREEN	1395	M	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00424	WEST LAKE	600	M	x	*	x	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00404	WILLOW CREEK	565	M	*	x	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00708	ARROW GAP	135	C	*	*	*	*	*

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Lakeview	Lakeview Resource Area RMP 2003	PGH	01002	BAR 75 RANCH FRF	73	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00200	BLUE CREEK	131	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00219	CAHILL FFR	280	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00502	FRF FITZGERALD	324	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00501	FRF FLYNN	121	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00507	FRF LAIRD	120	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00223	HICKEY FFR	64	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00411	JONES CANYON	13	C	*	*	*	x	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00524	LANE INDIVIDUAL	65	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00505	LYNCH	20	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	02647	MURPHY FFR	33	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00203	O'KEEFFE	48	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00403	PINE CREEK	18	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	06125	ROARING SPRINGS FFR	374	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	06114	ROCK CREEK FFR	148	C	*	na	*	na	*
Lakeview	Lakeview Resource Area RMP 2003	PPH	00508	ROCK CREEK RANCH	9	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00209	SHADLER	57	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00716	SILVER LAKE-LAKEBED	250	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00503	TAYLOR	295	C	*	*	*	*	*
Lakeview	Lakeview Resource Area RMP 2003	PGH	00410	TIM LONG CREEK	15	C	*	*	*	x	*
Prineville	Brothers/LaPine RMP 1989	PPH	00043	BARNEY BUCK CREEK	242	I	*	x	*	*	*
Prineville	Brothers/LaPine RMP 1989	PPH	05237	BROTHERS NORTH	1112	I	*	*	*	*	xl
Prineville	Brothers/LaPine RMP 1989	PGH	00025	BUCK CREEK FLAT	271	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00038	CAVE	227	I	*	x	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00009	COLD SPRINGS	4506	I	*	x	*	x	x

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Prineville	Brothers/LaPine RMP 1989	PGH	00044	G.I.	10723	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00003	HAMPTON	7084	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	15234	HAUGHTON	5361	I	x	xl	xl	*	xl
Prineville	Brothers/LaPine RMP 1989	PPH	00019	IBEX BUTTE	910	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00016	INDIAN CREEK	81	I	*	xl	xl	xl	xl
Prineville	Brothers/LaPine RMP 1989	PGH	00020	LOWER 12 MILE TABLE	684	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	15235	MOFFITT	2300	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	05245	RAM LAKE	812	I	*	xl	xl	*	xl
Prineville	Upper Deschutes Resource Area RMP	PGH	05140	SALT CREEK	1346	I	x	x	x	*	x
Prineville	Brothers/LaPine RMP 1989	PGH	00024	UPPER BUCK CREEK	789	I	*	xl	*	*	*
Prineville	Brothers/LaPine RMP 1989	PPH	00027	UPPER POCKET COMM	274	I	*	*	*	*	x
Prineville	Brothers/LaPine RMP 1989	PGH	05231	WEST BUTTE	1949	I	x	x	x	*	x
Prineville	Brothers/LaPine RMP 1989	PGH	00001	ALASKA PACIFIC	199	I					
Prineville	Brothers/LaPine RMP 1989	PPH	00022	LAUGHLIN	452	I					
Prineville	Brothers/LaPine RMP 1989	PPH	00023	ANGELL	141	I					
Prineville	Brothers/LaPine RMP 1989	PGH	00045	EAST MAURY	191	I					
Prineville	Brothers/LaPine RMP 1989	PPH	00047	LISTER	2011	I					
Prineville	Brothers/LaPine RMP 1989	PPH	00050	RABBIT VALLEY	548	I					
Prineville	Brothers/LaPine RMP 1989	PGH	00051	PAULINA CREEK	125	I					
Prineville	Brothers/LaPine RMP 1989	PPH	00060	FLAT TOP BUTTE	80	I					
Prineville	Brothers/LaPine RMP 1989	PGH	00064	CAMP CK COMMUNITY	965	I					
Prineville	Brothers/LaPine RMP 1989	PPH	04103	ROCK PILE	928	I					
Prineville	Brothers/LaPine RMP 1989	PPH	05251	96 RANCH	476	I					
Prineville	Brothers/LaPine RMP 1989	PGH	15233	SCOTT	536	I					
Prineville	Brothers/LaPine RMP 1989	PGH	05208	BARLOW CAVE	600	I					

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Prineville	Upper Deschutes Resource Area RMP	PGH	05212	MILLICAN	2887	I					
Prineville	Upper Deschutes Resource Area RMP	PGH	15210	HORSE RIDGE	1624	I					
Prineville	Brothers/LaPine RMP 1989	PGH	15238	ZX	7100	I	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PPH	00054	BEAVER CREEK	82	M	*	na	xl	na	xl
Prineville	Brothers/LaPine RMP 1989	PPH	00033	CONGLETON	197	M	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00056	DAGUS LAKE	487	M	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00059	DRY LAKE	33	M	*	*	*	*	*
Prineville	Upper Deschutes Resource Area RMP	PGH	15228	DUNHAM SOUTH	163	M	xl	xl	xl	na	xl
Prineville	Brothers/LaPine RMP 1989	PPH	05239	GRASSY BUTTE	6036	M	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PPH	00026	HUMPHREY	635	M	*	xl	xl	xl	xl
Prineville	Brothers/LaPine RMP 1989	PPH	00034	LOWER POCKET COMM	160	M	*	*	*	*	xl
Prineville	Brothers/LaPine RMP 1989	PPH	00039	PAULINA	57	M	xl	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PPH	00004	MINERS FLAT	291	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00013	SHEEP MTH COMM	383	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00021	MIDDLE FK 12 MILE	193	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00041	LAYTON	65	M					
Prineville	Brothers/LaPine RMP 1989	PGH	00053	NORTH FORK	738	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00058	COYOTE SPRINGS	404	M					
Prineville	Brothers/LaPine RMP 1989	PGH	00062	BENNETT FIELD	68	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00071	COFFEE BUTTE	468	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05020	RIVERSIDE NORTH	38	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05130	PILOT BUTTE	168	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05131	MCCLELLAN	109	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05149	BEOLETTO	55	M					
Prineville	Brothers/LaPine RMP 1989	PPH	05240	FEHRENBACHER	984	M					

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Prineville	Brothers/LaPine RMP 1989	PPH	05243	BRIGHT	643	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05247	LIZARD CREEK	280	M					
Prineville	Brothers/LaPine RMP 1989	PPH	00006	POST	118	M					
Prineville	Brothers/LaPine RMP 1989	PGH	05211	PINE MTN.	320	M	*	*	*	*	x
Prineville	Brothers/LaPine RMP 1989	PPH	02539	BIGGS	14	C					
Prineville	Brothers/LaPine RMP 1989	PPH	00073	BIRDSONG BUTTE	15	C	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00017	BONNIEVIEW	28	C	xl	xl	xl	xl	xl
Prineville	Brothers/LaPine RMP 1989	PGH	00066	BUTLER	13	C	xl	na	xl	na	xl
Prineville	Brothers/LaPine RMP 1989	PPH	00028	FERRIAN	15	C	xl	na	xl	na	xl
Prineville	Brothers/LaPine RMP 1989	PGH	00037	FOSTER ALLOT	7	C					
Prineville	Brothers/LaPine RMP 1989	PPH	00052	MILLER	22	C	*	*	*	*	*
Prineville	Brothers/LaPine RMP 1989	PGH	00049	MCCULLOUGH	10	C	*	xl	*	xl	xl
Prineville	Brothers/LaPine RMP 1989	PGH	05248	POTHOOK	122	C					
Prineville	Brothers/LaPine RMP 1989	PPH	00029	JIMMY CCCUEN	47	C					
Prineville	Brothers/LaPine RMP 1989	PPH	00036	DELORE	12	C					
Prineville	Brothers/LaPine RMP 1989	PGH	11037	NEWSOME ALLOT	8	C					
Prineville	Brothers/LaPine RMP 1989	PPH	05249	MCCORMACK HOME	68	C					
Prineville	Brothers/LaPine RMP 1989	PPH	00012	WINDMILL	140	C	xl	xl	xl	na	xl
Vale District	Baker RMP 1989	PGH	15201	BRANNON GULCH	195	I					
Vale District	Baker RMP 1989	PGH	01318	MORMON BASIN	857	I	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	03026	SODA CREEK	988	I	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	11301	SOUTH BRIDGEPORT	928	I	*	xl	*	xl	x
Vale District	Baker RMP 1989	PPH	03014	TIMBER CANYON	526	I	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	01206	WHITEHORSE BUTTE	10978	I	xl	x	xl	x	xl
Vale District	Southeast Oregon Resource Management	PPH	00148	BROGAN CANYON	360	I					

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Vale District	Southeast Oregon Resource Management	PPH	00161	AGENCY MOUNTAIN	1400	I	*	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	00162	CALF CREEK	2372	I	x	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	00301	HARPER	5375	I					
Vale District	Southeast Oregon Resource Management	PPH	00304	BLACK BUTTE	5780	I					
Vale District	Southeast Oregon Resource Management	PGH	00306	JONESBORO	2661	I					
Vale District	Southeast Oregon Resource Management	PPH	00309	SOUTH STAR MTN	5394	I					
Vale District	Baker RMP 1989	PGH	01006	HUNTINGTON	1980	I					
Vale District	Baker RMP 1989	(PGH)	01007	SCHOOL SECTION	63	I					
Vale District	Baker RMP 1989	PGH	01009	SLAUGHTERHOS MTN	110	I					
Vale District	Baker RMP 1989	PGH	01013	BENSON CREEK	858	I					
Vale District	Baker RMP 1989	(PPH)	01016	TABLE MTN	1999	I					
Vale District	Baker RMP 1989	PGH	01017	BURNED	343	I					
Vale District	Southeast Oregon Resource Management	PGH	01019	MARSHALL CREEK	23	I					
Vale District	Baker RMP 1989	PGH	01020	DIXIE CREEK	343	I					
Vale District	Baker RMP 1989	PGH	01021	PEDRO MOUNTAIN	552	I					
Vale District	Baker RMP 1989	PGH	01023	RATTLESNAKE GULCH	92	I					
Vale District	Baker RMP 1989	PGH	01026	NORTH DIXIE CREEK	193	I					
Vale District	Baker RMP 1989	PGH	01037	RYE VALLEY	263	I					
Vale District	Baker RMP 1989	PGH	01048	NODINE CREEK	684	I					
Vale District	Baker RMP 1989	PGH	01053	SPRING GULCH	7	I					
Vale District	Baker RMP 1989	PGH	01064	GOLD CREEK	41	I					
Vale District	Baker RMP 1989	PGH	01068	MORGAN MOUNTAIN	846	I					
Vale District	Baker RMP 1989	PGH	01069	SISLEY CREEK	832	I					
Vale District	Baker RMP 1989	PGH	01070	WELLS BASIN	428	I					
Vale District	Baker RMP 1989	PGH	01072	SUMMIT SPRING	358	I					

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Vale District	Southeast Oregon Resource Management	PPH	01201	15-MILE COMM	25585	I					
Vale District	Southeast Oregon Resource Management	PPH	01202	MCCORMICK	6228	I					
Vale District	Southeast Oregon Resource Management	PPH	01203	ZIMMERMAN	7342	I					
Vale District	Baker RMP 1989	PGH	02020	CREWS CREEK	420	I					
Vale District	Baker RMP 1989	PGH	02024	TABLE ROCK	286	I					
Vale District	Baker RMP 1989	PGH	02037	BALM CREEK	334	I					
Vale District	Baker RMP 1989	PGH	02048	UPPER CLOVER CREEK	116	I					
Vale District	Baker RMP 1989	PGH	02055	CLOVER CREEK	105	I					
Vale District	Baker RMP 1989	PGH	02084	POWDER RIVER CYN	102	I					
Vale District	Baker RMP 1989	PGH	02099	VIRTUE HILLS	450	I					
Vale District	Baker RMP 1989	PGH	02109	RUCKLES CREEK	900	I					
Vale District	Baker RMP 1989	PGH	02115	TUCKER CREEK	260	I					
Vale District	Baker RMP 1989	PGH	03012	SQUAW CREEK	302	I					
Vale District	Baker RMP 1989	PGH	03029	DRY GULCH	184	I					
Vale District	Southeast Oregon Resource Management	PPH	10140	COTTONWOOD CREEK	38	I	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PPH	10201	ALLOTMENT N0. 2	7480	I	x	xl	x	x	x
Vale District	Southeast Oregon Resource Management	PPH	10202	ALLOTMENT N0. 3	13480	I	xl	xl	x	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	10205	RAIL CANYON	11781	I	*	xl	x	*	x
Vale District	Southeast Oregon Resource Management	PPH	10211	CASTLE ROCK	4816	I	xl	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	10214	RICHIE FLAT	3168	I	*	x	x	*	x
Vale District	Southeast Oregon Resource Management	PPH	10217	BEULAH RESERVOIR	1982	I	xl	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	10218	BUCKBRUSH	2797	I	xl	x	x	x	x
Vale District	Southeast Oregon Resource Management	PPH	10222	WILLOW BASIN	7006	I	x	xl	x	x	xl
Vale District	Southeast Oregon Resource Management	PPH	10223	LAVA RIDGE	1722	I	xl	x	x	xl	xl
Vale District	Southeast Oregon Resource Management	PPH	10302	RED HILLS	4410	I					

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Vale District	Southeast Oregon Resource Management	PPH	10401	KENNEY CREEK	7180	I					
Vale District	Southeast Oregon Resource Management	PPH	10503	THREE FINGERS	9981	I					
Vale District	Southeast Oregon Resource Management	PPH	10504	SPRING MOUNTAIN	6177	I					
Vale District	Southeast Oregon Resource Management	PPH	10505	MCCAIN SPRINGS	1948	I					
Vale District	Southeast Oregon Resource Management	PPH	10506	BIRCH CREEK	1099	I					
Vale District	Southeast Oregon Resource Management	PPH	10507	BOARD CORRAL	4185	I					
Vale District	Southeast Oregon Resource Management	PPH	10508	ROCKVILLE	2688	I					
Vale District	Southeast Oregon Resource Management	PPH	10509	MAHOGANY MTN	5666	I					
Vale District	Southeast Oregon Resource Management	PPH	10512	TUNNEL CANYON	1380	I					
Vale District	Baker RMP 1989	PGH	11001	SNAKE RIVER	661	I					
Vale District	Baker RMP 1989	PGH	11002	IRON MOUNTAIN	867	I					
Vale District	Southeast Oregon Resource Management	PPH	11003	WROTEN	492	I					
Vale District	Southeast Oregon Resource Management	PPH	11004	WILLOW CREEK	10044	I					
Vale District	Southeast Oregon Resource Management	PPH	11008	WHITEHORSE	4478	I					
Vale District	Southeast Oregon Resource Management	PPH	15215	DENNY FLAT	376	I					
Vale District	Southeast Oregon Resource Management	PPH	21002	ANTELOPE	10099	I					
Vale District	Southeast Oregon Resource Management	PGH	20101	ALKALI SPRINGS	5750	I					
Vale District	Southeast Oregon Resource Management	PGH	20102	COTTON WOOD MTN	7342	I					
Vale District	Southeast Oregon Resource Management	PGH	20105	WILLOW CR LIVESTOCK	229	I					
Vale District	Southeast Oregon Resource Management	PGH	00513	GORDON GULCH	161	I					
Vale District	Southeast Oregon Resource Management	PGH	00030	SKULL CREEK	320	M					
Vale District	Southeast Oregon Resource Management	PPH	00131	BALDY MOUNTAIN	520	M					
Vale District	Southeast Oregon Resource Management	PPH	00132	BULLY CREEK	980	M					
Vale District	Southeast Oregon Resource Management	PGH	00139	PHIPPS CREEK(N)	734	M					
Vale District	Southeast Oregon Resource Management	PGH	00303	TURNBULL	6854	M					

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Vale District	Southeast Oregon Resource Management	PGH	00305	BRIDGE CREEK	1178	M					
Vale District	Southeast Oregon Resource Management	PGH	00307	BONEY BASIN	2662	M					
Vale District	Southeast Oregon Resource Management	PGH	00308	BUTTE	2056	M					
Vale District	Southeast Oregon Resource Management	PGH	00310	NORTH STAR MTN	9030	M					
Vale District	Southeast Oregon Resource Management	PGH	00405	WALLROCK	6656	M					
Vale District	Baker RMP 1989	PGH	01014	FREEWAY	122	M					
Vale District	Baker RMP 1989	PGH	01015	EAST TABLE MTN	279	M					
Vale District	Baker RMP 1989	PGH	01018	UPPER DURBIN CREEK	197	M					
Vale District	Baker RMP 1989	PGH	01022	BOWMAN FLAT	65	M					
Vale District	Baker RMP 1989	PGH	01038	BEAVER CREEK	47	M					
Vale District	Baker RMP 1989	PGH	01039	TURNER GULCH	485	M					
Vale District	Baker RMP 1989	PGH	01040	LITTLE VALLEY	695	M					
Vale District	Baker RMP 1989	PGH	01041	CINDER BUTTE	243	M					
Vale District	Baker RMP 1989	PGH	01044	JUNIPER MTN	316	M					
Vale District	Baker RMP 1989	PGH	01046	DURKEE TIMBER	122	M					
Vale District	Baker RMP 1989	PGH	01050	NORTH SWAYZE CR	24	M					
Vale District	Baker RMP 1989	PGH	01055	N MANNING CREEK	50	M					
Vale District	Baker RMP 1989	PGH	01056	HORSESHOE	7	M					
Vale District	Baker RMP 1989	PGH	01066	FAREWELL BEND	162	M					
Vale District	Southeast Oregon Resource Management	PGH	01101	JACKIES BUTTE SUMM	2661	M					
Vale District	Southeast Oregon Resource Management	PGH	01304	ALBISU-ALCORTA	1136	M	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	01307	LOUSE CYN COMM	12764	M	*	xl	x	x	xl
Vale District	Southeast Oregon Resource Management	PGH	01401	ANDERSON	2964	M	*	na	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	01402	STAR VALLEY COMM	6600	M	*	xl	*	xl	xl
Vale District	Baker RMP 1989	PGH	02004	FIVE MILE	150	M					

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Vale District	Baker RMP 1989	PGH	02005	SECOND CREEK	450	M					
Vale District	Baker RMP 1989	PGH	02012	BIG CREEK	282	M					
Vale District	Baker RMP 1989	PGH	02015	MAGPIE PEAK	448	M					
Vale District	Baker RMP 1989	PGH	02019	SALT CREEK	343	M					
Vale District	Baker RMP 1989	PGH	02021	SEEDING	150	M					
Vale District	Baker RMP 1989	PGH	02023	UPPER PITTSBURG	36	M					
Vale District	Baker RMP 1989	PGH	02025	UPPER SPRING CREEK	80	M					
Vale District	Baker RMP 1989	PGH	02027	WEST BALM CREEK	25	M					
Vale District	Baker RMP 1989	PGH	02030	LOWER POWDER	78	M					
Vale District	Baker RMP 1989	PGH	02031	BULLDOZER	1332	M					
Vale District	Baker RMP 1989	PGH	02032	GOOSE CREEK	268	M					
Vale District	Baker RMP 1989	PGH	02034	LOVE CREEK	180	M					
Vale District	Baker RMP 1989	PGH	02035	WATERSPOUT	374	M					
Vale District	Baker RMP 1989	PGH	02036	TABLE MTN NORTH	52	M					
Vale District	Baker RMP 1989	PGH	02040	SPRING CREEK	94	M					
Vale District	Baker RMP 1989	PGH	02041	LOWER SAWMILL	41	M					
Vale District	Baker RMP 1989	PGH	02042	L.HOUGHTON CREEK	117	M					
Vale District	Baker RMP 1989	PGH	02049	LOWER SPRING CREEK	78	M					
Vale District	Baker RMP 1989	PGH	02050	UPPER RITTEER CREEK	525	M					
Vale District	Baker RMP 1989	PGH	02070	SUMMIT PASTURE	165	M					
Vale District	Baker RMP 1989	PGH	02071	MCCAIN SPRINGS	450	M					
Vale District	Baker RMP 1989	PGH	02074	PRICHARD CREEK	1665	M					
Vale District	Baker RMP 1989	PGH	02077	RITTER CREEK	154	M					
Vale District	Baker RMP 1989	PGH	02078	NORTH FLAGSTAFF	175	M					
Vale District	Baker RMP 1989	PGH	02081	UP HOUGHTON CREEK	87	M					

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Vale District	Baker RMP 1989	PGH	02085	WEST CLOVER CREEK	95	M					
Vale District	Baker RMP 1989	PGH	02105	LOVE PASTURE	400	M					
Vale District	Baker RMP 1989	PGH	02108	KEATING PASTURE	600	M					
Vale District	Baker RMP 1989	PGH	02112	MAIDEN GULCH	99	M					
Vale District	Baker RMP 1989	PGH	02116	EAST BALM CREEK	158	M					
Vale District	Baker RMP 1989	PGH	02121	EAST PLEAS VALLEY	88	M					
Vale District	Baker RMP 1989	PGH	02127	KELLY CREEK	264	M					
Vale District	Baker RMP 1989	PGH	02128	RISLEY BUTTE	380	M					
Vale District	Baker RMP 1989	PGH	15209	CAMP CREEK	140	M	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	02129	CHALK BUTTE	90	M					
Vale District	Southeast Oregon Resource Management	PGH	10203	ALLOTMENT N0. 4	5502	M					
Vale District	Southeast Oregon Resource Management	PGH	10206	DEARMOND-MURPHY	6503	M	x	xl	xl	x	xl
Vale District	Southeast Oregon Resource Management	PGH	10215	BRIAN CREEK	1092	M	xl	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PGH	10216	WHITLEY CANYON	2436	M	xl	xl	xl	xl	xl
Vale District	Southeast Oregon Resource Management	PGH	10403	NYSSA	5882	M					
Vale District	Southeast Oregon Resource Management	PGH	10404	SOURDOUGH	6538	M					
Vale District	Southeast Oregon Resource Management	PGH	10406	QUARTZ MOUNTAIN	7472	M					
Vale District	Southeast Oregon Resource Management	PGH	10407	LITTLE VALLEY	1373	M					
Vale District	Southeast Oregon Resource Management	PGH	10410	RADAR HILL	686	M					
Vale District	Southeast Oregon Resource Management	PGH	10411	DRY CREEK	5052	M					
Vale District	Southeast Oregon Resource Management	PGH	10501	BLACKJACK	1050	M					
Vale District	Southeast Oregon Resource Management	PGH	10502	LOWER OWYHEE	244	M					
Vale District	Southeast Oregon Resource Management	PGH	10510	SCHNABLE CREEK	1067	M					
Vale District	Southeast Oregon Resource Management	PGH	10702	SHEEPHEAD	3949	M					
Vale District	Southeast Oregon Resource Management	PGH	10801	BARREN VALLEY	200	M	*	*	*	*	*

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Vale District	Southeast Oregon Resource Management	PGH	10803	BOWDEN HILLS	1810	M					
Vale District	Southeast Oregon Resource Management	PGH	10804	COYOTE LAKE	3358	M					
Vale District	Southeast Oregon Resource Management	PGH	10901	LODGE	3150	M					
Vale District	Southeast Oregon Resource Management	PGH	10903	EAST COW CREEK	7179	M					
Vale District	Southeast Oregon Resource Management	PGH	10905	OLIVER	713	M					
Vale District	Southeast Oregon Resource Management	PGH	11005	BIGHORN	841	M					
Vale District	Southeast Oregon Resource Management	PGH	11303	SHERBURN	4000	M					
Vale District	Southeast Oregon Resource Management	PGH	11305	EIGUREN	6000	M					
Vale District	Southeast Oregon Resource Management	PGH	11306	CAMPBELL	35	M	*	xl	x	xl	xl
Vale District	Southeast Oregon Resource Management	PGH	20103	POALL CREEK	589	M					
Vale District	Southeast Oregon Resource Management	PGH	20104	WEST BENCH	193	M	*	*	xl	*	*
Vale District	Southeast Oregon Resource Management	PGH	20603	MCEWEN	6011	M					
Vale District	Southeast Oregon Resource Management	PGH	20805	SADDLE BUTTE	6426	M					
Vale District	Southeast Oregon Resource Management	PGH	20902	WEST COW CREEK	9204	M					
Vale District	Southeast Oregon Resource Management	PGH	21001	AROCK	9868	M					
Vale District	Southeast Oregon Resource Management	PGH	21301	GILBERT	4277	M					
Vale District	Southeast Oregon Resource Management	PGH	21302	ECHAVE	1700	M					
Vale District	Baker RMP 1989	PGH	03015	DALY CREEK	160	M	*	xl	*	*	*
Vale District	Baker RMP 1989	PGH	03003	RUTH GULCH	662	M	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	10155	AMELIA BUTTE	24	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05210	BEAVERDAM CREEK	3	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15203	BIG CREEK	8	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	01326	BRINKER CREEK	5	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15202	BROWN ROCKS	134	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05233	BULLRUN	4	C	*	*	*	*	*

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Vale District	Baker RMP 1989	PGH	03016	BURNSIDE	36	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15208	CAMP DITCH	8	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03027	CANYON CREEK	4	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05227	COPPER CREEK	28	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15214	CORNET CREEK (USFS)	24	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05236	COTTONWOOD CREEK	32	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05226	COW CREEK	12	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	03037	DALY CREEK INDIV	70	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	03019	DEER GULCH	3	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	01329	DEVILS CANYON	60	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	00146	ELDORADO CREEK	36	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15217	ELMS RESERVIOR	12	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15204	HAWRY FLAT	54	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15207	HEREFORD VALLEY	8	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03024	HORSESHOE	10	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05225	JOB CREEK	7	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15218	JUNCTION	112	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03028	KEYSTONE MINE	30	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15211	KING MOUNTAIN	28	C	xl	*	xl	*	*
Vale District	Baker RMP 1989	PGH	05337	KOONTZ CREEK	4	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05342	LOG CREEK	16	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	03033	LOOKOUT MOUNTAIN	12	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03030	LOWER TIMBER CYN	18	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03025	MAIDEN GULCH	32	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	00118	MALHEUR RESERVOIR	75	C	*	*	*	*	*

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Vale District	Baker RMP 1989	PGH	01327	MEYER GULCH	28	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05235	N FK BURNT R (USFS)	40	C	xl	*	xl	*	*
Vale District	Baker RMP 1989	PGH	15205	NORTH HEREFORD	35	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05234	REED CREEK	34	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15219	RIPLEY GULCH	32	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05133	RIVERDALE HILL	13	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15212	ROCK CREEK	10	C	*	*	*	*	*
Vale District	Southeastern Oregon RMP 2002	PPH	00154	SHASTA BUTTE	24	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	03017	SHEEP MOUNTAIN	10	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05238	SHORT CREEK	8	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15322	STACK CREEK	5	C	*	*	*	*	*
Vale District	Southeastern Oregon RMP 2002	PPH	05206	STOCKADE F.F.R.	63	C	*	x	*	x	x
Vale District	Baker RMP 1989	PGH	05228	SUNFLOWER FLAT	16	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	05080	THIEF VALLEY	18	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15325	TOWNE GULCH	32	C	*	*	*	*	*
Vale District	Baker RMP 1989	PPH	03031	UPPER DRY GULCH	45	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	15323	WENDT BUTTE	84	C	*	*	*	*	*
Vale District	Baker RMP 1989	PGH	05220	WHITTED DITCH	8	C	*	*	*	*	*
Vale District	Southeastern Oregon RMP 2002	PPH	06105	WRENCH RANCH FFR	51	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	00108	GOLDEN EAGLE MINE	46	C					
Vale District	Southeast Oregon Resource Management	PGH	00109	BRIDGE CREEK WEST	4	C					
Vale District	Southeast Oregon Resource Management	PGH	00110	RESERVOIR BUTTE	61	C					
Vale District	Southeast Oregon Resource Management	PGH	00111	LYMAN CREEK	7	C					
Vale District	Southeast Oregon Resource Management	PGH	00112	IRONSIDE MTN WEST	124	C					
Vale District	Southeast Oregon Resource Management	PGH	00113	BOSTON HORSE CAMP	83	C	*	*	*	*	*

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Southeast Oregon Resource Management	PGH	00114	IRONSIDE MTN EAST	140	C					
Vale District	Southeast Oregon Resource Management	PGH	00115	COW VALLEY	43	C					
Vale District	Southeast Oregon Resource Management	PGH	00119	LOST VALLEY	210	C					
Vale District	Southeast Oregon Resource Management	PGH	00120	BOSWELL SPRING	30	C					
Vale District	Southeast Oregon Resource Management	PGH	00121	MIDDLE WILLOW CR	45	C					
Vale District	Southeast Oregon Resource Management	PGH	00122	SHEEPCORRAL CREEK	337	C					
Vale District	Southeast Oregon Resource Management	PGH	00124	PHIPPS CREEK WEST	155	C					
Vale District	Southeast Oregon Resource Management	PGH	00127	THORN FLAT	987	C					
Vale District	Southeast Oregon Resource Management	PGH	00129	DRY GULCH	62	C					
Vale District	Southeast Oregon Resource Management	PGH	00130	MALHEUR CITY	289	C					
Vale District	Southeast Oregon Resource Management	PGH	00133	KEVETT	46	C					
Vale District	Southeast Oregon Resource Management	PGH	00134	JUNIPER MOUNTAIN	126	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	00137	PHIPPS CREEK E	35	C					
Vale District	Southeast Oregon Resource Management	PGH	00138	BOULDER CREEK	31	C					
Vale District	Southeast Oregon Resource Management	PGH	00143	ALDER CREEK	198	C					
Vale District	Southeast Oregon Resource Management	PGH	00144	COW CREEK	112	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	00145	BRIDGE CREEK EAST	78	C					
Vale District	Baker RMP 1989	PGH	00146	ELDARADO CREEK	36	C					
Vale District	Southeast Oregon Resource Management	PGH	00151	CANYON CREEK	35	C					
Vale District	Southeast Oregon Resource Management	PGH	00152	CANAL	16	C					
Vale District	Southeast Oregon Resource Management	PGH	00153	SOUTH WILLOW CREEK	85	C					
Vale District	Southeast Oregon Resource Management	PGH	00224	LOCKHART MOUNTAIN	159	C					
Vale District	Southeast Oregon Resource Management	PGH	00225	CHUKAR PARK	46	C					
Vale District	Southeast Oregon Resource Management	PGH	00226	COTTONWOOD CREEK	68	C					
Vale District	Southeast Oregon Resource Management	PGH	00228	SCRATCH POST BUTTE	132	C	*	*	*	*	*

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Southeast Oregon Resource Management	PGH	00229	ROAD GULCH	12	C					
Vale District	Southeast Oregon Resource Management	PGH	00233	SQUAW BUTTE	35	C					
Vale District	Southeast Oregon Resource Management	PGH	00244	POST CREEK	98	C					
Vale District	Southeast Oregon Resource Management	PGH	01008	LIME PLANT	48	C					
Vale District	Southeast Oregon Resource Management	PGH	01010	WEST HIGHWAY	30	C					
Vale District	Southeast Oregon Resource Management	PGH	01012	CAVANAUGH CREEK	16	C					
Vale District	Baker RMP 1989	PGH	01025	BALDY MTN	10	C					
Vale District	Southeast Oregon Resource Management	PGH	01034	CLOUGH GULCH	2	C					
Vale District	Southeast Oregon Resource Management	PGH	01035	UPPER CLOUGH GULCH	35	C					
Vale District	Southeast Oregon Resource Management	PGH	01036	WEATHERBY MTN	28	C					
Vale District	Southeast Oregon Resource Management	PGH	01043	WHISKEY GULCH	27	C					
Vale District	Southeast Oregon Resource Management	PGH	01045	JORDAN CREEK	91	C					
Vale District	Southeast Oregon Resource Management	PGH	01049	LOWER MANNNG CK	40	C					
Vale District	Baker RMP 1989	PGH	01051	ALDER CREEK	13	C					
Vale District	Southeast Oregon Resource Management	PGH	01052	VANDECAR	107	C					
Vale District	Southeast Oregon Resource Management	PGH	01057	HIBBARD CREEK	24	C					
Vale District	Southeast Oregon Resource Management	PGH	01059	IRON GULCH	16	C					
Vale District	Southeast Oregon Resource Management	PGH	01062	POWELL CREEK	39	C					
Vale District	Baker RMP 1989	PGH	01063	BAY HORSE	36	C					
Vale District	Southeast Oregon Resource Management	PGH	01071	HOMESTEAD MDWS	11	C					
Vale District	Southeast Oregon Resource Management	PGH	01102	AMBROSE-MAHER	580	C					
Vale District	Southeast Oregon Resource Management	PGH	01103	JACKIES BUTTE WTR	489	C					
Vale District	Southeast Oregon Resource Management	PGH	01308	TEN MILE	664	C	*	na	x	*	x
Vale District	Southeast Oregon Resource Management	PGH	01309	BLACK HILL	103	C					
Vale District	Baker RMP 1989	PGH	01329	DEVILS CANYON	60	C					

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Baker RMP 1989	PGH	02001	MILLER CREEK	12	C					
Vale District	Baker RMP 1989	PGH	02002	SUNNY SLPOE	51	C					
Vale District	Baker RMP 1989	PGH	02003	POWDER RIVER	35	C					
Vale District	Baker RMP 1989	PGH	02006	CRYSTAL PALACE	19	C					
Vale District	Baker RMP 1989	PGH	02007	SARDINE CREEK	104	C					
Vale District	Baker RMP 1989	PGH	02008	RIVER INDIVIDUAL	66	C					
Vale District	Baker RMP 1989	PGH	02010	BONE GULCH	5	C					
Vale District	Baker RMP 1989	PGH	02011	BEAGLE CREEK	7	C					
Vale District	Baker RMP 1989	PGH	02013	HIGHWAY # 203	1	C					
Vale District	Baker RMP 1989	PGH	02016	EAST TUCKER CREEK	2	C					
Vale District	Baker RMP 1989	PGH	02017	WEST MAGPIE PEAK	123	C					
Vale District	Baker RMP 1989	PGH	02026	EAST SPRING CREEK	12	C					
Vale District	Baker RMP 1989	PGH	02028	SAWMILL CREEK	35	C					
Vale District	Baker RMP 1989	PGH	02033	LOWER SALT CREEK	26	C					
Vale District	Baker RMP 1989	PGH	02038	WEST GOOSE CREEK	4	C					
Vale District	Baker RMP 1989	PGH	02044	NORTH TABLE MTN	2	C					
Vale District	Baker RMP 1989	PGH	02051	GALE PLACE	11	C					
Vale District	Baker RMP 1989	PGH	02060	FARLEY HILLS	45	C					
Vale District	Baker RMP 1989	PGH	02062	MAGPIE CREEK	9	C					
Vale District	Baker RMP 1989	PGH	02063	UPPER CREWS CREEK	16	C					
Vale District	Baker RMP 1989	PGH	02065	TOWN GULCH	2	C					
Vale District	Baker RMP 1989	PGH	02067	RANCH CREEK	36	C					
Vale District	Baker RMP 1989	PGH	02068	ROSEBUD MINE	6	C					
Vale District	Baker RMP 1989	PGH	02069	LONE PIN MTN	45	C					
Vale District	Baker RMP 1989	PGH	02075	UNITY CREEK	88	C					

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Baker RMP 1989	PGH	02076	PRICHARD FLAT	47	C					
Vale District	Baker RMP 1989	PGH	02079	SOUTH FLAGSTAFF	8	C					
Vale District	Baker RMP 1989	PGH	02080	FLAGSTAFF	6	C					
Vale District	Baker RMP 1989	PGH	02083	BIG RATTLESNAKE	16	C					
Vale District	Baker RMP 1989	PGH	02086	WHITE SWAN MINE	65	C					
Vale District	Baker RMP 1989	PGH	02087	FIRST CREEK	66	C					
Vale District	Baker RMP 1989	PGH	02092	CANYON CREEK WEST	8	C					
Vale District	Baker RMP 1989	PGH	02094	NORTH BACHER	33	C					
Vale District	Baker RMP 1989	PGH	02095	HOMESITE	11	C					
Vale District	Baker RMP 1989	PGH	02096	VIRTUE FLAT	40	C					
Vale District	Baker RMP 1989	PGH	02097	DRY CREEK	6	C					
Vale District	Baker RMP 1989	PGH	02100	ENCINA	2	C					
Vale District	Baker RMP 1989	PGH	02101	QUARTZ CREEK	4	C					
Vale District	Baker RMP 1989	PGH	02102	EAST SARDINE CK	19	C					
Vale District	Baker RMP 1989	PGH	02103	LAWRENCE CREEK	9	C					
Vale District	Baker RMP 1989	PGH	02106	CHRISTY SPRINGS	31	C					
Vale District	Baker RMP 1989	PGH	02111	BACHER CREEK	116	C					
Vale District	Baker RMP 1989	PGH	02114	LITTLE LOOKOUT	77	C					
Vale District	Baker RMP 1989	PGH	02118	FRUIT SPRINGS	30	C					
Vale District	Baker RMP 1989	PGH	02120	PLEASANT VALLEY	28	C					
Vale District	Baker RMP 1989	PGH	02130	LYLE CREEK	24	C					
Vale District	Baker RMP 1989	PGH	02132	RUYKENDAHL CREEK	4	C					
Vale District	Baker RMP 1989	PGH	02139	WEST CREWS	13	C					
Vale District	Baker RMP 1989	PGH	02142	NORTH RIDLEY CREEK	4	C					
Vale District	Baker RMP 1989	PGH	06523	TELOCASET ROAD	6	C					

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Baker RMP 1989	PGH	06550	FISK RESERVOIR	7	C					
Vale District	Baker RMP 1989	PGH	06587	RATTLESNAKE HILL	20	C					
Vale District	Baker RMP 1989	PGH	06589	SEVEN DIAMOND	49	C					
Vale District	Baker RMP 1989	PGH	06597	MEDICAL SPRINGS	8	C					
Vale District	Southeast Oregon Resource Management	PGH	06629	PONDOSA	22	C					
Vale District	Southeast Oregon Resource Management	PGH	10106	JAMIESON	5	C					
Vale District	Southeast Oregon Resource Management	PGH	10117	BECKER CREEK	567	C					
Vale District	Southeast Oregon Resource Management	PGH	10141	FERRIERS GULCH	28	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	10142	IRONSIDE SCHOOL	4	C					
Vale District	Southeast Oregon Resource Management	PGH	10155	AMELIA BUTTE	24	C					
Vale District	Southeast Oregon Resource Management	PGH	10208	RING BUTTE	32	C					
Vale District	Southeast Oregon Resource Management	PGH	10210	CLOVER CR INDIV	248	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	10212	BUTTE TREE	69	C					
Vale District	Southeast Oregon Resource Management	PGH	10213	WEST CLOVER CREEK	235	C	*	*	*	*	*
Vale District	Southeast Oregon Resource Management	PGH	10219	MALHEUR RIVER	170	C					
Vale District	Southeast Oregon Resource Management	PGH	10224	BULLY RESERVOIR	72	C					
Vale District	Southeast Oregon Resource Management	PGH	10408	MITCHELL BUTTE	114	C					
Vale District	Southeast Oregon Resource Management	PGH	10806	CROOKED CREEK	144	C					
Vale District	Southeast Oregon Resource Management	PGH	10904	BOGUS CREEK	256	C					
Vale District	Southeast Oregon Resource Management	PGH	10907	MORCOM	220	C					
Vale District	Southeast Oregon Resource Management	PGH	11006	EIGUREN INDIVIDUAL	326	C					
Vale District	Southeast Oregon Resource Management	PGH	11007	ROME INDIVIDUAL	70	C					
Vale District	Southeast Oregon Resource Management	PGH	11009	PARSNIP PEAK	126	C					
Vale District	Southeast Oregon Resource Management	PGH	11010	SKINNER INDIVIDUAL	178	C					
Vale District	Southeast Oregon Resource Management	PGH	11011	ANTELOPE INDIVID	36	C					

District Name	Plan ID	BLM GRSG Habitat	Allotment Number	Allotment Name	Total Allotment AUMs	Allotment Management Category	STD 1: Upland	STD 2: Riparian	STD 3: Ecological	STD 4: Water Quality	STD 5: Native, Threatened and Endangered
Vale District	Southeast Oregon Resource Management	PGH	11012	MILLER INDIVID	117	C					
Vale District	Southeast Oregon Resource Management	PGH	11013	DANNLER INDIVID	33	C					
Vale District	Southeast Oregon Resource Management	PGH	11014	CHERRY CREEK	65	C					
Vale District	Southeast Oregon Resource Management	PGH	11015	LITTLE ANTELOPE	109	C					
Vale District	Baker RMP 1989	PGH	15206	WHIPPLE GULCH	125	C					
Vale District	Southeast Oregon Resource Management	PGH	21003	RATTLESNAKE	374	C					

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Appendix O

Mineral Resources from Summary of Science, Activities, Programs, and Policies That Influence the Rangewide Conservation of Greater Sage-Grouse (*Centrocercus urophasianus*)

APPENDIX O
MINERAL RESOURCES FROM SUMMARY OF SCIENCE, ACTIVITIES, PROGRAMS, AND POLICIES THAT INFLUENCE THE RANGEWIDE CONSERVATION OF GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*)

Table O-1
Acres Open and Closed to Oil and Gas Leasing within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Acres Closed to Oil and Gas Leasing			Acres Open to Oil and Gas Leasing		
		Total	Within PGH	Within PPH	Total	Within PGH	Within PPH
BLM	IV	0	0	0	3,990,600	1,878,400	2,112,200
	V	1,400	400	1,100	6,011,500	3,717,500	2,294,000
	VI	0	0	0	0	0	0
Forest Service	IV	0	0	0	0	0	0
	V	0	0	0	0	0	0
	VI	0	0	0	0	0	0

Table O-1
Acres Open and Closed to Oil and Gas Leasing within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Acres Closed to Oil and Gas Leasing			Acres Open to Oil and Gas Leasing		
		Total	Within PGH	Within PPH	Total	Within PGH	Within PPH
Tribal and Other Federal	IV	0	0	0	0	0	0
	V	0	0	0	0	0	0
	VI	0	0	0	0	0	0
Private	IV	0	0	0	0	0	0
	V	200	0	200	0	0	0
	VI	0	0	0	0	0	0
State	IV	0	0	0	0	0	0
	V	700	700	0	0	0	0
	VI	0	0	0	0	0	0
Other	IV	0	0	0	0	0	0
	V	0	0	0	0	0	0
	VI	0	0	0	0	0	0

Source: Manier et al. 2013
[1]Assumes footprint of 9.4 meters

Table O-2
Acres of Oil and Gas Leases within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres	Acres within PGH	Acres within PPH
BLM	IV	34,700	32,700	2,000
	V	0	0	0
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	900	900	0
	V	0	0	0
	VI	0	0	0
Private	IV	6,900	5,900	1,000
	V	0	0	0
	VI	0	0	0
State	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Table O-3
Acres of Oil and Gas Leases Held by Production within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres of Oil and Gas Leases Held by Production	Acres within PGH	Acres within PPH
BLM	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Private	IV	0	0	0
	V	0	0	0
	VI	0	0	0
State	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Table O-4
Acres of Oil and Gas Wells within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres[1]	Acres within PGH	Acres within PPH
BLM	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Private	IV	0	0	0
	V	0	0	0
	VI	0	0	0
State	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013
[1]Assumes footprint of 62 square meters per well

Table O-5
Acres of Geothermal Resource Potential within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres with Geothermal Resource Potential[1]	Acres within PGH	Acres within PPH
BLM	IV	3,990,600	1,878,400	2,112,200
	V	6,013,000	3,717,900	2,295,100
	VI	0	0	0
Forest Service	IV	32,400	7,900	24,500
	V	143,700	106,600	37,100
	VI	0	0	0
Tribal and Other Federal	IV	60,100	33,200	26,900
	V	313,400	66,000	247,400
	VI	0	0	0
Private	IV	1,230,500	598,100	632,400
	V	1,743,200	1,121,300	621,900
	VI	0	0	0
State	IV	372,900	273,400	99,500
	V	164,000	110,200	53,800
	VI	0	0	0
Other	IV	3,800	3,800	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013
[1]Derived from areas identified by Idaho National Engineering and Environmental Laboratory as favorable for the discovery and shallow depth of thermal water of sufficient temperature for direct-heat applications

Table O-6
Acres of Geothermal Leases within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres	Acres within PGH	Acres within PPH
BLM	IV	4,700	4,700	0
	V	40,600	30,600	10,000
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	100	100	0
	V	0	0	0
	VI	0	0	0
Private	IV	0	0	0
	V	800	500	300
	VI	0	0	0
State	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Table O-7
Acres of Non-Energy Leasable Mineral Permits within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres	Acres within PGH	Acres within PPH
BLM	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Private	IV	0	0	0
	V	0	0	0
	VI	0	0	0
State	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Table O-8
Acres of Locatable Mineral Claims within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres	Acres within PGH	Acres within PPH
BLM	IV	3,900	1,600	2,300
	V	7,100	6,300	800
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Private	IV	1,000	600	400
	V	100	100	0
	VI	0	0	0
State	VI	500	500	0
	V	0	0	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Table O-9
Acres of Mineral Material Disposal Sites within Sage-Grouse Habitat in the Planning Area

Surface Management Agency	Management Zone	Total Acres	Acres within PGH	Acres within PPH
BLM	IV	78,000	4,000	74,000
	V	10,000	8,600	1,400
	VI	0	0	0
Forest Service	IV	0	0	0
	V	0	0	0
	VI	0	0	0
Tribal and Other Federal	IV	0	0	0
	V	100	100	0
	VI	0	0	0
Private	IV	1,900	600	1,300
	V	1,100	800	300
	VI	0	0	0
State	IV	900	800	100
	V	100	100	0
	VI	0	0	0
Other	IV	0	0	0
	V	0	0	0
	VI	0	0	0

Source: Manier et al. 2013

Appendix P

Detailed Employment and Earnings Data

APPENDIX P
DETAILED EMPLOYMENT AND EARNINGS DATA

Tables P-1 through **P-4** provide employment and earnings data used in the socioeconomic analysis of this report.

Table P-1
Employment Levels by Industry Sector and County in 2010[1,2]

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[3]
Farm	920	823	491	738	628	2,119	1,050	1,629
Forestry, fishing, & related activities[4]	(D)	221	217	161	(D)	(D)	(D)	782
Mining (including oil and gas)	(D)	47	58	11	(D)	(D)	(D)	229
Utilities	75	(D)	(D)	(D)	(D)	28	(D)	312
Construction	437	528	200	(D)	186	390	716	6,521
Manufacturing	610	834	(D)	(D)	222	1,056	1,204	4,629
Wholesale trade	119	753	59	58	74	774	247	1,851
Retail trade	1,031	751	389	463	419	2,178	1,817	10,850
Transportation and warehousing	263	(D)	(D)	(D)	(D)	494	(D)	1,375
Information	99	58	54	38	(D)	130	151	1,802
Finance and insurance	268	233	107	140	82	395	478	4,550
Real estate and rental and leasing	356	568	(D)	119	199	369	358	7,343
Professional and technical services	326	295	94	(D)	129	387	466	6,289
Management of companies and enterprises	77	99	0	(D)	(D)	(D)	40	356
Administrative and waste services	242	339	138	126	(D)	(D)	359	5,673
Educational services	59	70	(D)	(D)	(D)	80	117	1,447
Health care and social assistance	1,039	719	(D)	(D)	(D)	1,965	1,967	10,876
Arts, entertainment, and recreation	(D)	156	(D)	(D)	49	109	265	3,111
Accommodation and food services	(D)	526	(D)	(D)	254	1,128	970	8,031
Other services, except public administration	559	526	177	201	188	831	735	5,269
Federal government	301	383	319	304	301	319	328	1,463
State government	203	128	117	98	162	1,141	1,380	1,005
Local government	712	693	632	678	549	1,971	1,071	6,414
Categories for which data were not disclosed	1,025	567	898	1,070	682	1,333	1,001	0
Total employment	**8,721**	**9,317**	**3,950**	**4,205**	**4,124**	**17,197**	**14,720**	**91,807**

Source: U.S. Department of Commerce 2012a. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income & Employment. Available at: http://www.bea.gov/regional/index.htm.

[1] (D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
[2] (L) Fewer than 10 jobs, but the estimates for this item are included in the totals.
[3] Deschutes County, Oregon constitutes a "secondary" Socioeconomic Study Area, as documented in the text.
[4] "Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage.

Table P-2
Employment Percentages by Industry Sector and County in 2010[5,6]

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[7]
Farm	10.5%	8.8%	12.4%	17.6%	15.2%	12.3%	7.1%	1.8%
Forestry, fishing, & related activities[8]	(D)	2.4%	5.5%	3.8%	(D)	(D)	(D)	0.9%
Mining (including oil and gas)	(D)	0.5%	1.5%	0.3%	(D)	(D)	(D)	0.2%
Utilities	0.9%	(D)	(D)	(D)	(D)	0.2%	(D)	0.3%
Construction	5.0%	5.7%	5.1%	(D)	4.5%	2.3%	4.9%	7.1%
Manufacturing	7.0%	9.0%	(D)	(D)	5.4%	6.1%	8.2%	5.0%
Wholesale trade	1.4%	8.1%	1.5%	1.4%	1.8%	4.5%	1.7%	2.0%
Retail trade	11.8%	8.1%	9.8%	11.0%	10.2%	12.7%	12.3%	11.8%
Transportation and warehousing	3.0%	(D)	(D)	(D)	(D)	2.9%	(D)	1.5%
Information	1.1%	0.6%	1.4%	0.9%	(D)	0.8%	1.0%	2.0%
Finance and insurance	3.1%	2.5%	2.7%	3.3%	2.0%	2.3%	3.2%	5.0%
Real estate and rental and leasing	4.1%	6.1%	(D)	2.8%	4.8%	2.1%	2.4%	8.0%
Professional and technical services	3.7%	3.2%	2.4%	(D)	3.1%	2.3%	3.2%	6.9%
Management of companies and enterprises	0.9%	1.1%	0.0%	(D)	(D)	(D)	0.3%	0.4%
Administrative and waste services	2.8%	3.6%	3.5%	3.0%	(D)	(D)	2.4%	6.2%
Educational services	0.7%	0.8%	(D)	(D)	(D)	0.5%	0.8%	1.6%
Health care and social assistance	11.9%	7.7%	(D)	(D)	(D)	11.4%	13.4%	11.8%
Arts, entertainment, and recreation	(D)	1.7%	(D)	(D)	1.2%	0.6%	1.8%	3.4%
Accommodation and food services	(D)	5.6%	(D)	(D)	6.2%	6.6%	6.6%	8.7%
Other services, except public administration	6.4%	5.6%	4.5%	4.8%	4.6%	4.8%	5.0%	5.7%
Federal government	3.5%	4.1%	8.1%	7.2%	7.3%	1.9%	2.2%	1.6%
State government	2.3%	1.4%	3.0%	2.3%	3.9%	6.6%	9.4%	1.1%
Local government	8.2%	7.4%	16.0%	16.1%	13.3%	11.5%	7.3%	7.0%
Categories for which data were not disclosed	11.8%	6.1%	22.7%	25.4%	16.5%	7.8%	6.8%	0.0%

Source: U.S. Department of Commerce 2012a. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income & Employment. Available at: http://www.bea.gov/regional/index.htm.

[5] (D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
[6] (L) Fewer than 10 jobs, but the estimates for this item are included in the totals.
[7] Deschutes County, Oregon constitutes a "secondary" Socioeconomic Study Area, as documented in the text.
[8] "Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage.

Table P-3
Labor Income Levels by Industry Sector and County and Non-Labor Income Levels by County in 2010, presented in 2010 dollars

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[9]
Population	16,089	20,901	7,466	7,409	7,882	31,321	25,758	157,932
Non-labor income ($ millions)[10]	$267	$338	$116	$107	$113	$389	$369	$2,628
Dividends, interest, and rent ($ millions)	$121	$135	$50	$45	$47	$146	$148	$1,398
Personal current transfer receipts ($ millions)[11]	$146	$203	$66	$62	$66	$243	$221	$1,230
Adjustment for residence ($ millions)[12]	$7	$4	$3	$1	-$1	-$115	$6	$11
Contributions for government social insurance ($ millions)[13]	$35	$45	$16	$15	$16	$75	$66	$445
Total personal income by place of residence ($ millions)	$482	$622	$221	$211	$233	$767	$796	$5,757
Earnings by place of work ($ millions)[14]	$243	$325	$117	$119	$137	$569	$487	$3,563
Total earnings by place of work by sector ($ thousands)[15,16]								
Farm	$2,033	-$8,064	-$152	$6,327	$14,527	$38,460	$16,758	-$13,630
Forestry, fishing, & related activities[17]	(D)	$14,021	$5,359	$3,666	(D)	(D)	(D)	$17,949
Mining (including oil and gas)	(D)	$612	(L)	(L)	(D)	(D)	(D)	$5,028
Utilities	$7,336	(D)	(D)	(D)	(D)	$1,610	(D)	$32,869
Construction	$9,926	$20,650	$7,376	(D)	$5,506	$10,830	$24,348	$319,269
Manufacturing	$26,803	$32,752	(D)	(D)	$9,065	$38,608	$60,336	$193,948
Wholesale trade	$3,491	$57,567	$1,724	$1,460	$2,602	$29,620	$10,205	$98,533

[9] Deschutes County, Oregon constitutes a "secondary" Socioeconomic Study Area, as documented in the text.
[10] Non-labor income includes dividends, interest, and rent and personal current transfer receipts.
[11] Personal current transfer receipts are benefits received by persons for which no current services are performed. They are payments by government and business to individuals and institutions, such as retirement and disability insurance benefits.
[12] Residence adjustment represents the net inflow of the earnings of inter-area commuters. A positive number indicates that, on balance, area residents commute outside to find jobs; a negative number indicates that, on balance, people from outside the area commute in to find jobs.
[13] Contributions for government social insurance consist of payments by employers, employees, the self-employed, and other individuals who participate in the following government programs: Old-age, Survivors, and Disability Insurance; Medicare; unemployment insurance; railroad retirement; pension benefit guarantee; veterans' life insurance; publicly-administered workers' compensation; military medical insurance; and temporary disability insurance.
[14] Earnings by place of work differs from total personal income by the exclusion of dividends, interest, and rent, as well as adjustments to account for net transfer payments (e.g., unemployment benefits and Social Security taxes and payments) and the residential adjustment.
[15] (D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
[16] (L) Fewer than $50,000, but the estimates for this item are included in the totals.
[17] "Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage.

Table P-3
Labor Income Levels by Industry Sector and County and Non-Labor Income Levels by County in 2010, presented in 2010 dollars

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[9]
Retail trade	$21,643	$17,560	$8,421	$9,922	$8,768	$59,841	$43,482	$330,064
Transportation and warehousing	$10,924	(D)	(D)	(D)	(D)	$17,353	(D)	$59,510
Information	$3,255	$2,431	$2,125	$1,289	(D)	$3,787	$4,990	$118,435
Finance and insurance	$5,935	$4,428	$3,554	$1,900	$1,670	$12,483	$11,780	$163,553
Real estate and rental and leasing	$4,796	$6,841	(D)	$3,040	$4,242	$5,457	$4,203	$175,200
Professional and technical services	$8,322	$7,253	$1,876	(D)	$4,295	$13,307	$13,699	$296,712
Management of companies and enterprises	$1,344	$4,611	$0	(D)	(D)	(D)	$2,678	$22,311
Administrative and waste services	$3,599	$7,196	$2,376	$1,391	(D)	(D)	$6,931	$155,350
Educational services	$1,026	$1,305	(D)	(D)	(D)	$1,242	$904	$29,039
Health care and social assistance	$34,896	$24,823	(D)	(D)	(D)	$71,192	$75,076	$634,900
Arts, entertainment, and recreation	(D)	$2,063	(D)	(D)	$236	$1,200	$2,149	$52,775
Accommodation and food services	(D)	$9,913	(D)	(D)	$3,220	$19,207	$16,378	$179,668
Other services, except public administration	$14,249	$16,210	$4,528	$4,881	$5,683	$22,640	$17,144	$170,049
Federal government	$23,259	$31,756	$24,420	$23,504	$24,252	$22,647	$24,440	$109,936
State government	$13,384	$7,067	$6,483	$5,675	$9,790	$76,902	$60,038	$55,134
Local government	$31,267	$35,087	$29,788	$31,252	$24,853	$82,453	$45,576	$356,866
Categories for which data were not disclosed	$15,368	$28,859	$19,426	$24,398	$18,324	$40,145	$46,282	$0

Source: U.S. Department of Commerce 2012a. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income & Employment. Available at: http://www.bea.gov/regional/index.htm.

Table P-4
Labor Income Percentages by Industry Sector and County and Non-Labor Income Percentages by County in 2010

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[18]
Population	16,089	20,901	7,466	7,409	7,882	31,321	25,758	157,932
Non-labor income as a proportion of total personal income[19]	55.4%	54.3%	52.6%	50.7%	48.6%	50.7%	46.4%	45.6%
Dividends, interest, and rent as a proportion of total personal income	25.1%	21.6%	22.8%	21.3%	20.2%	19.0%	18.6%	24.3%
Personal current transfer receipts as a proportion of total personal income[20]	30.3%	32.6%	29.8%	29.4%	28.4%	31.7%	27.8%	21.4%
Adjustment for residence as a proportion of total personal income[21]	1.4%	0.7%	1.5%	0.3%	-0.5%	-15.0%	0.7%	0.2%
Contributions for government social insurance as a proportion of total personal income[22]	7.2%	7.2%	7.2%	7.3%	7.0%	9.8%	8.4%	7.7%
Total personal income by place of residence ($ millions)	$482	$622	$221	$211	$233	$767	$796	$5,757
Earnings by place of work ($ millions)[23]	$243	$325	$117	$119	$137	$569	$487	$3,563
Total earnings by place of work by sector[24,25]								
Farm	0.8%	-2.5%	-0.1%	5.3%	10.6%	6.8%	3.4%	-0.4%
Forestry, fishing, & related activities[26]	(D)	4.3%	4.6%	3.1%	(D)	(D)	(D)	0.5%
Mining (including oil and gas)	(D)	0.2%	(L)	(L)	(D)	(D)	(D)	0.1%
Utilities	3.0%	(D)	(D)	(D)	(D)	0.3%	(D)	0.9%

[18] Deschutes County, Oregon constitutes a "secondary" Socioeconomic Study Area, as documented in the text.

[19] Non-labor income includes dividends, interest, and rent and personal current transfer receipts.

[20] Personal current transfer receipts are benefits received by persons for which no current services are performed. They are payments by government and business to individuals and institutions, such as retirement and disability insurance benefits.

[21] Residence adjustment represents the net inflow of the earnings of inter-area commuters. A positive number indicates that, on balance, area residents commute outside to find jobs; a negative number indicates that, on balance, people from outside the area commute in to find jobs.

[22] Contributions for government social insurance consist of payments by employers, employees, the self-employed, and other individuals who participate in the following government programs: Old-age, Survivors, and Disability Insurance; Medicare; unemployment insurance; railroad retirement; pension benefit guarantee; veterans' life insurance; publicly-administered workers' compensation; military medical insurance; and temporary disability insurance.

[23] Earnings by place of work differs from total personal income by the exclusion of dividends, interest, and rent, as well as adjustments to account for net transfer payments (e.g., unemployment benefits and Social Security taxes and payments) and the residential adjustment.

[24] (D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

[25] (L) Fewer than $50,000, but the estimates for this item are included in the totals.

[26] "Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage.

Table P-4
Labor Income Percentages by Industry Sector and County and Non-Labor Income Percentages by County in 2010

	Baker, OR	Crook, OR	Grant, OR	Harney, OR	Lake, OR	Malheur, OR	Union, OR	Deschutes, OR[18]
Construction	4.1%	6.4%	6.3%	(D)	4.0%	1.9%	5.0%	9.0%
Manufacturing	11.0%	10.1%	(D)	(D)	6.6%	6.8%	12.4%	5.4%
Wholesale trade	1.4%	17.7%	1.5%	1.2%	1.9%	5.2%	2.1%	2.8%
Retail trade	8.9%	5.4%	7.2%	8.4%	6.4%	10.5%	8.9%	9.3%
Transportation and warehousing	4.5%	(D)	(D)	(D)	(D)	3.0%	(D)	1.7%
Information	1.3%	0.7%	1.8%	1.1%	(D)	0.7%	1.0%	3.3%
Finance and insurance	2.4%	1.4%	3.0%	1.6%	1.2%	2.2%	2.4%	4.6%
Real estate and rental and leasing	2.0%	2.1%	(D)	2.6%	3.1%	1.0%	0.9%	4.9%
Professional and technical services	3.4%	2.2%	1.6%	(D)	3.1%	2.3%	2.8%	8.3%
Management of companies and enterprises	0.6%	1.4%	0.0%	(D)	(D)	(D)	0.5%	0.6%
Administrative and waste services	1.5%	2.2%	2.0%	1.2%	(D)	(D)	1.4%	4.4%
Educational services	0.4%	0.4%	(D)	(D)	(D)	0.2%	0.2%	0.8%
Health care and social assistance	14.4%	7.6%	(D)	(D)	(D)	12.5%	15.4%	17.8%
Arts, entertainment, and recreation	(D)	0.6%	(D)	(D)	0.2%	0.2%	0.4%	1.5%
Accommodation and food services	(D)	3.1%	(D)	(D)	2.3%	3.4%	3.4%	5.0%
Other services, except public administration	5.9%	5.0%	3.9%	4.1%	4.1%	4.0%	3.5%	4.8%
Federal government	9.6%	9.8%	20.8%	19.8%	17.7%	4.0%	5.0%	3.1%
State government	5.5%	2.2%	5.5%	4.8%	7.1%	13.5%	12.3%	1.5%
Local government	12.9%	10.8%	25.4%	26.3%	18.1%	14.5%	9.4%	10.0%
Categories for which data were not disclosed	6.3%	8.9%	16.6%	20.6%	13.4%	7.1%	9.5%	0.0%

Source: U.S. Department of Commerce 2012a. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income & Employment. Available at: http://www.bea.gov/regional/index.htm.

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Appendix Q

Non-Market Valuation Methods

APPENDIX Q
NON-MARKET VALUATION METHODS

NON-MARKET VALUATION METHODS

This section addresses economic valuation of three categories of non-market resources that are present in the study area and could potentially be affected by the alternatives. These three categories of non-market value are recreation, values of GRSG to households in the intermountain west, and value of the ranching tradition to the ranchers themselves, residents, and visitors to the region. Recreation is included because actions that promote the conservation of GRSG habitat may result in changes in recreation opportunities, such as increasing the amount of habitat for other wildlife species that may be hunted or viewed that depend on public lands, roads open or closed for recreation access, and the quality of the recreation experience.

The economic non-market values described in this appendix are not directly comparable to regional economic indicators commonly used to describe how natural resources on public lands contribute to the regional economic indicators such as output/sales, labor income, and employment. These indicators provide valuable information to the local public as well as to regional government agencies for purposes of public service and infrastructure planning. These impacts or contributions are often referred to as distributional effects as they describe the effects to the region. However, these indicators do not represent net economic value. For example, in economic terms, labor income associated with mineral production would actually be considered a cost to the producer. Similarly, expenditures by a recreation visitor associated with a visit to public lands would be viewed by the recreationist as a cost. One last example would be the total sales generated by the sale of minerals extracted from federally owned minerals: the total sales do not reflect the net economic value since the costs associated with the extraction are not accounted for (including labor income, supplies, and equipment, as well as potentially non-market costs such as those associated with pollution). This section considers the economic value of the non-market outputs, a concept described below.

Total Non-Market Economic Value

Many of the multiple uses in the study area are not bought and sold in competitive markets. For instance, many recreational visitors to public lands pay no or low admission fees, and the presence of wild animals such as GRSG have no "market price," yet both have value to people. In some cases people gain value from using these non-market resources, such as recreation on public lands; in other cases, protection of some natural resources provides both a use value (e.g., wildlife viewing) as well as a non-use value (e.g., the value some people hold for knowing that a specific natural resource exists and is protected even if they never intend to "use" or visit it).

Economists call the sum of these two values Total Economic Value. Use values typically can be consumptive use (e.g., hunting) and/or non-consumptive, such as viewing or being present on site (e.g., camping and hiking). In contrast, non-use values occur off-site to people who derive enjoyment from knowing a natural environment, habitat or species exists in its natural state, either for themselves (existence value) and/or future generations (bequest value). Krutilla (1967) documents the conceptual origins of these two elements of non-use value, and Freeman (2003) provides a rigorous theoretical treatment.

Non-use or existence values can potentially be enjoyed by millions if the good or service (e.g., the presence of a specific wild species such as wild salmon or rare bird species) is of widespread interest. Thus, while the non-use value per household may much lower than a value per day received by a visitor, in total, non-use values may be quite large.

Recreation Values

Economists measure the net economic use and non-use values as "Consumer Surplus." At its most basic level, consumer surplus is the maximum amount a person would pay minus the amount they actually have to pay. Consumer surplus, which is also sometimes referred to as "net willingness to pay," is a measure of benefit has been used by economists and federal agencies for decades (US Water Resources Council 1983; US Environmental Protection Agency 2009, 2010).

For public land recreation, especially on BLM recreation sites, entrance fees are typically very low or non-existent, so the value people place on these public land recreation opportunities is not fully measured simply by the entrance fees they pay. In economic terms, there is not a competitive market or a "market clearing price" for access to public recreation sites. Therefore, there can be a substantial difference between what people pay to visit a recreation site (e.g., entrance fees plus travel costs, including the value of time) and the maximum amount they would pay.

A common non-market valuation method used for recreation is the travel cost method. In this method, economists survey visitors to a recreation site and collect data on their frequency of trips, travel distance and costs incurred to

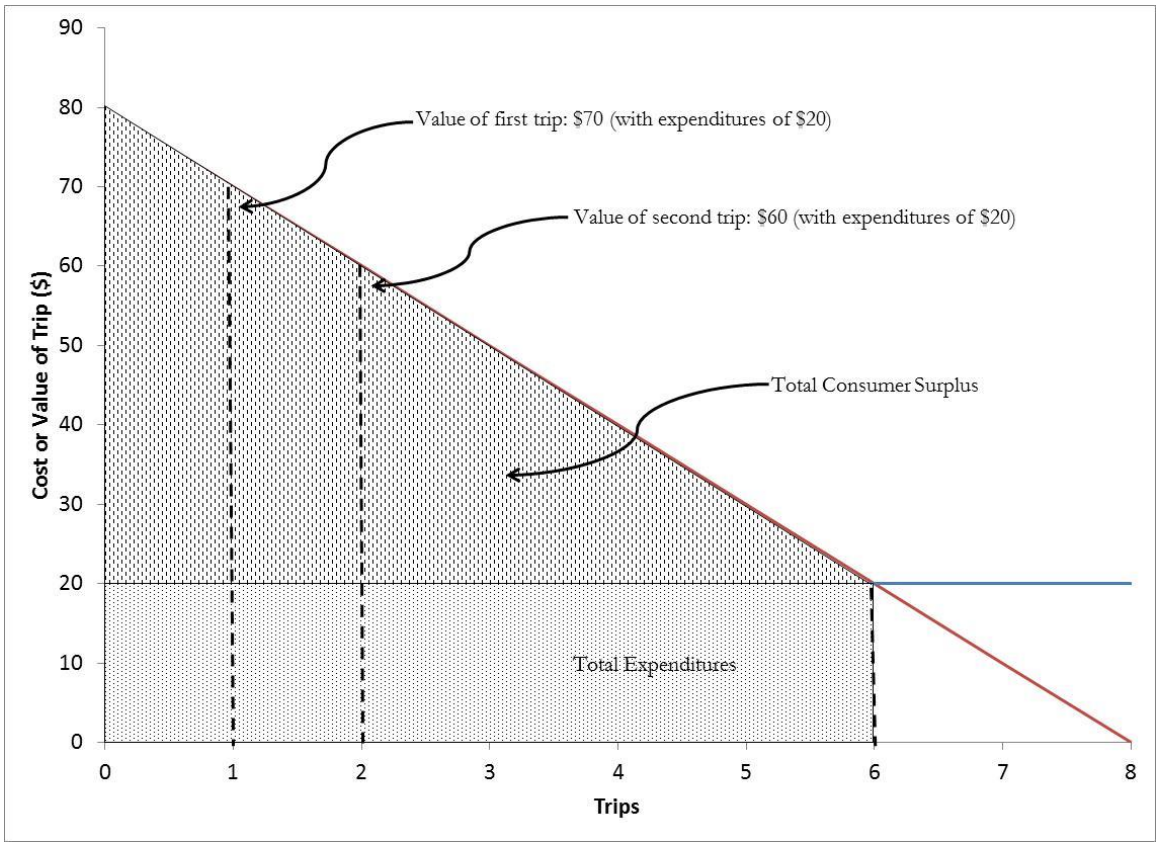
access the site. Because the survey uses information from actual visitors, the travel cost method is a "revealed preference" method of valuation; economists use the travel costs as a proxy to determine the value that people gain from using the site. Variations in the travel cost across visitors, along with their respective number of trips, allow economists to statistically estimate a relationship between travel cost and quantity of trips – an aggregate demand curve for the recreation site, much like a demand curve for goods and services that are sold in competitive markets. This aggregate demand curve will tend to show that individuals with a relatively high travel cost take fewer trips on average, while individuals with a lower cost take more trips on average. From this aggregate demand curve, economists can calculate consumer surplus. Many of the consumer surplus values for recreation in the literature (Loomis 2005) and recently developed by the Forest Service (Bowker et al. 2009) rely upon the travel cost method.

Diagram Q-1 provides an illustration of a demand curve for recreation on a particular site. In Diagram Q-1, the aggregate demand is shown on an average basis, that is, for an average individual consumer. The downward-sloping diagonal line in Diagram Q-1 represents the relationship between the travel cost and quantity of trips demanded by this average consumer. In the diagram, the value of the first several trips is relatively high ($70 for the first and $60 for the second trip), while the value of the sixth trip is lower ($20 in the diagram). In a travel cost method study, these values are statistically derived from the aggregate demand calculated for the entire population. The downward slope of the demand curve corresponds to declining value associated with each trip, which is typical for most goods and services.[1] It also corresponds to the fact that visitors will take fewer trips to areas with a higher travel cost.

Each visitor receives a net benefit from each trip, which is measured by the difference between what they had to pay and the maximum amount they would pay for each trip. In **Diagram Q-1** the net benefit for the average visitor is the difference between their actual expenditures of $20 per trip and the maximum amount they would pay for each trip. As shown, the first trip has a net benefit of $50 ($70 of value less $20 in expenditures), the second trip $40 ($60 less $20), and so on until the sixth trip. At the sixth trip the visitor's cost is the same as their benefit, and hence there is no net benefit from further trips. Thus, this gain to the visitor over and above what they spend is their "consumer surplus."

[1] Note that for some types of recreation use, users may gain increased value over a portion of the number of trips; for example, mountain bikers may experience increased enjoyment of subsequent trips to a single location as their trail-specific skills and knowledge increase with repeat visits. Climbers and other users may also experience similar gains over repeat visits. However, even these users will likely hit a point where the marginal value begins to decrease with more trips.

Diagram Q-1. Consumer Demand Curve and Consumer Surplus for Recreation Trips



Given the large range and diversity of sites in the study area, the BLM did not perform original travel cost method analysis of visitation in the study area. Rather, they relied upon transferring existing recreation values from travel cost method studies such as Bowker et al. (2009) and other recreation values from the existing literature (Loomis 2005; Loomis and Richardson 2007; USFWS 2009) to the recreation activities in the study area, focusing on existing studies in the Pacific Northwest region (Oregon and Washington). This approach, known as "Benefit Transfer," is well-developed in academic and policy literature and has been used by federal agencies including the US Environmental Protection Agency (see Griffiths et al. 2012 for a recent listing of economic studies where benefit transfer was used), US Army Corps of Engineers, US Bureau of Reclamation, Forest Service (Forest Service 1991; also see Ervin et al. 2012 for a recent application of benefit transfer to the Mount Hood National Forest), and other agencies. Benefit transfer is widely used in academic applications as well; see Wilson and Hoehn (2006) for a series of journal articles on benefit transfer.

The BLM measures recreation activity in various units, including a "visitor hour," which represents the presence of one or more persons in an area for continuous or simultaneous periods of time aggregating 1 hour (i.e., one person for 1 hour or two persons for 30 minutes each). A "visitor day" as defined by

BLM represents 12 visitor hours (BLM 2003). The BLM Recreation Management Information System provides data on recreation visitor days (RVDs); to be compatible with these units, BLM identified non-market values for various recreation activities in units of dollars per RVD. Values from economic literature, based on primary research conducted on various recreation sites, were matched to BLM recreation activity classifications. **Table Q-1** provides a listing of the values per day representing Oregon.

Table Q-1
Consumer Surplus for Recreation Activities

Recreation Activity Category	Consumer Surplus per Visitor Day (2012 dollars)
Backpacking	31.41
Camping	67.02
Cross Country Skiing	58.80
Fishing	55.00
Floatboating/Rafting/Canoeing	33.84
General Recreation	46.07
Hiking	52.74
Hunting	90.54
Motorboating	32.74
Mountain Biking	64.36
Off-Road Vehicle Driving/Off-Highway Vehicle	57.51
Other Recreation	46.62
Picnicking	25.83
Pleasure Driving	29.26
Rock Climbing	61.32
Sightseeing	30.71
Snowmobiling	50.33
Swimming	33.17
Waterskiing	69.23
Wildlife Viewing	52.00

Sources: Rosenberger 2012; Loomis 2005; Loomis and Richardson 2007; Bowker et al., 2009; USFWS 2009.

Consistent with the description above of consumer surplus and the travel cost method, readers should interpret the values in **Table Q-1** as the consumer surplus or the amount of value that the average visitor derives from a full day of recreation beyond their actual expenditures. Thus, a typical off-highway vehicle user would pay an average value of $57.51 more than their trip cost to have the opportunity to participate in a typical day of driving off-road vehicles.

Table Q-2 shows the total consumer surplus associated with recreation activities on BLM-administered lands for the Oregon sub-region, including the BLM Resource Areas of Andrews, Baker, Central Oregon, Jordan, Klamath Falls, Lakeview, Malheur, and Three Rivers, as well as the Steens Mountain Cooperative Management and Protection Area (CMPA). RVDs on BLM lands

Table Q-2
Total Consumer Surplus for Recreation in Oregon Sub-Region

Recreation Activity	Average RVDs Per Year	Total Consumer Surplus (millions of 2012 dollars)
Backpacking	39,124	$1.2
Big Game Hunting	114,650	$10.4
Camping	1,012,548	$67.9
Cross Country Skiing	5,934	$0.3
Fishing	260,383	$14.3
Floatboating/Rafting/Canoeing	31,123	$1.1
General Recreation	81,996	$3.8
Hiking	20,564	$1.1
Hunting – Other	36,204	$3.3
Motorboating	7,707	$0.3
Mountain Biking	103,827	$6.7
Off Road Vehicle Driving/ Off-Highway Vehicle	175,326	$10.1
Other Recreation	88,687	$4.1
Picnicking	70,372	$1.8
Pleasure Driving	12,347	$0.4
Rock Climbing	147,039	$9.0
Sightseeing	55,712	$1.7
Small Game Hunting	3,467	$0.3
Snowmobiling	20,430	$1.0
Swimming	6,292	$0.2
Waterfowl Hunting	12,499	$1.1
Wildlife Viewing	80,082	$4.2
Total	**2,730,629**	**$144.2**

Source: BLM 2012; consumer surplus per RVD shown in **Table Q-1**, Consumer Surplus for Recreation Activities.

presented in **Table Q-2** are calculated directly from Report 26 from the BLM RMIS (Report 26 provides RVDs based on recorded visitor hours – defined above – and dividing by twelve). For this analysis, BLM used average RVDs per year over the period 2008 to 2012. Note that conservation measures for GRSG may affect only specific types and fractions of the public lands that contributed to the visitor days used to estimate the surplus values in **Table Q-2**.

To estimate impacts on consumer surplus associated with changes in RVDs, BLM economists worked with BLM recreation specialists to project how RVDs for various activities would change under the alternatives. Because BLM recreation specialists indicated that RVDs would not differ under the alternatives, no differences in consumer surplus are anticipated.

Values Associated with Greater Sage-Grouse Populations

Economists have long recognized that wildlife species, especially rare, threatened, and endangered species, have economic values beyond just viewing. This is supported by a series of legal decisions and technical analyses. The US

Court of Appeals in 1989 first clarified that the US Department of the Interior, in assessing damages in Natural Resource Damage Assessment cases, should include what it termed as "passive use values," that is, existence values provided to non-users of the species, as a compensable value in addition to any use value. These passive use values are also included in Oil Pollution Act damage assessments as well. The term passive values is interchangeable with the term non-use values defined previously. This ruling and subsequent analysis for Natural Resource Damage Assessment and Oil Pollution Act assessments are consistent with well-established economic theory showing that people derive value from passive use or non-use as well as active uses of resources (Krutilla 1967). Economists have devoted a great deal of conceptual and empirical work to refining concepts and developing methods to measure these passive use values.

The dominant methods are "stated preference" methods, of which the most prominent is the Contingent Valuation Method. The basic element of this method is to use a survey to construct or simulate a market or referendum for protection or improvement of a natural environment, habitat, or species, and then having the respondent indicate whether or not they would pay for an increment of protection, and if so, how much they would pay. While the method has developed a great deal of sophistication that has increased the validity of the willingness to pay responses, there is admittedly a degree of bias that can result in stated willingness to pay exceeding actual willingness to pay by a factor averaging two to three (Loomis 2011; Murphy et al. 2005; List and Gallet 2001). While not a perfect estimator of willingness to pay, the Contingent Valuation Method provides a useful means for estimating the public's passive use values.

Numerous academic papers and even entire books have been written on the Contingent Valuation Method. Mitchell and Carson (1989) was one of the first, while Alberini and Kahn (2006) is a more recent treatment. To date there have been about 7,500 Contingent Valuation Method studies in over 130 countries (Carson 2011). A number of federal agencies have used or referenced stated preference methods, including the US Bureau of Reclamation, US Environmental Protection Agency, National Park Service, and state agencies such as the California Department of Fish and Game, Idaho Fish and Game, and Montana Fish, Wildlife, and Parks. The USFWS commissioned an original Contingent Valuation Method study of the economic values the public receives from reintroduction of wolves in the areas of Idaho, Montana, and Wyoming, and used those values in an EIS on wolf reintroduction (USFWS 1994). The US Bureau of Reclamation, National Park Service, and Lower Elwha S'Klallam Tribe commissioned a Contingent Valuation Method study on the value of removal of the Elwha and Glines Canyon Dams (Meyer et al. 1995). The US Bureau of Reclamation also commissioned an original Contingent Valuation Method study on the values of providing stable river flows to benefit riparian vegetation, endangered species, and cultural resources. That study was cited by then-

Secretary of the Interior Bruce Babbitt as a factor in selecting the more protective flow regime from Glen Canyon Dam despite it having more foregone hydroelectricity (Babbitt 1996).

The BLM conducted a literature search to demonstrate the potential range of values that could be associated with species that are candidates for listing as threatened or endangered, such as GRSG populations. Analysts first verified there are no existing studies on Total Economic Value or non-use valuation specific to the GRSG. This is not an uncommon occurrence, as there are dozens of rare or potentially threatened species that have not been valued despite the very high policy relevance of the species and the large magnitude of economic value at stake in these policy decisions.

The BLM used three criteria to identify studies that are most applicable to the current analysis: (1) whether the species valuation study was located in the same geographic region as the GRSG habitat; (2) whether the species was listed or not listed as threatened or endangered; and (3) whether the species was hunted or not (implying a mix of use and non-use values).

The primary database of articles was the recent peer-reviewed journal article by Richardson and Loomis (2009), which is a compilation of the economic values of threatened, endangered, and rare species. A literature review was also conducted to determine if there had been any recent studies on GRSG or closely related species. Unfortunately, there is not a perfect match in the literature in terms of geographic region (intermountain) and a species that is both hunted and rare. **Table Q-3** provides a summary of the studies with features most similar to the GRSG species.

As can be seen in **Table Q-3** there is one study with a geographic region overlapping the sub-region (Mexican spotted owl), and one study on a species that was hunted at the time (wild turkey). At the time of the study, the Mexican spotted owl was a threatened species under the Endangered Species Act, and respondents were told in the survey that it was a threatened species. The whooping crane, red-cockaded woodpecker, and peregrine falcon studies involved an endangered species.

All of these studies used the Contingent Valuation Method in a mail survey. Households were asked whether they would pay a specific dollar amount, with that amount varying across individuals in the sample (i.e., the valuation questions were "closed-ended," although the wild turkey study and red-cockaded woodpecker also used an open-ended valuation question for some respondents). Researchers used the closed-ended valuation questions to generate a statistical valuation function. This valuation function exhibited internal validity: the higher the dollar amount households were asked to pay, the lower the percentage of them that would pay that dollar amount.

Table Q-3
Existing Estimates of Annual Total Economic Value of Protecting Habitat for Species Similar to GRSG

Region	Species	Listed	Hunted	Annual Value per Household[b]	Change Valued
Four Corners (AZ, CO, NM, UT)	Mexican Spotted Owl	Yes	No	$58.49	Avoid extinction in 15 years in Four Corners region
New England	Wild Turkey	No	Yes	$16.72[a]	Avoid extinction in New England
Texas (also L.A., NYC, Chicago, Atlanta)	Whooping Crane	Yes	No	$43.69[a]	Avoid extinction
Maine	Peregrine Falcon	Yes	No	$32.37 (one time)	Restore self-sustaining population
South Carolina & Rest of US	Red-Cockaded Woodpecker	Yes	No	$14.69	Restore habitat to increase chance of survival to 99%

Sources: Loomis and Ekstrand 1997 (Mexican spotted owl); Stevens et al. 1991 (New England wild turkey); Bowker and Stoll 1988 (whooping crane); Kotchen and Reiling 2000 (peregrine falcon); Reaves et al. 1999 (red-cockaded woodpecker). All of these sources are as cited in Richardson and Loomis (2009).
Notes:

a. Average of estimates from the study.
b. As noted in the text, these stated preference values for household may have a degree of hypothetical bias that could overstate the actual monetary amount households would pay by a factor of two to three.

With the exception of the peregrine falcon study, which asked respondents to commit to a one-time payment, each survey asked respondents to pay annually to accomplish the stated goal (typically, preventing the species from going extinct in the region of interest, although this varied by study as the table shows). For the peregrine falcon and red-cockaded woodpecker, households were told that their payment would restore a self-sustaining population (i.e., one that would not go extinct).

The original wild turkey study provided an estimate of three values (in 1990 dollars) that were averaged and then adjusted to 2012 dollars using the Consumer Price Index, resulting in a value of $16.72 per household per year. The same procedure was used to update the 1996 dollar values of the Mexican spotted owl to 2012, resulting in values of $58.49 per household per year. The higher values for the Mexican spotted owl may be due to the large area of habitat (4.6 million acres stated in the survey and shown on a map) that would be protected in the Four Corners area by paying, and the fact the species was not a hunted species. The whooping crane values are fairly large at $43.69 per household per year; this value represents a Total Economic Value, including both use and non-use value, as some of the sample included people who actively "used" the species (as wildlife viewers).

The study values in **Table Q-3** demonstrate that many people, or segments of the public, hold substantial value for protecting threatened and endangered species, which may carry over to the GRSG. Given that protection is a public good available to all households in the intermountain west, the aggregate or intermountain regional value could be substantial.

Values Associated with Grazing Land

Public lands managed for livestock grazing provides both market values (e.g., forage for livestock) and non-market values. Many ranchers themselves value the ranching lifestyle in excess of the income generated by the ranching operations. This is evident in some ranch sales transaction data which suggests some ranch properties have sold for more than the market value of the public land forage (Bartlett et al. 2002; Taylor 2006). One of the primary reasons public lands ranchers indicate they own land is for the "tradition, values and culture" rather than primarily for profit (Tanaka et al. 2005). Many public land ranchers work elsewhere part-time and rely on the ranch for only 20 percent of their income (Hanus 2011), relying instead on outside jobs or other savings to support their ranching lifestyle. Land appreciation has also provided increased value and therefore served as an economic resource for ranchers (Tanaka et al. 2005; Torell et al. 2005). As several of these authors note, changes in public land grazing that reduce the profitability of grazing may not directly translate to withdrawal from ranching, due to the fact that economic factors are not necessarily the primary motivation for public land ranching.

Some studies have found non-market values of ranching associated with use values to residents (Mangun et al. 2005) and tourists in the form of open space and western ranch scenery (Ellingson et al. 2006). However, some others see non-market opportunity costs associated with livestock grazing that may, depending on management methods and other variables, reduce native plant species and forage for wildlife (Todres et al. 2003). The potential exists for other residents or visitors to prefer lifestyles or have lifestyle needs that are not consistent with grazing or ranching lifestyles or landscapes.

Methods available to measure the use values to residents and tourists associated with grazing land include stated preference methods similar to contingent valuation (Ellingson et al. 2006; Mangun et al. 2005). Methods for attempting to isolate any amenity values that ranchers themselves may hold include the hedonic price method. This method uses observed sale prices of ranch land as a function of the characteristics, including both conventional market factors (e.g., size of ranch and quantity of forage) but also amenity values (e.g., scenic views, presence of wildlife species, and on-site fishing or hunting opportunities) that may be provided by the ranch (Torell et al. 2005). The additional value that ranchers pay for the amenity values of the ranch provide some indication of how much they value these amenities. Using the hedonic price method to estimate a "lifestyle value" separate from the market and amenity values has yet to be done in the literature. This may be due to the fact that lifestyle values

attributed to living on a ranch or ranching is present on nearly all ranch properties sold. As such, statistically it is difficult to isolate the contribution of ranching lifestyle to differences in ranch property values as ranching lifestyle is a common feature of nearly all ranch properties sold.

References

Alberini, A., and J. Kahn. 2006. Handbook on Contingent Valuation. Edward Elgar, Northampton, MA.

Babbitt, B. 1996. Record of Decision, Operation of Glen Canyon Dam. Final Environmental Impact Statement. US Department of the Interior, Washington, DC.

Bartlett, T., L. A. Torell, N. Rimbey, L. van Tassell, and D. McCollum. 2002. Valuing Grazing on Public Land. Journal of Range Management 55: 426-438.

BLM (United States Department of the Interior, Bureau of Land Management). 2003. Guidelines to Reporting Recreation Visitation. June 23. US Department of the Interior, Washington, DC.

_____. 2012. Recreation Management Information System. Report 26, Visitor Days and Participants by Office and Activity. US Department of the Interior, Washington, DC.

Bowker, J. M., M. Starbuck, D. English, J. Bergstrom, R. Rosenberger, and D. McCollum. 2009. Estimating the Net Economic Value of National Forest Recreation: An Application of the National Visitor Use Monitoring Data. Faculty Series Working Paper, FS-09-02. Department of Agricultural and Applied Economics, University of Georgia, Athens, GA.

Bowker, J. M., D. B. K. English, and H. K. Cordell. 1999. Projections of Outdoor Recreation Participation to 2050. *In* Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends (ed. H. K. Cordell). Sagamore Publishing.

Bowker, J. M., and J. R. Stoll. 1988. Use of dichotomous choice nonmarket methods to value the whooping crane resource. American Journal of Agricultural Economics 70, 372–381.

Carson, R. 2011. Contingent Valuation: A Comprehensive Bibliography and History. Edward Elgar, Northampton, MA.

Ellingson, L., A. Seidl, and C. J. Mucklow. 2006. Tourists' Value of Routt County's Working Landscape, 2005: Summary Report. EDR 0-07, Economic Development Report, Dept. of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO. Internet Web site: http://dare.colostate.edu/pubs/EDR/EDR06-07.pdf.

Ervin, D., G. Larsen, and C. Shin. 2012. Simple Ecosystem Service Valuation Can Impact National Forest Management, AERE Newsletter 32(1): 17-22. May.

Forest Service (United States Department of Agriculture, Forest Service). 1991. Resource Pricing and Valuation Procedures for the Recommended 1990 RPA Program. US Department of Agriculture, Washington, DC.

Freeman, M. 2003. The Measurement of Environmental and Resource Values. Resources for the Future Press, Washington, DC.

Griffiths, C., H. Klemick, M. Massey, C. Moore, S. Newbold, D. Simpson, P. Walsh, and W. Wheeler. 2012. US Environmental Protection Agency Valuation of Surface Water Quality Improvements. Environmental Economics and Policy 6(1): 130-146.

Hanus, A. 2011. Socio-Economic Profile and Analysis of Seven Oregon Counties Included in the Greater Sage-Grouse Conservation Strategy for Oregon. Association of Oregon Counties.

Kotchen, M., and S. Reiling. 2000. Environmental attitudes, motivations, and contingent valuation of nonuse values: a case study involving endangered species. Ecological Economics 32, 93–107.

Krutilla, J. V. 1967. Conservation Reconsidered. American Economic Review 57: 777-786.

List, J., and C. Gallet. 2001. What experimental protocol influences disparities between actual and hypothetical stated values? Environmental and Resource Economics 20: 241–254.

Loomis, J. 2005. Updated Outdoor Recreation Use Values on National Forests and Other Public Lands. General Technical Report PNW-GTR-658. USDA Forest Service Pacific Northwest Research Station, Portland, OR. Internet Web site: http://www.fs.fed.us/pnw/pubs/pnw_gtr658.pdf.

Loomis, J. 2011. What's to Know about Hypothetical Bias in Stated Preference Valuation Studies. Journal of Economic Surveys 25(2): 363-370.

Loomis, J., and E. Ekstrand. 1997. Economic Benefits of Critical Habitat for the Mexican Spotted Owl: A Scope Test Using a Multiple Bounded Contingent Valuation Survey. Journal of Agricultural and Resource Economics 22(2): 356-366.

Loomis, J., and L. Richardson, 2007. Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats. Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO. Internet Web site: http://dare.colostate.edu/tools/benefittransfer.aspx.

Mangan, N., A. Seidl, C. J. Mucklow, and D. Alpe. 2005. The Value of Ranchland to Routt County Residents 1995-2005. EDR 05-02, Economic Development Report, Dept. of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO. Internet Web site: http://dare.colostate.edu/pubs/EDR/EDR05-02.pdf.

Meyer, P. A., R. Lichtkoppler, R. B. Hamilton, D. A. Harpman, C. L. Borda, and P. M. Engel. 1995. Elwha River Restoration Project: Economic Analysis, Final Technical Report. Developed by the Project Human Effects Team. A Report to the US Bureau of Reclamation, National Park Service, and Lower Elwha S'Klallam Tribe. Davis, CA. Internet Web site: http://digital.library.ucr.edu/cdri/documents/R264_Economic_analysis.pdf.

Mitchell, R., and R. Carson. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington DC.

Murphy, J. J., P. G. Allen, T. H. Stevens, and D. Weatherhead. 2005. A meta-analysis of hypothetical bias in stated preference valuation. Environmental and Resource Economics 30: 313-325.

Reaves, D. W., R. Kramer, and T. Holmes. 1999. Does Question Format Matter? Valuing an Endangered Species. Environmental and Resource Economics 14: 365-383.

Richardson, L., and J. Loomis. 2009. The Total Economic Value of Threatened, Endangered and Rare Species: An Updated Meta- Analysis, Ecological Economics 68: 1535-1548.

Rosenberger, R. 2012. Recreation Use Values Database. Downloaded October 13, 2012. Internet Web site: http://recvaluation.forestry.oregonstate.edu/sites/default/files/ RECREATION_USE_VALUES_DATABASE_%20SUMMARY.pdf.

Rosenberger, R., and J. Loomis. 2000. Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database. Water Resources Research, 36(4): 1097-1107.

Stevens, T., J. Echeverria, R. Glass, T. Hager, and T. Moore. 1991. Measuring the Existence Value of Wildlife. Land Economics 67(4): 390-400.

Tanaka, J., L. A. Torell, and N. Rimbey. 2005. Who Are Public Land Ranchers and Why are They Out There? Western Economic Forum: 14-20. Fall 205.

Taylor, T. 2006. Rural Communities and Public Lands in the West: Impacts and Alternatives. University of Wyoming. USDA Research, Education and Economics Information System.

Todres, T., A. Seidl, D. McLeod, A. Bittner, R. Coupal, and K. Inman. 2003. Preferred Public Land Use and Policy in Moffat County: Final Report of Countywide Opinion Survey. APRPR03-11. Agricultural and Resource Policy Report, Dept. of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO. Internet Web site: http://dare.colostate.edu/pubs/ARPR/ ARPR%2003-11.pdf.

Torrell, L. A., N. Rimbey, O. Ramirez, and D. McCollum. 2005. Income Earning Potential versus Consumptive Amenities in Determining Ranchland Values. Journal of Agricultural and Resource Economics 30(3): 537-560.

US Court of Appeals, DC Circuit. 1989. State of Ohio v. US Department of Interior (880 F.2d. 432).

US Environmental Protection Agency. 2000. Guidelines for Preparing Economic Analyses. EPA 240-R-00-003. Washington, DC.

_____. 2009. Valuing the Protection of Ecological Systems and Services. EPA-SAB-09-012. Washington, DC.

_____. 2010. Guidelines for Preparing Economic Analyses. EPA 240-R-10-001. Washington, DC.

USFWS (United States Fish and Wildlife Service). 1994. Final Environmental Impact Statement: The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho. US Department of Agriculture, Washington, DC.

_____. 2009. Net Economic Values of Wildlife-Related Recreation in 2006. Report 2006-5. US Department of Agriculture, Washington, DC.

US Census Bureau. 2011. Population Estimates, Intercensal Estimates of the Resident Population for Counties: April 1, 2000 to July 1, 2010. Internet Web site: http://www.census.gov/popest/data/intercensal/county/CO-EST00INT-01.html.

US Department of Commerce. 2012. Bureau of Economic Analysis, Regional Economic Information System, Local Area Personal Income and Employment. Internet Web site: http://www.bea.gov/regional/index.htm.

US Water Resources Council. 1983. Principles and Guidelines for Water and Related Land Resource Implementation Studies. Washington, DC.

Wilson, M., and J. Hoehn. 2006. Valuing Environmental Goods and Services Using Benefit Transfer: The State-of-the-art and Science. Ecological Economics. Special Issue Volume 60.

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Appendix R

Economic Impact Analysis Methodology

APPENDIX R
ECONOMIC IMPACT ANALYSIS METHODOLOGY

INTRODUCTION

This appendix describes the methods and data that underlie the economic impact modeling analysis. Input-output models such as the Impact Analysis for Planning (IMPLAN) model, an economic impact analysis model, provide a quantitative representation of the production relationships between individual economic sectors. Thus, the economic modeling analysis uses information about physical production quantities and the prices and costs for goods and services. The inputs required to run the IMPLAN model are described in the following narrative and tables. The resulting estimates from the IMPLAN model, by alternative, are in Chapter 4, Environmental Consequences, Section 4.19, Social and Economic Impacts (Including Environmental Justice). The first portion of the following information describes general aspects of the IMPLAN model and how it was used to estimate economic impacts. The following section provides additional detailed data used in the analysis for livestock grazing and wind energy development.

THE IMPLAN MODEL

IMPLAN is a regional economic model that provides a mathematical accounting of the flow of money, goods, and services through a region's economy. The model provides estimates of how a specific economic activity translates into jobs and income for the region. It includes the ripple effect (also called the multiplier effect) of changes in economic sectors that may not be directly impacted by management actions, but are linked to industries that are directly impacted. In IMPLAN, these ripple effects are termed indirect impacts (for changes in industries that sell inputs to the industries that are directly impacted) and induced impacts (for changes in household spending as household income increases or decreases due to the changes in production).

This analysis used IMPLAN 2011; prior to running the model, cost and price data were converted to a consistent dollar year (2011) using sector-specific

adjustment factors from the IMPLAN model. However, the values in this appendix are expressed in year 2010 dollars for comparison with baseline data.

The current IMPLAN model has 440 economic sectors, of which 198 are represented in the Socioeconomic Study Area counties. This analysis involved direct changes in economic activity for 32 IMPLAN economic sectors, as well as changes in all other related sectors due to the ripple effect. The IMPLAN production coefficients were modified to reflect the interaction of producing sectors in the primary and secondary Socioeconomic Study Areas. As a result, the calibrated model does a better job of generating multipliers and the subsequent impacts that reflect the interaction between and among the sectors in the Socioeconomic Study Area compared to a model using unadjusted national coefficients. Key variables used in the IMPLAN model were filled in using data specific to the Socioeconomic Study Area, including employment estimates, labor earnings, and total industry output. In addition, for two of the three types of economic activities analyzed – wind energy development and geothermal energy development – input was used from the National Renewable Energy Laboratory's Jobs and Economic Development Impact (JEDI) models (NREL, 2012). These models collected background data for calibrating renewable energy impact models and, therefore, were useful as inputs.

The trade data available in the current version of IMPLAN (Version 3.0) make it possible to do multi-region analysis to track how an impact on any of the IMPLAN sectors in the Study Area affects production in any of the sectors in any other region of the US. For this analysis, this feature allowed the estimation of how an impact in the primary Study Area disperses into the secondary Study Area, and how these effects in the secondary Study Area create additional local effects in the primary Study Area. As a result, it was possible to estimate not only the jobs and income generation in the primary Study Area, but to also estimate how the economic activity in the primary Study Area affected jobs and income generation in the secondary Study Area.

LIVESTOCK GRAZING

Economic impacts from changes to livestock grazing are a function of the amount of forage available and the economic value of forage.

Forage availability was measured in Animal Unit Months (AUMs), with one AUM defined as the amount of forage needed to feed one cow, one horse, or five sheep for one month. Data on forage availability were obtained from BLM's Rangeland Administration System (BLM 2012). Two types of AUM measures were used: active AUMs and billed AUMs. Active AUMs measure the amount of forage from land available for grazing. Billed AUMs measure the amount of forage for which BLM bills annually (i.e., the amount of forage that ranchers actually use, which is typically less than the amount of forage available). Data for 2011 were used for active AUMs. Billed AUMs may be less than active AUMs for various reasons. BLM may require non-use of a portion of the active AUMs

granted for conservation and protection of habitat or for improvement of rangeland conditions. On the other hand, the permittee may choose to reduce the amount of AUMs after land treatments or fire rehabilitation projects or for business reasons (BLM 2014a; 2014b). Because billed AUMs fluctuate considerably from one year to another, data for 2000 to 2011 were used to develop a 12-year average for billed AUMs. Data capture AUMs for entire allotments when those allotments intersect with GRSG habitat.

Forage availability was estimated for all alternatives (BLM 2015). Alternatives A, B, and E used the current data for active AUMs (obtained as explained above) in PHMA and GHMA. The analysis estimated 771,773 total active AUMs in GRSG habitat in the Socioeconomic Study Area (BLM 2015). As under current management, some acres (152,844) in GRSG would be closed for grazing under Alternatives A, B, and E. Alternative C removed 100 percent of active AUMs in GRSG habitat (PPMA and PGMA). Alternative D discounted the current data to remove all Research Natural Areas (RNAs) with at least 20 percent of PPMA acres and 50 percent of PGMA acres. Closures to these areas would be voluntary or by termination. Alternative F assumed that 25 percent of the acreage in GRSG habitat would be rested each year and not available for grazing. In addition, Alternative F assumed a target utilization of only 25 percent of the non-rested acreage in GRSG habitat. This target utilization would be attempted by setting active AUMs at 50 percent of the non-rested acreage in GRSG habitat. This would result in the targeted 25 percent utilization of the non-rested area, if livestock operators follow NRCS stocking rate guides (that typically result in 50 percent use of the authorized area). Therefore, under Alternative F, active AUMs were set at 0.75 x 0.5 = 37.5 percent of the active AUMs under current management. The analysis estimated that of the 771,773 total active AUMs in GRSG habitat (PHMA and GHMA) in the Socioeconomic Study Area, 77,177 would be in the Andrews Field Office (FO) area, 30,871 in the Baker FO area, 38,589 in the Central Oregon FO area, 7,718 in the Deschutes FO area, 316,426 in the Jordan FO and Malheur FO area, 123,484 in the Lakeview FO area, and 177,508 in the Three Rivers FO area. This information was used to calculate the total active AUMs that would be available for grazing under each alternative in GRSG habitat. The results of these calculations are presented below in **Table R-1**.

Table R-2 shows two scenarios for the number of billed AUMs under each alternative. For the high impact scenario, the analysis assumed that livestock operators would choose to maintain a constant ratio of active to billed AUMs so any reduction to active AUMs would result in a proportional reduction to billed AUMs. The analysis applied the current ratio of active to billed AUMs to the calculated number of reduced active AUMs under each alternative to calculate the corresponding number of reduced billed AUMs under each alternative. In addition, the high impact scenario considered the possibility that the loss of AUMs on public lands could lead to the loss of additional AUMs due

Table R-1
Estimated Active Annual Animal Unit Months for Allotments in GRSG Habitat by Alternative for the Study Area

Field Office	Initial	Alternatives A, B, and E	Alternative C	Alternative D	Alternative F	Proposed Plan
Andrews	77,177	77,177	0	77,137	28,941	77,130
Baker	30,871	30,871	0	30,455	11,577	30,871
Central Oregon	38,589	38,589	0	38,589	14,471	38,589
Deschutes	7,718	7,718	0	7,718	2,894	7,718
Jordan and Malheur	316,426	316,426	0	312,226	118,660	314,876
Lakeview	123,484	123,484	0	120,624	46,306	122,854
Three Rivers	177,508	177,508	0	177,508	66,565	177,347
Socioeconomic Study Area	771,773	771,773	0	764,257	289,414	769,385

Sources: Calculated based on data from BLM 2015

Table R-2
Estimated Billed Annual Animal Unit Months in GRSG Habitat by Alternative (High Scenario Does Not Include Adjustments for Loss of Seasonal Grazing Areas – Torell Adjustments)

Field Office	Initial	Alternatives A, B, E	Alternative C	Alternative D	Alternative F	Proposed Plan
High Impact Scenario						
Andrews	57,883	57,883	0	57,853	21,706	57,848
Baker	27,784	27,784	0	27,410	10,419	27,784
Central Oregon	21,996	21,996	0	21,996	8,248	21,996
Deschutes	4,168	4,168	0	4,168	1,563	4,168
Jordan and Malheur	256,305	256,305	0	252,903	96,115	255,050
Lakeview	85,204	85,204	0	83,231	31,951	84,769
Three Rivers	131,356	131,356	0	131,356	49,258	131,237
Socioeconomic Study Area	584,695	584,695	0	578,915	219,260	582,850
Low Impact Scenario						
Andrews	57,883	57,883	0	57,853	41,000	57,848
Baker	27,784	27,784	0	27,410	13,506	27,784
Central Oregon	21,996	21,996	0	21,996	21,996	21,996
Deschutes	4,168	4,168	0	4,168	4,168	4,168
Jordan and Malheur	256,305	256,305	0	252,903	156,236	255,050
Lakeview	85,204	85,204	0	83,231	70,231	84,769
Three Rivers	131,356	131,356	0	131,356	95,410	131,237
Socioeconomic Study Area	584,695	584,695	0	578,915	402,547	582,850

Sources: Calculated based on data from BLM 2015

to seasonal limitations of grazing areas. This would be the case if livestock operations have no reasonable alternative to seasonal grazing on public lands. Livestock grazing on federal lands is often done during the spring and summer seasons, with other feeding alternatives (hay) being used during fall and winter. If there are no grazing alternatives to federal lands during spring and summer, farmers may need to reduce their operations and the resulting loss of output,

jobs, and earnings would be larger than currently estimated. Torell et al. (2014) provides estimates of the potential impacts to a model ranch in Oregon of seasonal closures of federal lands for cattle grazing. These estimates show the total number of AUMs lost for each AUM lost on BLM lands under various scenarios. These scenarios range from a 25 percent reduction in BLM AUMs to a complete elimination of AUMs on BLM lands with the livestock operation going out of business. The estimates are based on an economic model that assumes farmers respond to the loss of availability of federal lands for grazing in several ways to maximize their profits (gross margins), including reducing the size of their operations. Based on the Torell et al. (2014) estimates, BLM assumed that for each BLM AUM lost under Alternative C, an additional 1.44 AUMs would be lost for a total of 2.44 AUMs lost (mid-point between the scenarios of 100 percent loss of BLM AUMs with and without closure of operations). Under Alternative D and the Proposed Plan, no additional AUMs would be lost, because the loss in BLM AUMs would be less than 1 percent of the total. Under Alternative F, 0.45 additional AUMs would be lost for each reduction of BLM AUMs for a total of 1.45 AUMs (mid-point of scenarios of loss of 50 percent of AUMs on BLM lands and scenario of loss of 75 percent of AUMs on BLM lands). These AUM adjustment factors are based on a model Oregon ranch that relies on a total of approximately 7,500 AUMs, of which 2,400 AUMs (32%) are linked to federal land. These factors were applied only to cattle AUMs, because no similar estimate was available for sheep. In **Tables R-2** and **R-3** these factors are referred to as "Torell Adjustments."

For the low impact scenario, livestock operators would continue to bill AUMs at the observed level as long as there are enough active AUMs to do so. In other words, the stocking rate would increase if necessary to keep billed AUMs constant. If active AUMs were not reduced beyond the initial amount of billed AUMs, livestock operators would continue to bill the same amount of AUMs, resulting in no impact. If active AUMs were reduced beyond the initial amount of billed AUMs, ranchers would use all of the reduced active AUMs. Thus, when the number of reduced active AUMs was less than number of the initial billed AUMs, the analysis used the number of reduced active AUMs as the number of reduced billed AUMs under each alternative. Otherwise, the analysis assumed no change in the number of billed AUMs.

Table R-3 shows the two scenarios for resulting AUM reductions, calculated as the difference between the initial billed AUMs and the reduced billed AUMs under each alternative. AUMs are distinguished between those allocated to sheep and those allocated to cattle and other animals, to allow different valuation of forage, as explained further below[1].

[1] Note that if livestock operators followed the NRCS stocking rate guides and utilization were 50 percent of active AUMs under all alternatives, the impacts of the action alternatives would tend to be reduced, given that utilization under current management would actually be less than observed.

Table R-3
Estimated Reduction in Annual Animal Unit Months by Alternative and Livestock Type (High Scenario Includes Adjustments for Loss of Seasonal Grazing Areas – Torell Adjustments)

Field Office	High Impact Scenario					Low Impact Scenario				
	Alts. A, B, E	Alt. C	Alt. D	Alt. F	Proposed Plan	Alts. A, B, E	Alt. C	Alt. D	Alt. F	Proposed Plan
Total										
Andrews	0	0	-141,212	-30	-52,453	-35	0	-57,884	-30	-16,883
Baker	0	0	-67,509	-374	-25,123	0	0	-27,784	-374	-14,278
Central Oregon	0	0	-53,011	0	-19,805	0	0	-21,996	0	0
Deschutes	0	0	-10,170	0	-3,777	0	0	-4,168	0	0
Jordan and Malheur	0	0	-620,782	-3,402	-231,377	-1,256	0	-256,305	-3,402	-100,070
Lakeview	0	0	-207,896	-1,973	-77,216	-435	0	-85,203	-1,973	-14,973
Three Rivers	0	0	-320,363	0	-119,014	-119	0	-131,357	0	-35,946
Socio-economic Study Area	0	0	-1,420,941	-5,780	-528,765	-1,845	0	-584,696	-5,780	-182,149
Cattle and Other										
Andrews	0	-141,195	-30	-52,442	-35	0	-57,867	-30	-16,878	-35
Baker	0	-67,312	-372	-25,000	0	0	-27,587	-372	-14,176	0
Central Oregon	0	-52,553	0	-19,519	0	0	-21,538	0	0	0
Deschutes	0	-10,170	0	-3,777	0	0	-4,168	0	0	0
Jordan and Malheur	0	-617,586	-3,360	-229,380	-1,243	0	-253,109	-3,360	-98,822	-1,243
Lakeview	0	-207,896	-1,973	-77,216	-435	0	-85,203	-1,973	-14,973	-435
Three Rivers	0	-320,260	0	-118,950	-119	0	-131,254	0	-35,918	-119
Socio-economic Study Area	0	-1,416,971	-5,735	-526,283	-1,832	0	-580,726	-5,735	-180,766	-1,832
Sheep										
Andrews	0	-17	0	-11	0	0	-17	0	-5	0
Baker	0	-197	-3	-123	0	0	-197	-3	-101	0
Central Oregon	0	-458	0	-286	0	0	-458	0	0	0
Deschutes	0	0	0	0	0	0	0	0	0	0
Jordan and Malheur	0	-3,196	-42	-1,998	-13	0	-3,196	-42	-1,248	-13
Lakeview	0	0	0	0	0	0	0	0	0	0
Three Rivers	0	-103	0	-64	0	0	-103	0	-28	0
Socio-economic Study Area	0	-3,971	-45	-2,482	-13	0	-3,971	-45	-1,382	-13

Sources: Calculated based on data from BLM 2012 and BLM 2015

The economic value of forage is estimated based on the value of production associated with the forage. Values for cattle and sheep are estimated separately, with the value of forage for other animals is considered equivalent to the value for cattle. Due to price fluctuations, average per-AUM values for cattle and sheep are based on the 2002 to 2011 average value of production estimates from the (US Department of Agriculture, Economic Research Service 2012). The value for cattle is $50.37 per AUM in the primary Socioeconomic Study

Area, and the value for sheep is $57.20 per AUM in the primary Socioeconomic Study Area (in 2010 dollars). Including indirect and induced impacts, the value of one AUM in the primary Socioeconomic Study Area is $96.18 for cattle and is $119.39 for sheep (in 2010 dollars). **Table R-4** shows the economic impact assumptions for cattle and sheep. The direct economic impact is the estimated change in livestock output per AUM; IMPLAN generates the indirect and induced impacts.

Table R-5 provides a summary of the employment impacts that would result, according to IMPLAN, based on unit changes in livestock AUMs.

Table R-4
Assumptions for Analysis of Impacts on Output for Livestock Grazing

Economic Impact	Cattle	Sheep
Primary Study Area		
Direct Economic Impact ($/AUM)	$50.37	$57.20
Indirect Economic Impact ($/AUM)[1]	$40.67	$54.24
Induced Economic Impact ($/AUM)[2]	$5.14	$7.95
Total Economic Impact ($/AUM)	$96.18	$119.39
Multiplier (Total Impact/Direct Impact)	1.91	2.09
Primary and Secondary Study Area		
Direct Economic Impact ($/AUM)	$50.37	$57.20
Indirect Economic Impact ($/AUM)[1]	$41.76	$55.90
Induced Economic Impact ($/AUM)[2]	$5.69	$8.77
Total Economic Impact ($/AUM)	$97.82	$121.87
Multiplier (Total Impact/Direct Impact)	1.94	2.13

Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the livestock industry.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

Table R-5
Assumptions for Analysis of Employment Impacts for Livestock Grazing

Employment Impact	Cattle	Sheep
Primary Study Area		
Direct Employment (Jobs/1,000 AUMs)	0.000559	0.000980
Indirect Employment (Jobs/1,000 AUMs)	0.000445	0.000957
Induced Employment (Jobs/1,000 AUMs)	0.000051	0.000075
Total Employment (Jobs/1,000 AUMs)	0.001055	0.002013
Multiplier (Total Impact/Direct Impact)	1.89	2.05
Average Earnings per Job (2010 dollars)	$31,791	$17,530
Primary and Secondary Study Area		
Direct Employment (Jobs/1,000 AUMs)	0.000559	0.000980
Indirect Employment (Jobs/1,000 AUMs)	0.000461	0.000980
Induced Employment (Jobs/1,000 AUMs)	0.000056	0.000081
Total Employment (Jobs/1,000 AUMs)	0.001076	0.002042

Table R-5
Assumptions for Analysis of Employment Impacts for Livestock Grazing

Employment Impact	Cattle	Sheep
Multiplier (Total Impact/Direct Impact)	1.93	2.08
Average Earnings per Job (2010 dollars)	$31,767	$17,730

Note: Direct, indirect, and induced employment impacts and average earnings per job are calculated using IMPLAN.

Output, labor, and earning impacts summarized in **Table 4-50** in the economic impact section of the EIS are presented as lower and upper bound impacts. Estimates of lower bound impacts are equal to the 'low impact scenario' reductions in AUMs in **Table R-3** multiplied by impact multipliers in **Tables R-4** and **R-5**; calculations are performed for cattle and sheep separately and then added together. Estimates of upperbound impacts are equal to the 'high impact scenario' reductions in AUMs in **Table R-3**, and multiplied by multipliers in **Tables R-4** and **R-5** in a similar manner, noting that the high impact reductions in AUMs include the Torell production adjustment factors as described earlier (Torell adjustment factors are not available for sheep).

The IMPLAN sectors used to model an exogenous change in demand for livestock grazing were the following (IMPLAN sector numbers are shown in brackets): grain farming (2), all other crop farming (10), support activities for agriculture and forestry (19), residential structures maintenance and repairs (40), wholesale trade (319), truck transportation (335), banking (354), real estate (360), accounting (368), veterinary services (379), equipment repair and maintenance (417), and labor income (NA). Cattle grazing used the following additional sector: cattle ranching and farming (11). Sheep grazing used the following additional sectors: animal production except cattle and poultry and eggs (14) and retail-food and beverages (324).

GEOTHERMAL EXPLORATION AND DEVELOPMENT

Economic impacts from geothermal exploration and development are a function of construction and operation expenditures for geothermal electricity development, including drilling wells (exploratory, production, and injection), constructing power plants, and operating facilities.

To estimate economic activity associated with geothermal development, BLM first used the National Renewable Energy Laboratory's Jobs and Economic Development Impact (JEDI) model (NREL, 2012) to determine approximate capital and operating costs associated with a representative power plant. The assumptions used a 50 MW nameplate capacity and typical conditions for the planning area: a resource at about 300 degrees Fahrenheit at a depth of 3,000 feet; binary cycle; and 1.93 production wells per injection well. BLM used standard assumptions from the National Renewable Energy Laboratory for the local share of construction and operating expenses that would be spent within the state of Oregon, as an approximation for the study area (local spending

assumptions were available at the state level but not the county level). BLM then used IMPLAN, calibrated to the specific region of the Socioeconomic Study Area, to calculate indirect and induced impacts associated with a given direct expenditure. **Table R-6** shows the resulting assumptions for construction and operation of an individual power plant.

Table R-6
Assumptions for Analysis of Impacts on Output for Geothermal Exploration and Development

	Traditional Hydrothermal Plant (millions of 2010 dollars)
Construction	
Direct Economic Impact[1]	$35.78
Indirect Economic Impact[2]	$2.83
Induced Economic Impact[3]	$8.40
Total Economic Impact	$47.02
Multiplier (total impact/direct impact)	1.31
Operation	
Direct Economic Impact[1]	$2.25
Indirect Economic Impact[2]	$0.00
Induced Economic Impact[3]	$1.17
Total Economic Impact	$3.42
Multiplier (total impact/direct impact)	1.52

Notes: Details may not add to total due to rounding.
[1]Direct economic impact is the average expenditure per plant, assuming a nameplate capacity of 50 MW.
[2]Indirect impacts from IMPLAN reflect increased demand in sectors that directly or indirectly provide support for the geothermal exploration and development industry.
[3]Induced impacts from IMPLAN reflect increased demand in the consumer and government sectors (e.g., employee wages).

Table R-7 provides a summary of employment impacts according to IMPLAN results, based on construction and operations.

Output, labor, and earning impacts summarized in **Table 4-52** in the economic impact section of the EIS are presented for construction and operations of geothermal wells. Impacts during construction are equal to the average annual MW installed per year multiplied by impact multipliers in **Tables R-6** and **R-7**. Estimates of impacts during operations are equal to the average annual MW in operation multiplied by the multipliers in **Tables R-6** and **R-7**. These estimates assume only a share of the wells drilled produce and about half of the production wells are producing by year 5. Impacts are estimated by multiplying the number of wells producing by the multipliers in **Tables R-6** and **R-7**.

The IMPLAN sectors used to model an exogenous change in demand for geothermal development were the following (IMPLAN sector numbers are shown in brackets): drilling oil and gas wells (28), support activities for oil and gas operations (29), construction of new manufacturing structures (35),

Table R-7
Assumptions for Employment Impact Analysis for Geothermal Exploration and Development Activities

	Traditional Hydrothermal Plant (number of jobs per plant)
Construction	
Direct Employment	243.7
Indirect Employment	224.8
Induced Employment	81.1
Total Employment	549.6
Multiplier (Total Impact/Direct Impact)	2.26
Average Earnings per Job (2010 dollars)	$34,899
Operation	
Direct Employment	17.0
Indirect Employment	0.0
Induced Employment	11.0
Total Employment	28.0
Multiplier (Total Impact/Direct Impact)	1.65
Average Earnings per Job (2011 dollars)	$91,759

Note: Direct, indirect, and induced employment impact and average earnings per job are calculated using IMPLAN, as described in the text.

nonresidential maintenance and repair (39), wholesale trade (319), retail – food and beverages (324), truck transportation (335), commercial and industrial equipment leasing (365), architectural and engineering services (369), environmental and consulting services (375), miscellaneous professional/scientific/technical services (380), and labor income change (NA).

WIND ENERGY

The economic impact of wind energy depends on the expenditures made with installation and operations of wind farms. Expenditures made in the primary Study Area were estimated based on the amount of electricity (nameplate capacity in megawatts, MW) projected under each alternative, and the installation and operations costs per MW.

Although there are many locations in the Study Area where wind development is feasible, these locations may or may not overlap with sage-grouse habitat. For the purposes of IMPLAN analysis, BLM considered that two currently existing applications for wind development in the Burns District (Harney County) would no longer occur under Alternatives B, C, F, and the Proposed Plan, both projects being in PGMA, with some of the associated transmission lines and access roads in PPMA. These two projects are estimated to have, when completed, 182 MW of installed capacity. For the purposes of IMPLAN analysis only, BLM assumed that construction would be distributed over a 10-year period.

Installation and operation costs per MW were obtained from default values for the State of Oregon used by the JEDI (Jobs and Economic Development Impact) model. The JEDI model for wind energy was developed by the National Renewable Energy Laboratory, and default values for construction and operation costs per MW were determined based on extensive interviews with power generation project developers, state tax representatives, and others in the appropriate industries (NREL 2012). Default values were based on projects of 100 MW (50 turbines of 2,000 kilowatts each) and were estimated to be, in 2008 dollars, $2,000 per kilowatt for installed project costs and $20 per kilowatt for operations and maintenance costs.

Tables R-8 and **R-9** below show the estimated multipliers for output and employment during installation and operations in the primary study area, primary and secondary study area, and in Harney County, where two proposed wind energy projects were analyzed.

Output, labor, and earning impacts summarized in **Table 4-53** and **Table 4-54** in the economic impact section of the EIS are presented for construction and operations of wind energy projects. Impacts during construction are equal to the average MW of construction multiplied by impact multipliers in **Table R-8**. Estimates of impacts during operations assume half of the MW are installed and in production by year 5. Impacts are estimated by multiplying the number of wells producing by the multipliers in **Table R-9**.

Table R-8
Assumptions for Analysis of Impacts on Output for Wind Energy

Economic Impact	Primary Study Area	Primary and Secondary Study Area	Harney County
Installation			
Direct Economic Impact ($/MW)	$299,358	$299,358	$305,780
Indirect Economic Impact ($/MW)[1]	$40,823	$46,811	$4,990
Induced Economic Impact ($/MW)[2]	$41,212	$44,476	$14,712
Total Economic Impact ($/MW)	$381,393	$390,645	$325,482
Multiplier (Total Impact/Direct Impact)	1.27	1.30	1.06
Operations			
Direct Economic Impact ($/MW)	$11,727	$11,727	$11,978
Indirect Economic Impact ($/MW)[1]	$276	$311	$179
Induced Economic Impact ($/MW)[2]	$3,260	$3,433	$2,386
Total Economic Impact ($/MW)	$15,263	$15,471	$14,544
Multiplier (Total Impact/Direct Impact)	1.30	1.32	1,21

Source: IMPLAN. Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the installation and operations of wind farms.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

Table R-9
Assumptions for Analysis of Impacts on Employment for Wind Energy

Employment Impact	Primary Study Area	Primary and Secondary Study Area	Harney County
	Installation		
Direct Employment (jobs/MW)	1.69	1.69	1.1
Indirect Employment (jobs/MW)	0.28	0.28	0.06
Induced Employment (jobs/MW)	0.40	0.43	0.14
Total Employment Impact (jobs/MW)	2.37	2.43	1.29
Multiplier (Total Impact/Direct Impact)	1.40	1.44	1.17
Average Earnings per Job (2010 dollars)	$44,577	$44,514	$38,796
	Operations		
Direct Employment (jobs/MW)	0.15	0.15	0.15
Indirect Employment (jobs/MW)	<0.01	<0.01	<0.01
Induced Employment (jobs/MW)	0.03	0.03	0.02
Total Employment Impact (jobs/MW)	0.19	0.19	0.18
Multiplier (Total Impact/Direct Impact)	1.23	1.25	1.16
Average Earnings per Job (2010 dollars)	$45,302	$45,164	$45,888

Source: IMPLAN. Note: All dollar values are in 2010 dollars.
[1] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the installation and operations of wind farms.
[2] Induced impacts reflect increased demand in the consumer and government sectors.

The IMPLAN sectors used to model an exogenous change in demand for wind energy development were the following (IMPLAN sector numbers are shown in brackets): sand and gravel mining (26), ready-mix concrete manufacturing (161), wholesale trade (319), retail-building materials and garden supply (323), hotels and motels (411), food services and drinking places (413), and labor income change (NA). In the case of wind energy operations, the IMPLAN sectors used were the following: electrical power (31), nonresidential maintenance and power (39), wholesale trade (319), retail – motor vehicle and parts (320), retail – building materials and garden supply (323), retail – gasoline stations (326), other state and local government enterprises (432), labor income change (NA), state and local government – non-educational (NA), and local government – educational (NA). Unlike other sectors modeled in IMPLAN for this EIS, the state and local government sector was included when modeling wind energy operations following the NREL JEDI model on which the model for this EIS was based.

REFERENCES

BLM (United States Department of the Interior, Bureau of Land Management). 2012. Data from BLM Rangeland Administration System.

BLM (United States Department of the Interior, Bureau of Land Management). 2014a. Personal communication with BLM grazing specialist Michael Tietmeyer

BLM (United States Department of the Interior, Bureau of Land Management). 2014b. Fact Sheet on the BLM's Management of Livestock Grazing. Internet Website: http://www.blm.gov/wo/st/en/prog/grazing.html. Accessed in June 2014.

BLM (United States Department of the Interior, Bureau of Land Management). 2015. Livestock Grazing Data. Data provided in personal communication with Robert Hopper. Rangeland Management Specialist, BLM, Oregon State Office. April 2015

NREL (National Renewable Energy Laboratory). 2012. Methodology. JEDI, Jobs and Economic Development Impact Models. Internet Web site: http://www.nrel.gov/analysis/jedi/methodology.html

Torell, L.A, N. Rimbey, J. Tanaka, D. Taylor, J. Ritten, T. Foulke. 2014. Ranch-Level Economic Impacts of Altering Grazing Policies on Federal Land to Protect the Greater Sage-Grouse.

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Appendix S

Lek Buffer Distances

APPENDIX S
LEK BUFFER DISTANCES

APPLYING LEK BUFFER DISTANCES WHEN APPROVING ACTIONS

Buffer Distances and Evaluation of Impacts to Leks

Evaluate impacts to leks from actions requiring NEPA analysis. In addition to any other relevant information determined to be appropriate (e.g. State wildlife agency plans), the BLM will assess and address impacts from the following activities using the lek buffer-distances as identified in the USGS Report *Conservation Buffer Distance Estimates for Greater Sage-Grouse – A Review* (Open File Report 2014-1239). The BLM will apply the lek buffer-distances specified as the lower end of the interpreted range in the report unless justifiable departures are determined to be appropriate (see below). The lower end of the interpreted range of the lek buffer-distances is as follows:

- Linear features (roads) within 3.1 miles of leks.
- Infrastructure related to energy development within 3.1 miles of leks.
- Tall structures (e.g., communication or transmission towers, transmission lines) within 2 miles of leks.
- Low structures (e.g., fences, rangeland structures) within1.2 miles of leks.
- Surface disturbance (continuing human activities that alter or remove the natural vegetation) within 3.1 miles of leks.
- Noise and related disruptive activities including those that do not result in habitat loss (e.g., motorized recreational events) at least 0.25 miles from leks.

Justifiable departures to decrease or increase from these distances, based on local data, best available science, landscape features, and other existing

protections (e.g., land use allocations, state regulations) may be appropriate for determining activity impacts. The USGS report recognized "that because of variation in populations, habitats, development patterns, social context, and other factors, for a particular disturbance type, there is no single distance that is an appropriate buffer for all populations and habitats across the sage-grouse range". The USGS report also states that "various protection measures have been developed and implemented… [which have] the ability (alone or in concert with others) to protect important habitats, sustain populations, and support multiple-use demands for public lands". All variations in lek buffer-distances will require appropriate analysis and disclosure as part of activity authorization.

In determining lek locations, the BLM will use the most recent active or occupied lek data available from the state wildlife agency.

For Actions in GHMA

The BLM will apply the lek buffer-distances identified above as required conservation measures to fully address the impacts to leks as identified in the NEPA analysis. Impacts should first be avoided by locating the action outside of the applicable lek buffer-distance(s) identified above.

If it is not possible to relocate the project outside of the applicable lek buffer-distance(s) identified above, the BLM may approve actions in GHMA that are within the applicable lek buffer-distance identified above only if:

- Based on best available science, landscape features, and other existing protections, (e.g., land use allocations, state regulations), the BLM determines that a lek buffer-distance other than the applicable distance identified above offers the same or a greater level of protection to GRSG and its habitat, including conservation of seasonal habitat outside of the analyzed buffer area; or
- The BLM determines that impacts to GRSG and its habitat are minimized such that the project will cause minor or no new disturbance (ex. co-location with existing authorizations); and
- Any residual impacts within the lek buffer-distances are addressed through compensatory mitigation measures sufficient to ensure a net conservation gain, as outlined in the Mitigation Strategy (Appendix E).

For Actions in PHMA

The BLM will apply the lek buffer-distances identified above as required conservation measures to fully address the impacts to leks as identified in the NEPA analysis. Impacts should be avoided by locating the action outside of the applicable lek buffer-distance(s) identified above.

The BLM may approve actions in PHMA that are within the applicable lek buffer-distance identified above only if:

- The BLM, with input from the state fish and wildlife agency, determines, based on best available science, landscape features, and other existing protections, that a buffer distance other than the distance identified above offers the same or greater level of protection to GRSG and its habitat, including conservation of seasonal habitat outside of the analyzed buffer area.

Range improvements which do not impact GRSG, or, range improvements which provide a conservation benefit to GRSG such as fences for protecting important seasonal habitats, meet the lek buffer requirement.

The BLM will explain its justification for determining the approved buffer distances meet these conditions in its project decision.

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Appendix T

Greater Sage-Grouse Noise Protocol

APPENDIX T
GREATER SAGE-GROUSE NOISE PROTOCOL

The following protocol provides direction for collecting noise measurements in areas of existing and proposed development in GRSG habitat. The intent is to provide guidelines to **experienced personnel** so that measurements are made in a consistent and accurate manner and to highlight areas where specialized training and equipment is required. The goal is to develop a protocol that is efficient, effective, and produces consistent results. The protocol was written to facilitate the gathering of noise measurements relevant to stipulations for GRSG protection. Use of a standard protocol for noise monitoring will ensure that future measurements are comparable across locations, times, and surveyors. This protocol should be updated, as data needs and availability change (Blickley and Patricelli 2013).

SUMMARY OF NOISE-MONITORING RECOMMENDATIONS

- Measurements should be made by qualified personnel experienced in acoustical monitoring.
- Measurements should be made with a high quality, calibrated Type I (noise floor < 25 dB) sound level meter (SLM) with a microphone windscreen and (where applicable) environmental housing.
- Measurements should be collected during times when noise exposure is most likely to affect GRSG—nights and mornings (i.e., 6 pm – 9 am) and should be taken for ≥1 hour at each site, ideally over multiple days with suitable climactic conditions. To capture typical variability in noise levels at the site of interest, deployment of SLM units for multiple days is preferred.
- Environmental conditions should be measured throughout noise measurement periods so that measurements made during unsuitable conditions can be excluded.

- Measurements should be made at multiple (3-4) locations between each noise source and the edge of the protected area (NSO or PHMA boundary, or lek perimeter). On-lek measurements should exclude time periods when birds are lekking.
- Accurate location data should be collected for each measurement location. Surveyors also should catalog the type and location of all nearby sources of anthropogenic noise.
- Critical metrics should be collected: L50, L90, L10, Leq, and Lmax. All measurements should be collected in A-weighted decibels (dBA) and, if possible, also collected in unweighted (dBF) and C-weighted (dBC) decibels. If possible, SLM should log 1/3-octave band levels throughout the measurement period. Additional metrics may be collected, depending on the goals of the study.

Appendix U

Invasive Plant Species and Noxious Weeds

APPENDIX U
INVASIVE PLANT SPECIES AND NOXIOUS WEEDS

Table U-1
GRSG Habitat Acres of Occurrences for Federally Listed and State-Listed Noxious Weeds (sorted by PGH/PPH acres)[1]

Scientific Name	Common Name	Non-Habitat	PGH	PPH
Taeniatherum caput-medusae	Medusahead rye	10,151	10,539	12,561
Cirsium arvense	Canada thistle	2,030	7,478	620
Cirsium vulgare	Bull thistle	2,653	7,133	795
Onopordum acanthium	Scotch thistle	2,604	1,386	1,993
Cardaria draba	Whitetop (hoary cress)	2,243	1,316	1,408
Lepidium latifolium	Perennial pepperweed	1,285	1,546	263
Acroptilon repens	Russian knapweed	1,571	356	380
Salvia aethiopis	Mediterranean sage	502	375	249
Linaria dalmatica	Dalmation toadflax	2,136	572	21
Halogeton glomeratus	Halogeton	56	82	459
Centaurea stoebe	Spotted knapweed	1,691	302	35
Centaurea diffusa	Diffuse knapweed	2,455	258	48
Centaurea solstitialis	Yellow starthistle	675	46	90
Euphorbia esula	Leafy spurge	200	51	35
Chondrilla juncea	Rush skeletonweed	1,666	47	8
Tamarix ramosissima	Saltcedar	12	36	0.3
Cynoglossum officinale	Houndstongue	858	11	17
Xanthium spinosum	Spiny cocklebur	4	2	24
Tribulus terrestris	Puncturevine	149	24	0.9
Salsola tragus	Russian thistle	64	2	12
Carduus nutans	Musk thistle	10	7	0.0007
Convolvulus arvensis	Field bindweed	9	2	2
Hypericum perforatum	St. Johnswort	12	0.02	2
Aegilops cylindrical	Jointed goatgrass	6	1	0.7

Table U-1
GRSG Habitat Acres of Occurrences for Federally Listed and State-Listed Noxious Weeds (sorted by PGH/PPH acres)[1]

Scientific Name	Common Name	Non-Habitat	PGH	PPH
Orobanche minor	Small broomrape	0	0	1
Potentilla recta	Sulfur cinquefoil	18	0.2	0.05
Lythrum salicaria	Purple loosestrife	0.5	0	0.2
Centaurea virgata	Squarrose knapweed	35	0.1	0.006
Isatis tinctoria	Dyers woad	0	0.1	0.002
Polygonum cuspidatum	Japanese knotweed (fleece flower)	2	0	0.1
Linaria vulgaris	Yellow toadflax	32	0.1	0
Senecio jacobaea	Tansy ragwort	0	0.01	0.006
Conium maculatum	Poison hemlock	22	0	0.003
Cytisus scoparius	Scotch broom	0.4	0	0.002
Solanum elaeagnifolium	Silverleaf nightshade	0	0	0.0003
Anchusa officinalis	Common bugloss	14	0	0
Cardaria pubescens	Hairy whitetop	3	0	0
Carduus acanthoides	Plumeless thistle	26	0	0
Centaurea calcitrapa	Purple starthistle	0.0006	0	0
Centaurea iberica	Iberian starthistle	13	0	0
Clematis vitalba	Old man's beard	14	0	0
Dipsacus laciniatus	Cutleaf teasel	576	0	0
Euphorbia myrsinites	Myrtle spurge	1	0	0
Hemizonia pungens	Spikeweed	21	0	0
Hieracium aurantiacum	Orange hawkweed	2	0	0
Hieracium pratense	Meadow hawkweed	32	0	0
Iris pseudacorus	Yellow flag iris	10	0	0
Kochia scoparia	Kochia	155	0	0
Opuntia aurantiaca	Jointed prickly pear	0.01	0	0
Peganum harmala	African rue	0.4	0	0
Rubus aremeniacus	Himalayan blackberry	1	0	0
Solanum rostratum	Buffalobur	0.2	0	0
Total Noxious Weed Acres		**34,023**	**31,572**	**19,027**

Source: Oregon/Washington BLM 2013
[1]Acres of infestation are incomplete and therefore underestimated

Table U-2
GRSG Habitat Acres of Occurrences for Other Invasive Plant Species[1]

Scientific Name	Common Name	Non-Habitat	PGH	PPH
Centaurea melitensis	Maltese starthistle	0	0	0.0008
Cichorium intybus	Chicory	0	0	1
Cirsium undulatum	Wavyleaf thistle	0.1	0	0
Digitalis purpurea	Purple foxglove	10	0	0
Dipsacus fullonum	Fullers' teasel	26	0.0007	0.5
Elaeagnus angustifolia	Russian olive	11	1	0.0003
Hyoscyamus niger	Black henbane	0	1	1
Leucanthemum vulgare	Oxeye daisy	0.1	0	0.3
Melilotus officinalis	Yellow sweet clover	0	2	12
Phalaris arundinacea	Reed canarygrass	0.03	0	0
Sisymbrium altissimum	Tumble mustard	0.003	0	0
Solanum dulcamara	Bitter/climbing nighshade	0	0	0.0002
Verbascum thapsus	Common mullein	79	0	0
Vinca major	Bigleaf periwinkle	2	0	0
Xanthium strumarium	Rough cocklebur	0	0	0.05
	Total Acres	**129**	**4**	**15**

Source: Oregon/Washington BLM 2013
[1]Does not include annual grasses, which are estimated to occur on approximately 1 million acres

Table U-3
Acres of Occurrences of Invasive Plant Species within 3 Miles of Occupied and Unoccupied Leks by BLM District

Scientific Name	Common Name	Burns District	Lakeview District	Prineville District	Vale District
Acroptilon repens	Russian knapweed	16	34	264	18
Aegilops cylindrical	Jointed goatgrass				1
Cardaria draba	Whitetop (hoary cress)	2,407	73	360	1,224
Carduus nutans	Musk thistle	0.02	0.09		
Centaurea diffusa	Diffuse knapweed	118	0.001	7	60
Centaurea iberica	Iberian starthistle				0.007
Centaurea solstitialis	Yellow starthistle	7	0.001		79
Centaurea stoebe	Spotted knapweed	171	0.003	3	29
Chondrilla juncea	Rush skeletonweed				12
Cirsium arvense	Canada thistle	5,633	145	218	10
Cirsium vulgare	Bull thistle	5,542	56	114	0.8
Conium maculatum	Poison hemlock	0.003	0.0007		
Convolvulus arvensis	Field bindweed	9	0.0007		0.0002
Cynoglossum officinale	Houndstongue				22
Dipsacus fullonum	Fullers'teasel		1		0.1
Elaeagnus angustifolia	Russian olive	0.007			0.0003
Euphorbia esula	Leafy spurge				40
Hyoscyamus niger	Black henbane	1			0.4
Hypericum perforatum	St. Johnswort	2	0.2		
Isatis tinctoria	Dyers woad	0.1			
Lepidium latifolium	Perennial pepperweed	1,126	702	9	152
Leucanthemum vulgare	Oxeye daisy				0.3
Linaria dalmatica	Dalmation toadflax	342	0.0007		0.1
Lythrum salicaria	Purple loosestrife	0.1			0.2
Onopordum acanthium	Scotch thistle	1,190	5	0.1	339
Polygonum cuspidatum	Japanese knotweed (fleece flower)				0.1
Potentilla recta	Sulfur cinquefoil				0.05
Salvia aethiopis	Mediterranean sage	201	530		5
Senecio jacobaea	Tansy ragwort	0.008			
Solanum elaeagnifolium	Silverleaf nightshade				0.0003
Taeniatherum caput-medusae[1]	Medusahead rye	11,730	3,033	4	1,158
Tamarix ramosissima	Saltcedar				2
Tribulus terrestris	Puncturevine	0.02			1
Xanthium spinosum	Spiny cocklebur				0.1
Total invasive plant Lek acres		**28,495**	**4,582**	**980**	**3,155**

Source: Oregon/Washington BLM 2013
[1]Acres for medusahead rye is likely incomplete and underestimated

Appendix V

Public Comment Report

APPENDIX V
PUBLIC COMMENT REPORT

V.1 INTRODUCTION

After publishing the Draft EIS, the BLM had a 90-day public comment period to receive comments on it. The BLM received written comments by mail, email, and submitted at the public meetings. Comments covered a wide spectrum of thoughts, opinions, ideas, and concerns. The BLM recognizes that commenters invested considerable time and effort to submit comments on the Draft EIS, and developed a comment analysis methodology to ensure that all comments were considered as directed by NEPA regulations.

The BLM has identified and formally responded to all substantive public comments. A systematic process for responding to comments was developed to ensure all substantive comments were tracked and considered. Upon receipt, each comment letter was assigned an identification number and logged into the BLM's comment analysis database, CommentWorks. CommentWorks allowed the BLM to organize, categorize, and respond to comments. Substantive comments from each letter were coded to appropriate categories based on content of the comment, retaining the link to the commenter. The categories generally follow the sections presented in the Draft EIS, though some relate to the planning process.

Comments similar to each other were grouped under a topic heading; BLM drafted a statement summarizing the issue(s) contained in the comments. The responses were crafted to respond to the comments and, if warranted, a change to the EIS was made.

Although each comment letter was diligently considered, the comment analysis process involved determining whether a comment was substantive or nonsubstantive in nature. In performing this analysis, BLM relied on the CEQ's regulations to determine what constituted a substantive comment.

A substantive comment does one or more of the following:

- Questions, with a reasonable basis, the accuracy of the information and/or analysis in the EIS;
- Questions, with a reasonable basis, the adequacy of the information and/or analysis in the EIS;
- Presents reasonable alternatives other than those presented in the Draft EIS that meet the purpose and need of the proposed action and addresses significant issues;
- Questions, with a reasonable basis, the merits of an alternative or alternatives;
- Causes changes in or revisions to the preferred alternative; and
- Questions, with a reasonable basis, the adequacy of the planning process itself.

Additionally, BLM's NEPA handbook identifies the following types of substantive comments:

- Comments on the Adequacy of the Analysis: Comments that express a professional disagreement with the conclusions of the analysis or assert that the analysis is inadequate are substantive in nature but may or may not lead to changes in the Proposed RMPA/Final EIS. Interpretations of analyses should be based on professional expertise. Where there is disagreement within a professional discipline, a careful review of the various interpretations is warranted. In some cases, public comments may necessitate a reevaluation of analytical conclusions. If, after reevaluation, the manager responsible for preparing the EIS (authorized officer [AO]) does not think that a change is warranted, the response should provide the rationale for that conclusion.
- Comments That Identify New Impacts, Alternatives, or Mitigation Measures: Public comments on a draft EIS that identify impacts, alternatives, or mitigation measures that were not addressed in the draft are substantive. This type of comment requires the AO to determine whether it warrants further consideration. If it does, the AO must determine whether the new impacts, new alternatives, or new mitigation measures should be analyzed in the Final EIS, a supplement to the Draft EIS, or a completely revised and recirculated Draft EIS.
- Disagreements with Significance Determinations: Comments that directly or indirectly question, with a reasonable basis, determinations regarding the significance or severity of impacts are substantive. A reevaluation of these determinations may be

warranted and may lead to changes in the Final EIS. If, after reevaluation, the AO does not think that a change is warranted, the response should provide the rationale for that conclusion.

Comments that failed to meet the above description were considered nonsubstantive. Many comments received throughout the process expressed personal opinions or preferences, had little relevance to the adequacy or accuracy of the Draft EIS, represented commentary regarding resource management and/or impacts without any real connection to the document being reviewed, or were considered out of scope because they dealt with existing law, rule, regulation, or policy. These comments did not provide specific information to assist the planning team in making changes to the alternatives or impact analysis in the Draft EIS and are not addressed further in this document. Examples of some of these types of comments include the following:

- The best of the alternatives is Alternative D (or A, B, or C).
- The preferred alternative does not reflect balanced land management.
- More land should be protected as wilderness.
- BLM needs to change the Taylor Grazing Act and charge higher grazing fees.
- I want the EIS to reflect the following for this area: no grazing, no logging, no drilling, no mining, and no OHVs.
- More areas should be made available for multiple uses (drilling, OHVs, ROWs) without severe restrictions.

Opinions, feelings, and preferences for one element or one alternative over another, and comments of a personal and/or philosophical nature, were all read, analyzed, and considered, but because such comments are not substantive in nature, BLM did not include them in the report nor respond to them. It is also important to note that while all comments were reviewed and considered, comments were not counted as "votes." The NEPA public comment period is neither considered an election nor does it result in a representative sampling of the population. Therefore, public comments are not appropriate to be used as a democratic decision-making tool or as a scientific sampling mechanism.

Comments citing editorial changes to the document were reviewed and incorporated.

Copies of all comment documents received on the Draft EIS are available by request on CD from the BLM's Oregon/Washington State Office. The submission numbers for the comment documents are printed on the right margin of the first page of the comment document for comments received by mail or email, or at public meetings.

V.1.1 Campaign Letters

Several organizations and groups held standardized letter campaigns for the National Greater Sage-Grouse Planning Strategy through which their constituents were able to submit the standard letter or a modified version of the letter indicating support for the group's position on the BLM planning amendment actions. Individuals who submitted a modified standard letter generally added new comments or information to the letter or edited it to reflect their main concern(s). Modified letters with unique comments were given their own letter number and coded appropriately. All commenters who used an organization's campaign letter were tracked in the BLM's commenter list.

V.1.2 How the Appendix is Organized

This appendix is divided into three main parts. The first part, **Section V.1**, Introduction, provides an overview of the comment response process. The second part, **Section V.2**, Issue Topics, Responses, and Comments, is organized by the primary topic and then by specific issue subtopics that relate to an aspect of NEPA, the BLM planning process, or specific resources and resource uses. This includes subsections such as Required Design Features and Best Management Practices, the Elimination Criteria, and any of the six alternatives. Comments and responses for baseline information (such as the information found in **Chapter 3**, Affected Environment) and impact analysis (**Chapter 4**) are found under the respective resource topic. Each topic or subtopic contains excerpted comments from individual letters/emails, a summary statement, and the BLM's response to the summary statement. Each topic or subtopic contains a statement that summarizes all substantive comments received on that topic or subtopic and the BLM's response to the summary statement. These issues, summaries, and responses in the second part retain the section code numbers as they appear in CommentWorks. Excerpts of all substantive comments are posted on the project website: https://www.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=40504.

The third part, **Section V.3**, Commenter Lists, provides the names of those who submitted unique comment letters (not campaign letters) on the Draft RMPA/EIS. Commenters are listed alphabetically by the organization name or commenter's last name.

The terms preliminary priority management area (PPMA) and preliminary general management area (PGMA) were used in the Draft EIS to describe the relative prioritization of areas for GRSG conservation. These are BLM and Forest Service terms used to differentiate the degree of managerial emphasis a given area would have relative to GRSG. As the BLM and Forest Service moved from a Draft EIS to a Proposed RMPA/Final EIS, such prioritizations are no longer "preliminary" in nature. As such, they have been replaced with the terms

Priority Habitat Management Area (PHMA) and General Habitat Management Area (GHMA). Comments on the Draft RMPA/EIS referred to PPMA and PGMA. As such, the summary statements also use these terms. However, responses use the terminology used in the Proposed RMPA/Final EIS (PHMA and GHMA).

V.2 ISSUE TOPICS, RESPONSES, AND COMMENTS

The issues, summaries, and responses in **Section V.2**, Issue Topics, Responses, and Comments, retain the section code numbers as they appear in CommentWorks.

Section 4 – NEPA

Section 4.1 - Public Notification

Summary

The BLM needs to include project stakeholders in a collaborative process during the creation of the RMPA, and needs to include a complete listing of commenters on the Draft EIS, the number of commenters that are in favor of or against any particular alternative, and what changes resulted from the comments.

Response

Chapter 6, Consultation and Coordination, in the EIS described the public outreach and participation opportunities made available through the development of this RMPA/EIS, and consultation and coordination efforts with tribes, government agencies, and other stakeholders. In addition to formal scoping (**Section 6.5.1**, Scoping Process), the BLM implemented an extensive collaborative outreach and public involvement process that has included coordinating with cooperating agencies, holding public scoping and Draft EIS meetings, and holding a socioeconomic workshop. The BLM continues to meet with interested agencies and organizations throughout the planning process, as appropriate, and will continue coordinating closely with cooperating partners. For full details regarding the federal, state, local, and tribal stakeholders BLM has coordinated with, please see **Chapter 6** in the Final EIS.

All submissions sent to BLM during the Draft EIS public comment period have been recorded and tracked as part of the comment analysis process. Commenter names are included with this appendix and can be found in **Section V.3**, Commenter Lists.

The BLM reviewed all submissions received, and analyzed them for substantive comments. All substantive comments received on the Draft EIS were considered and reviewed for information that would result in changes to the document. Comments simply stating a preference for or against a specific alternative or opinions without reasonable basis were considered nonsubstantive since they do not meet the substantive comment requirement of BLM Handbook H-1790-1, Section 6.9.2.1. Issue statements and responses for the substantive comments are presented in this appendix (**Section V.2**, Issue Topics, Responses, and Comments).

Any changes that resulted from the comment analysis have been noted in the text of the Final EIS with a summary at the start of each chapter.

Section 4.3 - Range of Alternatives

Summary

Commenters stated that the alternatives fail to meet NEPA adequacy because:

1. One or more of the alternatives fail to meet the purpose and need for the action.
2. Alternatives were too similar and the BLM needs to provide a wider range of alternatives.
3. The BLM needs to consider the alternatives presented by cooperating agencies including the county alternatives, the Conservation Groups' alternative (specifically the Harney County Soil and Water Conservation District Rural Community Alternative), and alternatives for the listing of the species or not listing the species.
4. The BLM failed to adequately define the No Action Alternative and did not determine if the existing regulatory mechanisms are insufficient to protect the GRSG.
5. The alternatives do not address the key threats to GRSG as listed by the USFWS, notably fires, invasive weeds, and juniper encroachment.
6. CCAs and CCAAs have not been addressed in the alternatives.

Response

1. In accordance with NEPA, the BLM has discretion to establish the purpose and need for action (40 CFR 1502.13). The purpose and need statement provides a framework for issue identification and will inform the rationale for alternative selection. The breadth or narrowness of the purpose and need statement has a substantial influence on the range of alternatives. Since the purpose of BLM's action is narrowly focused on conserving GRSG habitats and population, the range of alternatives was constructed to meet this narrowly focused purpose and need.

   The RMP amendments' purpose was to identify and incorporate appropriate "regulatory mechanisms" in RMPs to conserve, enhance, and/or restore GRSG habitats in order to support GRSG population management objectives. Each of the alternatives include regulatory measures to meet, to varying degrees, this purpose. This purpose and need provides the appropriate scope to allow the BLM to analyze a reasonable range of alternatives to cover the full spectrum of potential impacts. The alternatives incorporate input from public scoping, and present goals, objectives, and actions to resolve planning issues, balance resource use at this stage of the process, and meet the stated purpose and need for action.

2. The CEQ regulations (40 CFR 1502.1) require that the BLM consider reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. While there are many possible alternatives or actions to manage public lands and GRSG in the planning area, the BLM fully considered the management opportunities presented in the planning issues and criteria developed during the scoping process to determine a reasonable range of alternatives. As a result, five action alternatives were analyzed in detail in the RMPA/EIS that best addressed the issues and concerns identified by the public and BLM.
3. **Section 2.11**, Alternatives Eliminated from Detailed Analysis, presents the alternatives that were reviewed but not analyzed in detail for the EIS. County alternative and other groups' alternatives were considered but not analyzed in detail in the Draft EIS primarily because they are contained within the existing range of alternatives (see **Section 2.8**, Draft RMPA/EIS Alternatives, for additional details). Although the potential listing of GRSG would also include conservation measures identified by USFWS, those conservation measures are not known at this time. Therefore, an alternative that includes a USFWS listing with associated speculative conservation measures for GRSG is not analyzed in detail. As noted in the Purpose and Need, the BLM was to consider regulatory mechanisms that would protect the species and its habitat. As such, the BLM did not develop alternatives should the USFWS choose to list or not list the GRSG.
4. The No Action Alternative represents the current regulatory mechanisms that the USFWS has determined were not "adequate" in their 2010 warranted but precluded for listing decision, and this inadequacy was identified as a significant threat in the USFWS finding on the petition to list the GRSG. In their 2010 decision, the USFWS identified conservation measures embedded in RMPs as the principal regulatory mechanisms for the BLM to address this inadequacy. Therefore, the BLM developed the range of alternatives that would contribute to the conservation of GRSG in this EIS.

   As part of the NEPA process, the BLM is required to consider the effects of continued management as part of the No Action Alternative. BLM analyzed the effects of taking no action (i.e., keeping current management) in **Chapter 4**, Environmental Consequences, in each resource section and serves as the baseline against which each action alternative is compared.

   The range of action alternatives presented different options that addressed the USFWS concerns and focused on areas affected by threats to GRSG habitat identified by the USFWS in the March 2010 listing decision. The primary threats to GRGS across its range are

habitat loss and fragmentation (including wildfire), invasive plants, energy development, urbanization, and agricultural conversion and grazing. To address these threats, BLM considered a range of changes in management of GRSG habitats to avoid the continued decline of populations and habitats across BLM-administered lands. While there are many possible alternatives or actions to manage public lands and GRSG in the planning area, the BLM fully considered the management opportunities presented in the planning issues and criteria developed during the scoping process to determine a reasonable range of alternatives.

5. Additional actions for managing wildland fire, invasive species, and juniper treatments have been added to the alternatives to more fully address these threats to GRSG in the Final EIS. Language has been added to **Appendix H** clarifying how the wildland fire and invasive species assessments were conducted.
6. Clarifications were added on linkages and connectivity between PACs and focal areas in **Chapter 3**. CCA and CCAAs are not a land management action, but rather a programmatic agreement between the BLM, USFWS, NRCS, private landowners, and other local, state, and federal agencies. As such, they cannot be included in the action alternatives. However, they have been added as a reasonably foreseeable future action in **Chapter 5**, along with a cumulative impacts analysis.

Section 4.4 - Best Available Information Baseline Data

Summary

Commenters stated that the baseline data used (e.g., the PPH and PPG data displayed on maps) is too broad and has not been ground-truthed, and allocations based on these maps will unnecessarily limit legitimate economic uses, such as wind power development, on public land. Commenters recommended additional sources of data (e.g., the 2013 Central & Eastern Oregon Land Use Planning Assessment) that should be considered in the analysis.

One commenter asked why this plan did not include an amendment of the John Day RMP and Two Rivers RMP, including occupied or historic GRSG habitat where BLM manages the land or the federal mineral estate or both.

Response

The CEQ regulations require an environmental impact statement to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The description shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less

important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues" (40 CFR 1502.15). Additionally, the Oregon GRSG RMPA/EIS is a programmatic NEPA effort to conserve GRSG and its habitat across a broad geographic area. As such, the BLM described the current conditions and trends in the affected environment broadly, across a range of conditions, appropriate to program-level land use planning actions.

The BLM complied with these regulations in describing the affected environment. The requisite level of information necessary to make a reasoned choice among the alternatives in an EIS is based on the scope and nature of the proposed decision. The affected environment provided in **Chapter 3** and various appendices in the Oregon GRSG RMPA/EIS is sufficient to support, at the general land use planning level of analysis, the environmental impact analysis resulting from management actions presented in the RMPA/EIS.

Programmatic documents are regional in scope and place emphasis on developing broad environmental policies, programs, or plans. Site-specific data are important during implementation-level decisions, which may be tiered to the decisions made in this document. Data scales include broad-scale, mid-scale, fine-scale, and site-scale. For this planning document, it is appropriate to use data at the mid-scale (e.g., WAFWA management zones) and fine-scale (e.g., sub-region data). For this document, the best available information was used as generated and provided by the organizations and agencies with authority and special expertise to provide that information on a planning scale.

The RMPA/EIS contains only planning actions and does not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM would conduct subsequent NEPA analyses that include site-specific project- and implementation-level actions. For example, BLM would verify the accuracy of GRSG habitat data layers at the site/project scale, consider ecological site potential when assessing habitat suitability, and, when necessary, adjust PPH/PGH maps through plan maintenance as more site-specific information becomes available. Site-specific concerns and more detailed environmental descriptions would be addressed when project-level reviews are tiered to the analysis in this EIS (40 CFR 1502.20, 40 CFR 1508.28). Per the Code of Federal Regulation, "Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review …". In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for any site-specific actions.

Before beginning the Oregon GRSG RMPA/EIS and throughout the planning effort, the BLM considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. The data needed to support broad-scale analysis of the planning area are substantially different than the data needed to support site-specific analysis of projects. The RMPA/EIS data and information is presented in map and table form and is sufficient to support the broad-scale analyses required for land use planning. Suggested references, such as the Central & Eastern Oregon Land Use Planning Assessment, have been reviewed and incorporated into the RMPA/EIS as appropriate. The plan acknowledges habitat within mapped PHMA and GHMA will be ground-truthed at the site/project scale, and the habitat maps will be updated periodically in cooperation with ODFW using the best available information (see Action SSS 7).

The GRSG amendments did not include the John Day and Two Rivers RMPs because there is no PPH, PGH, or any occupied habitat on BLM surface-administered land in those planning areas. The GRSG amendments provide conservation measures for some historical habitat within PGH, but only where it is capable of supporting sagebrush vegetation, and capable of providing suitable GRSG habitat. There is some PGH in the John Day RMP area on National Forest System lands where BLM manages the mineral estate, but since the Forest Service controls aboveground actions, nothing would be achieved by modifying BLM management on these parcels. Additionally, the Prineville BLM has revised the John Day RMP (and a portion of the Two Rivers RMP) via the John Day Basin RMP (Record of Decision issued in April 2015), and the Proposed Plan/FEIS (published 2012) included protection for currently unoccupied habitat with potential for sagebrush and GRSG; adding conservation measures in the GRSG planning effort would not produce an effect different than that already analyzed in the John Day Basin RMP/FEIS. Approximately 4,500 acres of federal mineral estate containing GRSG habitat occurs in the John Day Basin RMP, and those acres would be managed under that BLM RMP.

The bulk of the Two Rivers RMP area consists of small scattered parcels that, for the most part, are surrounded by private lands or are linear parcels in steep-sided river canyons not used by GRSG. No parcels are large enough nor are a sufficient number of parcels in close enough proximity to provide enough habitat for a viable population of GRSG.

Section 4.5 - GIS Data and Analysis

Summary

Commenters noted several issues with the GIS data and analysis conducted in the Draft EIS, including that the maps and data layers do not provide enough detail or are too coarse in scale, do not provide assurances to more localized

decision making, some habitat type areas are inaccurately identified in the maps, and some important data are missing or need to be updated.

Response

Before beginning the Oregon RMPA/DEIS and throughout the planning effort, the BLM considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. The data needed to support broad-scale analysis of the planning area are substantially different than the data needed to support site-specific analysis of projects.

Additionally, the BLM consulted with, collected, and incorporated data from other agencies and sources, including but not limited to the USFWS and Oregon Department of Fish and Wildlife (ODFW). Considerations included but were not limited to the following:

- All ownerships (e.g., Forest Service, USFWS, BLM, state lands)
- County boundaries
- District boundaries
- Streams – PFC ratings, fish bearing, perennial, intermittent
- Planning area boundary
- PPH/PGH – priority habitat/general habitat for GRSG, terms used for the Draft EIS
- PHMA/GHMA – priority habitat management areas/general habitat management areas
- Resource area boundaries
- WAFWA management zones – Western Association of Fish and Wildlife Agencies
- Land tenure
- Designated major rights-of-way
- Minor rights-of-way
- Utility corridors
- Wind and solar designations
- Minerals stipulations (leaseable, locatables, salables)
- Subsurface estate
- Grazing allotments
- Wild horse and burro herd management areas
- ACEC – areas of critical environmental concern
- OHV – off-highway vehicle areas
- Recreation sites
- Special recreation management sites
- Wilderness areas
- Areas with wilderness characteristics
- Wilderness study areas
- Oregon PACs – priority areas of concern
- Current vegetation classes

- Potential vegetation classes
- GRSG populations
- GRSG habitat viability

For GRSG habitat data, the ODFW is periodically collecting and refining population and habitat data for the species, and the Draft EIS notes that the BLM would incorporate any refinements or updates once the data were made available.

As described above in **Section 4.4**, Best Available Information/Baseline Data in this appendix, the RMPA/EIS data and information presented in map and table form are of the appropriate scale and are sufficient to support the broad-scale analyses required for land use planning.

In the Final EIS, the management allocations (PHMA and GHMA) will be depicted on only BLM-administered lands to provide additional clarification that land use decisions for the RMPA/EIS will only apply to BLM-administered lands and will not be applied to private, local, or state-owned lands.

GIS data for the Oregon GRSG RMPA/DEIS were made available to the public when the Draft EIS was published and can be found on the project website at: http://www.blm.gov/or/gis/sage-grouse.php.

Section 4.7 - Cumulative Impacts

Summary
The EIS cumulative impacts analysis is inadequate because it does not adequately identify the reasonably foreseeable future actions, present a comprehensive listing of the effects across all sub-regions, provide sufficient analysis of primary threats to GRSG, or analyze how the alternatives' actions would affect adjacent private lands in Oregon and in neighboring states.

Response
The BLM thoroughly explained its consideration and analysis of cumulative effects in the RMPA/EIS in **Chapter 5**. The RMPA/EIS considered the present effects of past actions, to the extent that they are relevant, and present and reasonably foreseeable (not highly speculative) federal and non-federal actions, taking into account the relationship between the proposed alternatives and these reasonably foreseeable actions. This discussion summarizes CEQ guidance from June 24, 2005, stating that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The BLM explicitly described their assumptions regarding proposed projects and other reasonably foreseeable future actions.

The BLM has complied fully with the requirements of 40 CFR 1508.7 and prepared a cumulative impact analysis to the extent possible based on the broad nature and scope of the proposed management options under consideration at the land use planning level.

The Draft RMPA/EIS contains a qualitative discussion of cumulative effects at the WAFWA Management Zone-scale to set the stage for a more quantitative analysis that is contained in this Proposed RMPA/FEIS. Additional quantitative cumulative analysis was added to the FEIS in **Chapter 5**.

The Oregon sub-region has been collaborating with adjacent sub-regions and states to analyze the effects of protections across sub-regional boundaries. Per 40 CFR 1503, the BLM provided cooperating agencies the opportunity to comment on cumulative impacts and reasonably foreseeable future actions during both the comment period for the administrative in the draft RMPA/EIS and the public comment period for the Draft RMPA/EIS. All reasonably foreseeable future actions that cooperating agencies provided to the BLM were added to **Table 5-23**, Reasonably Foreseeable Future Actions, in **Section 5.5**, Past, Present, and Reasonably Foreseeable Future Actions, in the RMPA/EIS. If an action is overly speculative or did not involve development (e.g., wind testing applications), it was not included in the table.

Since the release of the Draft EIS, CCAs, and CCAAs have been entered into. The first allotment CCA under the Programmatic CCA was signed on May 21, 2014, covering 29,800 acres of GRSG habitat on Burns District. In addition, 48 grazing permittees have submitted written or verbal requests to develop a CCA on a total of 85 allotments covering 1.4 million acres of BLM-administered rangelands. Burns is on one of the four BLM districts included in the Programmatic CCA. On Lakeview District, BLM is drafting two new CCAs covering five allotments that encompass 159,936 acres of public land. Cumulative impacts of the CCAs and CCAAs have been added to the document in **Chapter 5**.

Section 4.8 - Disturbance Cap

Summary

Commenters requested clarification of the 3 percent disturbance cap, including the following:

1. The methods by which the 3 percent level was decided.
2. The current level of disturbance in the planning area.
3. What specific activities will count towards the disturbance, including if transmission line disturbance, temporary construction disturbance, water developments, range improvements, and conversion of sage brush to crop/pasture will count towards the disturbance cap.

4. The order of approval for applications for surface-disturbing uses.
5. The feasibility of the 3 percent disturbance cap and how it will be implemented.
6. How the disturbance cap will impact development on private lands.

Response

1. Ample literature establishes a relationship between disturbance and GRSG occupancy and persistence. Two papers in particular establish caps of disturbance related to development and GRSG persistence. **Section 3.3** of the RMPA/EIS, which specifically references Aldridge et al. 2008, Wisdom et al. 2011, Kirol 2012, and Knick et al. 2013, discusses recent studies done on disturbance caps and GRSG. Based on this literature, the alternatives consider a range of appropriate disturbance caps.
2. While the caps would set a particular level of disturbance, the implementation of the disturbance caps would occur after the RMPA is approved in the Record of Decision. The BLM inventoried GRSG habitat with the best available information at the time of the Draft EIS, but would also perform additional in-depth analysis and inventory within management zones at the implementation stage. The process BLM will use to inventory current disturbance levels and potential impacts across the planning area is explained in **Appendix G** in the RMPA/EIS. This process was developed through a collaborative process with the BLM and USFWS. In addition, the disturbance cap in the Final EIS was revised to provide additional detail such as enhanced descriptions of what types of activities would count towards the disturbance totals, where disturbance activities would count against the cap, reclamation and habitat requirements for a disturbed area for both temporary and permanent disturbance, and how the cap would be calculated, implemented, and monitored in cooperation with ODFW and other state agencies.
3. Future activities that are expected to cause disturbance, such as ROW/SUP applications, would be evaluated and approved on a case-by-case basis based upon site-specific determination of the ability to avoid, minimize, and/or mitigate impacts on GRSG habitat at the implementation phase. A proposed project's contribution to the amount of disturbance on the landscape would be evaluated in cooperation with ODFW and other state agencies during site-specific NEPA analysis following the guidance outlined in **Appendix I**.
4. Additional specificity regarding the disturbance cap has been added to the Final EIS in response to public comments. Per the original April 2014 NPT guidance on disturbance, the Proposed RMPA/Final

EIS would use the 3 percent disturbance cap at the Biologically Significant Unit (BSU) and project scale. Specific language has been included in the Proposed RMPA alternative (see **Chapter 2**, **Section 2.6**), as well as additional guidance for how they would be implemented and accounted for and what data are appropriate for determining disturbance (see **Appendix I** in the RMPA/EIS). BLM added a disturbance cap calculation methodology as **Appendix I**. When the cap is reached, no new discretionary disturbances will be allowed.

5. BLM added a disturbance cap calculation methodology as **Appendix I** in the RMPA/EIS.
6. Per requirements of NEPA, the BLM considers disturbance in private lands when making land use decisions since it is required by NEPA to analyze direct, indirect and cumulative impacts from all activities in the analysis area and those that could impact the BLM's ability to manage for GRSG. While the BLM cannot make planning or implementation decisions on private lands, the disturbance levels of nearby private lands will be considered in these planning process and future project-level decision. In addition, the disturbance calculation methodology (**Appendix I**) includes lands of all ownerships, but decisions are made only for BLM-administered lands.

Section 4.9 - Mitigation Measures

Summary

The BLM needs to include a monitoring, mitigation, and adaptive management plan/framework in the Final EIS that will include specific criteria for determining GRSG conservation success. The BLM should use intra and interstate coordination in the development of the mitigation plan and monitoring framework and provide a description of how these plans will coordinate with the state mitigation plan.

Response

Mitigation and monitoring frameworks were discussed in the Draft EIS in **Chapter 2** and in **Appendix E**. An Adaptive Management strategy was also discussed in Chapter 2 of the Draft EIS. A more detailed mitigation framework, monitoring framework, and adaptive management strategy has been incorporated into Chapter 2 of the Final EIS, **Section 2.7**, and **Appendices D, E,** and **G**.

Mitigation will be applied to all implementation actions/decisions that take place on federal lands within GRSG habitat during the life of this plan. Mitigation has been further defined as Regional Mitigation, and the Framework is in **Appendix**

E. The Regional Mitigation Framework was developed to follow the BLM's Draft Regional Mitigation Manual MS-1794 and CEQ 40 CFR 1508.20.

The Mitigation Framework, through the mitigation hierarchy, guides the BLM. The hierarchy direction is to: 1) avoid impacts entirely by not taking a certain action or parts of an action, 2) if unable to avoid, minimize impacts by limiting the degree or magnitude of an action or parts of an action, and 3) if avoidance or minimizing is not possible, compensate impacts associated with future implementation actions. If residual impacts on GRSG from implementation-level actions remain after applying avoidance or minimization measures, then compensatory mitigation projects will be used to offset the residual impacts in an effort to achieve the land use plan goals and objectives. As articulated in **Appendix E**, compensatory mitigation will occur on sites that have the potential to yield the greatest conservation benefit to GRSG, regardless of land ownership. These sites should be sufficiently "durable." According to BLM Draft Manual Section 1794, durability is defined as "the administrative, legal, and financial assurances that secure and protect the conservation status of a compensatory mitigation site, and the ecological benefits of a compensatory mitigation project, for at least as long as the associated impacts persist."

Regional mitigation strategies, based on the Regional Mitigation Framework, will be developed by regional teams (at the WAFWA Management Zone level) within one year of the issuance of the Record of Decision. The BLM will invite governmental and tribal partners to participate in these teams, including the State Wildlife Agency and USFWS, in compliance with the exemptions provided for committees defined in the Federal Advisory Committee Act and the regulations that implement that act. Regional mitigation strategies will guide the application of the mitigation hierarchy to address GRSG impacts within that WAFWA Management Zone. The WAFWA Management Zone Regional Mitigation Strategy will be applicable to BLM lands within the zone's boundaries. Subsequently, the BLM's NEPA analyses for implementation-level decisions that might impact GRSG will include analysis of mitigation recommendations from the relevant WAFWA Management Zone Regional Mitigation Strategy(ies).

The Monitoring Framework in **Appendix G** outlines the methods that the BLM will use to monitor and evaluate the implementation and effectiveness of the planning strategy and the land use plans to conserve the species and its habitat. The regulations for the BLM (43 CFR 1610.4-9) require that land use plans establish intervals and standards, as appropriate, for monitoring and evaluations, based on the sensitivity of the resource to the decisions involved.

Implementation monitoring results will provide information to allow the BLM to evaluate the extent that the decisions from the BLM resource management plans (RMPs) to conserve GRSG and their habitat have been implemented. Effectiveness monitoring will provide the information to evaluate whether BLM actions achieve the objective of the planning strategy (BLM IM 2012-044) and

the conservation measures contained in the land use plans to conserve GRSG populations and their habitats.

Incorporating adaptive management into the RMP will ensure a degree of certainty that the decisions in the plan will effectively contribute to the elimination or adequate reduction of one or more threats to GRSG and its habitat. The adaptive management approach incorporates a set of triggers in the plan, a soft and a hard trigger. These triggers were developed to inform the BLM as to when the federal agency needs to respond (take action) to address a declining trend in GRSG or GRSG habitat.

Soft triggers represent an intermediate cap indicating that management changes are needed at the project/implementation level to address habitat and population losses. Hard triggers represent a cap indicating that immediate action is necessary to stop a severe deviation from GRSG conservation goals and objectives as set forth in the BLM plans. The adaptive management soft and hard triggers and land use planning responses to these triggers are described and analyzed fully in this EIS in **Appendix D**.

The agencies will use the data collected from monitoring (**Appendix G**) to identify any changes in habitat conditions related to the goals and objectives of the plan. The BLM will use the information collected through monitoring to determine whether and when adaptive management triggers are reached and that recovery above trigger thresholds has occurred.

Section 5 – FLPMA

Section 5 - FLPMA

Summary

The purpose and need are too narrowly focused on protecting GRSG and do not meet FLPMA's multiple-use mandate requirement.

Response

The BLM's FLPMA (Section 103(c)) defines "multiple use" as the management of the public lands and their various resource values so that they are used in the combination that will best meet the present and future needs of the American people. The BLM's mandate of multiple use and sustained yield has required the BLM to balance the full range of resource uses on public lands, including the conservation of crucial wildlife habitat. Accordingly, the BLM is responsible for the complicated task of striking a balance among the many competing uses to which public lands can be put. The BLM's multiple-use mandate does not require that all uses be allowed on all areas of the public lands. The purpose of the mandate is to require the BLM to evaluate and choose an appropriate balance of resource uses, which involves tradeoffs between competing uses.

As stated in **Section 2.3.1** of the Draft RMPA/EIS, the alternatives "fulfill the purpose and need for the RMPA." The RMPA is a targeted amendment specifically addressing goals, objectives, and conservation measures to conserve GRSG and to respond to USFWS's 2010 listing determination that the GRSG is "warranted" to be listed under the Endangered Species Act (see Final RMPA/EIS **Section 1.3**, Purpose and Need. The BLM's planning processes allow for analysis and consideration of a range of alternatives in the Draft RMPA/EIS that identified and incorporated conservation measures to conserve, enhance, and restore GRSG habitat and to eliminate, reduce, or minimize threats to this habitat to ensure that a balanced management approach was recommended. The Draft RMPA/EIS includes alternatives that provide greater and lesser degrees of restrictions in various resource use programs but would not eliminate or invalidate any valid existing development rights.

Section 5.2 - Consistency with other State, County, or Local Plans

Summary

1. BLM did not undertake its coordination and consistency review obligations required by FLPMA. The BLM's actions considered in the alternatives conflict with local and state agency plans and policies. The BLM needs to undertake a consistency review of Harney County plans and ordinances.
2. The BLM should offer cooperating agency status to the Adel Water Improvement District.

Response

1. To the extent possible under existing law, the BLM's land use plans must be consistent with officially approved or adopted resource-related plans of Indian tribes, other federal agencies, and state and local governments (see 43 CFR 1610). The BLM has worked closely with state and local governments during preparation of the Draft RMPA/EIS. The Draft RMPA/EIS lists the cooperating agencies actively involved in the planning process in **Section 6.4**. In accordance with NEPA, and to assist in the consistency review, the BLM requested that the state, local, and tribal government cooperating agencies review the Draft RMPA/EIS and identify potential inconsistencies between the alternatives and each agency's applicable plans. This allowed state and local cooperating agencies to use their special expertise regarding the familiarity with their own state or local plans.

   While state, local, and federal planning processes, under FLPMA, are required to be as integrated and consistent as practical, the federal agency planning process is not bound by or subject to county plans, planning processes, or planning stipulations. On the local level, it is a county's responsibility to accurately identify and communicate any

inconsistencies between that county's plan and the proposed alternative. As the planning process moves towards the Final EIS and ROD, additional coordination will continue with cooperating agencies. This coordination will be necessary in order to identify consistency issues and to be compliant with the relevant laws and regulations.

The BLM reviewed local government plans, including the Harney County plans and ordinances, during preparation of the Draft RMPA/EIS; a list of these plans can be found in **Section 1.7**, Relationship to Other Policies, Plans, and Programs. BLM has described the inconsistencies between the proposed action and the other plans, policies, and/or controls within the EIS. This information has been updated in the Final EIS (**Section 1.9**, Relationship to Other Policies, Plans, Programs, and Guidance), so state and local governments have a complete understanding of the impacts of the Proposed RMP on state and local management options.

Additionally, the Policy for the Evaluation of Conservation Efforts (PECE) is the USFWS' responsibility and will be used by USFWS during their evaluation of BLM land use plans, as appropriate.

2. Both the CEQ and BLM planning regulations define cooperating agency status, including what it is, who is eligible to become a cooperating agency, and how the lead agency should invite participation as a cooperating agency (40 CFR 1501 and 1508; 43 CFR 1601.0-5). Cooperating relationships are limited to government entities: state agencies, local governments, tribal governments, and other federal agencies that have jurisdiction by law or special expertise. Special-purpose districts such as conservation and water districts can qualify for cooperator status if state law defines them as political subdivisions (BLM Desk Guide to Cooperating Agency Relationships, page 23), and if they meet the eligibility criteria set out in the regulations and policies. The specific role of each cooperating agency is based on jurisdiction by law or special expertise, which is determined on an agency-by-agency basis and identified in the Memorandum of Understanding. While the Adel Water Improvement District is a recognized political subdivision, they do not have jurisdiction and do not have special expertise relevant to this planning process. Therefore, they cannot serve as cooperators on this planning process.

   The BLM coordinates with cooperating agencies commensurate with each agency's recognized jurisdiction or expertise. In areas where the State of Oregon has clear jurisdiction, such as wildlife populations, the BLM has worked closely with that state agency. In cases where a county or agency has expertise, such as local county

socioeconomic information, the BLM has worked closely with the group to incorporate the information into the EIS. However, the Oregon GRSG RMPA/EIS does not make any management decisions on state or local lands.

Section 6 - Other Laws

Section 6 - Other Laws

Summary
The BLM has failed to document how the EIS and/or actions considered in the EIS comply with other laws, including Stock Raising Homestead Act of 1916, Administrative Procedure Act (APA), the Energy Policy Act of 2005, Mining and Minerals Policy Act of 1970, Common School Fund (via the Oregon Admissions Acts and the Oregon Constitution), and the Endangered Species Act.

Response
The Draft EIS **Section 2.5.1** and Final EIS **Section 2.8.1** discuss management common to all alternatives, and state that all alternatives would comply with state and federal laws, regulations, policies, and standards, and implement actions originating from laws, regulations, and policies. Additionally, in **Section 1.7**, Development of Planning Criteria, the BLM has a criterion stating that all BLM alternatives would comply with existing laws, regulations, and policies. The BLM has reviewed all actions in the Proposed RMPA and found them to be consistent and within the bounds of all required laws, regulations, and policies.

Section 7 - Sage Grouse

Section 7.1 - NTT Report/Findings

Summary
Commenters contended that the NTT report violated NEPA and FLPMA and contained arbitrary and unjustified recommendations related to several topic areas, including livestock grazing management, locatable minerals management, sagebrush cover requirements, and the anthropogenic disturbance cap.

Response
Using the NTT report did not violate NEPA. This is because the National Technical Team (NTT) was formed as an independent, science-based team made up primarily of recognized experts from the BLM, USFWS, Natural Resources Conservation Service, US Geological Survey, and state wildlife agencies from Colorado, Nevada, Oregon, Idaho, and Utah to ensure that the best information about how to manage the GRSG is reviewed, evaluated, and provided to the BLM and the Forest Service in the planning process. The group produced a report in December 2011 that identified science-based management considerations to promote sustainable GRSG populations. The NTT report (NTT 2011) used the best current scientific knowledge to ameliorate threats,

focusing primarily on priority GRSG habitats on public lands. The NTT report cited 122 references, including papers published from the formal scientific literature such as Journal of Wildlife Management, Conservation Biology, Biological Conservation, Wildlife Biology, BioScience, and others, as well as graduate theses and dissertations, conservation strategies, the USFWS 2010 findings, and others representing the best available science. In a letter to Secretary Salazar, dated January 15, 2013, more than 100 scientists endorsed the NTT report, stating that it "represented comprehensive compilation of the scientific knowledge needed for conserving Sage-Grouse" and that it "offers the best scientifically supportable approach to reduce the need to list Sage-Grouse as a Threatened or Endangered species."

The BLM used the NTT report per BLM IM 2012-044 to construct an alternative that would meet the purpose and need. This report was not the only source of information for developing a range of alternatives (see **Section 2.4** in the Final EIS).

Section 7.3 - COT

Summary
The BLM alternatives are not consistent with the COT report objectives. Several alternatives in the Draft RMPA/EIS could meet the COT report objectives if adaptive management strategy were implemented to account for the influences of wildfire in conjunction with a disturbance cap.

Response
In March 2012, the USFWS initiated a collaborative approach to develop range-wide conservation objectives for the GRSG to inform the 2015 decision about the need to list the species and to inform the collective conservation efforts of the many partners working to conserve the species. In March 2013, this team released the Conservation Objectives Team (COT) report based upon the best scientific and commercial data available at the time that identifies key areas for GRSG conservation, key threats in those areas, and the extent to which threats need to be reduced for the species to be conserved. The report serves as guidance to federal and state agencies and others in focusing efforts to achieve effective conservation for this species.

In developing the Draft RMPA/EIS, the BLM sought to develop a range of alternatives with management objectives and actions that are consistent with the purpose and need. The adaptive management strategy and disturbance cap have been revised in the EIS, as described more fully in **Section 4.8** of this appendix and **Appendices D** and **I** of the Final EIS. The BLM worked with the FWS and State agencies to develop a Proposed Plan addressing each of the threats identified in the COT report.

Section 7.4 - Policy Guidance

Summary

Commenters stated that BLM Washington Office Instruction Memoranda 2012-043 and 2012-044 should have undergone NEPA analysis since they constitute rulemaking.

Response

BLM's Instruction Memoranda are internal policy documents that are not subject to the NEPA. IM 2012-044 directs BLM staff, as internal guidance, to consider and analyze, as appropriate, all applicable conservation measures, including those developed by the NTT, when revising or amending its RMPs in GRSG habitat.

Section 7.5 - Range of Alternatives

Summary

1. Some commenters felt that existing regulations are adequate to protect GRSG, while others felt that the alternatives in the Draft RMPA/EIS are inadequate. Commenters proposed revisions or requested additional details and clarifications to the alternatives related to GRSG. Topics of concern included invasive plant treatments, conifer encroachment, wildland fire, goals for the alternatives, disturbance cap, Candidate Conservation Agreements (with Assurances), habitat connectivity, ACEC mapping and management, and fences.
2. Commenters were also concerned about GRSG habitat mapping, including the scale of the map, lack of field verification, omissions, and the need to identify connectivity habitat.

Response

1. The BLM does have existing laws, regulations, and guidance for special status species, including GRSG. These are listed in Chapter 1 under **Section 1.7** and **Section 1.9** in the Final EIS. While such relevant guidance does exist, the USFWS finding stated that "existing regulatory mechanisms are inadequate to protect the species. The absence of adequate regulatory mechanisms is a significant threat to the species, now and in the foreseeable future." This planning process is intended to provide more specific, planning-level direction for land managers in order to conserve GRSG on a sub-regional scale and by providing regulatory mechanisms to further GRSG conservation.

   As noted above in the response in **Section 4.3**, Range of Alternatives, in this appendix and **Section 2.3**, Alternatives Development Process, the Draft EIS describes how the Oregon GRSG RMPA/EIS planning team employed the BLM planning process

to develop a reasonable range of alternatives for the RMPA. The BLM complied with NEPA and the CEQ implementing regulations at 40 CFR 1500 in the development of alternatives for this draft RMPA/EIS, including seeking public input and analyzing reasonable alternatives. The alternatives include management options for the planning area that would modify or amend decisions made in the field office RMPs, as amended, to meet the planning criteria, to address issues and comments from cooperating agencies and the public, and to provide a reasonable range of alternatives. Since this is a plan amendment to address GRSG conservation, many decisions regarding other resources from the existing field office RMPs are acceptable and reasonable, and therefore remain unchanged in this planning amendment.

Meaningful differences among the six alternatives are described in **Table 2-5**, Summary Comparison of Resource Allocations in GRSG Habitat, and in **Section 2.9**, Comparison of Alternatives, of the Draft EIS. In addition, the Proposed Plan provides additional details and clarification in **Sections 2.6** and **2.7**, **Tables 2-2** through **2-8**, **2-10**, and **2-11**, and **Appendices D, E, G, I**, and **S**, and in **Chapter 4** where the impacts are addressed. The Proposed Plan shifted the focus of vegetation management to within 4 miles of occupied and pending leks, as this is the area used by greater than 80 percent of the GRSG in Oregon. In addition, invasive plant management targets invasive annual grasses as the primary focus of invasive plant management due to the impact these taxa have on wildfire risks in GRSG habitat.

2. A new appendix (**Appendix I**) was added to provide further details about the disturbance cap. Additional language about connectivity has been added to **Section 3.3.1** in the Final EIS. BLM, in cooperation with The Nature Conservancy, USFWS, and ODFW, has modeled and mapped connectivity habitat in Oregon (Jones et al. 2015). Action SSS 12 and the Adaptive Management Strategy (**Appendix D**) describe how the results will be applied to project-level NEPA, including GRSG habitat and populations in adjoining states within 4 miles of leks in Oregon. A description of the habitat mapping process for Alternative E is presented in **Section 2.8.6**, Description of Alternative E. In addition, Action SSS 7 in the Proposed Plan describes verification of GRSG habitat data layers at the site/project scale.

   ODFW will update its core area boundaries, as explained in Hagen (2011, pp. 87-88) not more frequently than every five years. The BLM may update PHMAs and GHMAs, in cooperation with ODFW and using the best available information. This would likely require land use plan maintenance or amendment. GRSG habitat maps can

be refined as often as the BLM and ODFW need without affecting the management area boundaries. When GRSG habitat maps are updated, it would not trigger a plan amendment because priority habitat and general habitat are not land allocations, while PHMAs and GHMAs are.

Section 7.6 - Best Available Info Baseline Data

Summary
Commenters suggested new or additional literature for the BLM to consider in the Draft RMPA/EIS. In addition, commenters questioned the accuracy and adequacy of information in the Draft RMPA/EIS. Topics of concern included:

- Accuracy of habitat mapping
- Effects of livestock grazing, roads, noise, and infrastructure
- Accuracy of GRSG population and habitat condition estimates
- Wildland fire management
- West Nile virus

Response
As described in **Section 4.4** of this comment report, the BLM used the most recent and best information available that was relevant to a land use planning level analysis, including the report Summary of Science, Activities, Programs, and Policies that Influence the Rangewide Conservation of Greater Sage-Grouse. Additionally, the BLM consulted with, collected, and incorporated data from other agencies and sources, including but not limited to the USFWS, ODFW, scientific literature, and field and district office data.

As a result of these actions, the BLM gathered the necessary data essential to make a reasoned choice among the alternatives analyzed in detail in the Draft RMPA/EIS, and provided an adequate analysis that led to an adequate disclosure of the potential environmental consequences of the alternatives (**Chapter 4** in the Final EIS). As a result, the BLM has taken a "hard look," as required by NEPA, at the environmental consequences of the alternatives in the Draft RMPA/EIS to enable the decision maker to make an informed decision. Finally, the BLM has made a reasonable effort to collect and analyze all available data.

A land use planning level decision is broad in scope and, therefore, does not require an exhaustive gathering and monitoring of baseline data. Although the BLM realizes that more data could always be gathered, the baseline data provides the necessary basis to make informed land use plan-level decisions. Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13). The BLM will conduct subsequent project-specific NEPA analyses for projects proposed for

implementation under the land use plan, which may include but are not limited to fuels treatment and habitat restoration. The subsequent NEPA analyses for project-specific actions will tier to the land use planning analysis and evaluate project impacts at the appropriate site-specific level (40 CFR 1502.20, 40 CFR 1508.28). As required by NEPA, the public will have the opportunity to participate in the NEPA process for site-specific actions.

Of the suggested studies and references put forth by the commenters, the BLM reviewed them to determine if they presented new information that would need to be incorporated into the Final EIS, were references already included in the Draft EIS, or if the references provided the same information as already used or described in the Draft EIS. The BLM determined that several of these references contained new or relevant information regarding GRSG and its habitat, and these were cited in **Chapter 3** of the Final EIS. In some cases, the additional literature was essentially the same as existing sources and was not incorporated.

A description of the habitat mapping process is presented in **Section 2.8.6** in the Final EIS. The BLM discusses West Nile Virus in **Section 3.3** in the Final EIS, including incidence of mortality (see Wildlife Health Bulletin USGS 06-08).

Section 7.7 - Impact Analysis

Summary
Commenters provided suggestions on how to improve, quantify, or modify the impact analysis on GRSG from other actions, including the following:

- Disturbance cap
- Hunting
- Livestock grazing
- Wild horses and burros
- Recreation
- Infrastructure
- West Nile virus

Response
The Proposed RMPA/Final EIS provides an updated and expanded discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives. For each threat, the Nature and Type of Effects section (**Section 4.3.2** in the Final EIS) provides a comprehensive description of the potential effects as measured by the GRSG indicators. As required by 40 CFR 1502.16, the Proposed RMPA/Final EIS provides a discussion of the environmental impacts of the alternatives, including the proposed action, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment

and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources should the proposal be implemented. The Proposed RMPA/Final EIS provides sufficiently detailed information to aid in determining whether to proceed with the Proposed Plan in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1.

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The Draft RMPA/EIS contains only planning actions and does not include any implementation actions. Therefore, effects on GRSG population levels are not required to be quantified as part of the impact analysis. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

In its 12 month finding, the USFWS determined that the threat of hunting, "is not significant to the species such that it causes the species to warrant listing under the Act" (75 Federal Register 13966, March 23, 2010). Thus hunting was not analyzed in detail in the Draft RMPA/EIS. However, changes have been made to the Proposed RMPA/Final EIS to include analysis of the cumulative effects of hunting on GRSG.

Impacts on GRSG were considered in **Section 4.2** of the Draft EIS. The section has been substantially rewritten and expanded to provide a more complete and accurate basis for the analysis of effects. While a land use planning-level action is broad in scope and, therefore, does not require site-specific impact analysis, a thorough review of the EIS's impact analysis relevant to predation, livestock grazing, noise, and infrastructure was found to need additional information and support for the conclusions/findings. The BLM has updated this information in the Proposed RMPA/Final EIS to provide the necessary information to make informed land use plan-level decisions.

Section 7.8 - Cumulative Impact Analysis

Summary

The BLM needs to provide additional analysis regarding the cumulative effects of mining, vegetation treatments, and fences on GRSG. In addition, the cumulative effects analysis shows that the alternatives do not meet the purpose and need.

Response
The BLM prepared a Tier II Cumulative Effects Analysis completed at the WAFWA Management Zone level that is included in Chapter 5 of the Proposed RMPA/Final EIS.

As described in **Section 4.7** of this comment report, the BLM analyzed cumulative effects in the Draft RMPA/EIS in **Chapter 5** in the EIS. The BLM expanded and quantified cumulative impacts, including vegetation treatments and mining, for the Proposed RMPA/Final EIS. This discussion summarizes CEQ guidance from June 24, 2005, stating that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The BLM explicitly described their assumptions regarding proposed projects and other reasonably foreseeable future actions.

The BLM has complied fully with the requirements of 40 CFR 1508.7 and prepared a cumulative impact analysis to the extent possible based on the broad nature and scope of the proposed management options under consideration at the land use planning level. As described in **Section 4.3** of this comment report, all the alternatives meet the purpose and need. There may be a decline in GRSG population numbers and habitat that may continue for a period of time, despite implementing the Proposed Plan, but the objective is to slow and eventually reverse the trend over the long term.

Section 7.9 - Mitigation Measures

Summary
The BLM's mitigation strategy needs clarification, particularly related to the disturbance cap, RDFs, compensatory mitigation, and monitoring. The primary threats to the bird's survival of wildfire, invasives, and juniper encroachment are not thoroughly addressed.

Response
The BLM has updated the Final EIS with additional information for the mitigation, monitoring, and adaptive management strategies.

Mitigation has been further defined as a Regional Mitigation Framework and is detailed in **Appendix E**. The framework is incorporated in the Proposed Plan and was developed to achieve a net conservation gain to the species by implementing the mitigation hierarchy (40 CFR 1508.20). Regional mitigation is a landscape-scale approach to mitigating impacts on resources. This involves anticipating future mitigation needs and strategically identifying mitigation sites

and measures that can help achieve the greatest conservation benefit for GRSG and its habitat.

If impacts on GRSG or its habitat from authorized land uses remain after applying avoidance and minimization measures, then compensatory mitigation projects will be used to fully offset impacts to achieve conservation benefits. Any compensatory mitigation will be durable, timely, and in addition to that which would have resulted without the compensatory mitigation.

Specific mitigation strategies, based on the framework, will be developed by regional teams within one year of the issuance of the Record of Decision and be consistent with the BLM's Draft Regional Mitigation Manual MS-1794 and CEQ regulations at 40 CFR 1508.20.

The Monitoring Framework in **Appendix G** outlines the methods that the BLM will use to monitor habitats and evaluate the implementation and effectiveness of the planning strategy to conserve the species and its habitat. The regulations for the BLM (43 CFR 1610.4-9) require that land use plans establish intervals and standards, as appropriate, for monitoring and evaluations, based on the sensitivity of the resource to the decisions involved. BLM will use the methods described in the appendix to collect monitoring data to evaluate implementation and effectiveness of the GRSG planning strategy and the conservation measures contained in land use plans.

To ensure that the BLM has the ability to make consistent assessments about GRSG habitats across the range of the species, the framework in **Appendix G** provides the methodology for monitoring the implementation and evaluating the effectiveness of BLM actions to conserve the species and its habitat through monitoring that informs effectiveness at multiple scales.

Implementation monitoring results will provide information to allow the BLM to evaluate the extent that decisions from the BLM resource management plans (RMP) to conserve GRSG and its habitat have been implemented. Effectiveness monitoring will provide the information to evaluate BLM actions to reach the objective of the planning strategy (BLM IM 2012-044), to conserve GRSG populations and habitats.

Monitoring efforts will include data for measurable quantitative indicators of sagebrush availability, anthropogenic disturbance levels, and sagebrush conditions. This information will assist the BLM with identifying whether or not they are achieving their land use plan goals and objectives, as well as providing information relative to the disturbance cap. Specifically, habitat degradation (percent of human activity in a biologically significant unit), habitat availability (percent of sagebrush in a biologically significant unit), and habitat degradation intensity (density of energy facilities and mining locations) will be the data gathered to inform the disturbance cap objective. A new appendix

(**Appendix I**) has been prepared for the Proposed Plan explaining how the disturbance cap would be calculated and administered.

Section 8 – ACECs

Section 8.1 - Range of Alternatives

Summary

A number of comments were provided related to the range of alternatives for ACECs and RNAs:

1. The Draft RMPA/EIS inconsistently qualifies Research Natural Areas (RNAs). On the one hand it states that RNAs are intended to be undisturbed and managed for minimum human disturbances, and on the other hand it describes them as areas where disturbances have occurred in the past and allow for future disturbances.
2. The RMPA does not evaluate whether the added ACEC purposes (GRSG) are compatible with the existing uses and management prescriptions. Some existing relevant and important values appear to be incompatible with GRSG management (e.g., wild horses, grand fir forests, and old growth juniper).
3. The analysis of the relevance and importance criterion doesn't provide scientific support for the conclusions that the areas are uniquely necessary for GRSG. The BLM doesn't analyze whether the areas require special management attention and no special management attention specific to the ACECs is prescribed.
4. The BLM does not explain why an entire area should be designated as an ACEC when only a portion of it may provide the requisite habitat values (e.g., suitable habitat at higher elevations).
5. There is an inadequate range of alternatives and the BLM must describe why ACECs for GRSG were not selected in the preferred alternative.
6. Additional fencing needed and monitoring protocols were not addressed in the Draft EIS.

Response

1. RNAs are part of a national network of reserved areas under various ownerships that contain important ecological and scientific values and are managed for minimum human disturbance. RNAs are managed to protect the key natural attributes for which the RNA was designated to: 1) preserve examples of all significant natural ecosystems for comparison with those influenced by man; 2) provide educational and research areas for ecological and environmental studies; and 3) preserve gene pools of typical and endangered plants and animals. RNAs are intended to represent the full

array of North American ecosystems with their biological communities, habitats, natural phenomena, and geological and hydrological formations. The RNAs in the plan area represent an array of plant communities within that network, and the Key RNAs in the Proposed Plan represent existing RNAs containing plant communities important for GRSG. Any future management actions (e.g., weed treatments and research) will be done only to maintain or enhance those values for which they are designated. See the objectives in **Table 2-2** and existing conditions in **Chapter 3**. Minimum disturbance could be allowed in a controlled manner to conduct research related to land management activities. Such activities could include weed treatments to protect natural plant communities, fuels treatments research, and grazing research. A very limited amount of disturbance may occur for administrative purposes, but this would be contained within small areas and would have only short-term impacts.

Landscape disturbances, including fire and historic grazing, have occurred on these lands in the past, and disturbances, especially fire, will occur in the future.

2. For the majority of the existing ACECs and RNAs within the plan area, there is no change in existing uses. The 15 Key RNAs and 3 ACECs in the Proposed Plan are the only ACECs and RNAs for which there are changes in management goals proposed; these areas are proposed to be closed, or partially closed, to disturbance actions, including grazing, OHV use, minerals development, and lands and realty actions to meet the purpose and need for the GRSG. In the Proposed Plan, Key RNAs and ACECs are those areas that are already being used by GRSG, are in PHMA, have or are in close proximity to leks, and have an array of sagebrush plant communities that are important for GRSG. These areas would be used for research-related activities such as studying sagebrush communities important for GRSG and, in the absence of BLM-permitted activities, would serve as comparative baseline areas. In response to public comments where there was a conflict in the original set of Key ACECs and RNAs identified in the Draft EIS (e.g., wild horses or non-habitat such as old growth fir forests), the Proposed Plan focused on a smaller subset for the final and 2 ACECs and 7 RNAs were dropped from consideration as Key ACECs or RNAs between the DEIS and FEIS. Those other non-GRSG values (wild horses, old growth white fir) are represented in other existing ACECs and RNAs for which there is no change in management from existing conditions.

3. A list of vegetation that is important for GRSG is in Final EIS **Table 3-4**. These plant communities important for GRSG are described in literature available to the public such as the May 2014 BLM GRSG Monitoring Framework and the USGS Open-file report 2013-1098. The BLM is not designating any new ACEC/RNAs under the Proposed Plan, and the need for and analysis of special management attention was addressed when the

RNAs were established in existing RMPs. The relevance and importance criteria found in **Appendix J** for Alternatives C and F propose new ACECs and the special management attention is the same as the goals and objectives identified and analyzed for PHMA within those alternatives described in **Chapter 2** and analyzed in **Chapter 4**.

4. Several alternatives propose new ACECs. GRSG need large areas of non-fragmented habitat, and such areas could include lands of varying degrees of habitat suitability. Alternative C designates all PHMA as an ACEC, and Alternative F designates 17 ACECs among areas of high lek densities and intact habitat.

5. The alternatives range from proposing no new ACECs (in the Proposed Plan and No Action Alternative) to over four million acres of ACECs in Alternatives C and F. Information in **Chapters 2** and **4** addresses these alternatives. The concepts of sagebrush focal areas (SFAs), PHMA, and strategic areas would provide for special management of high-quality GRSG habitat.

6. To remove grazing from all or portions of the 13 Key RNAs (2 of them are already fenced), the Proposed Plan estimated 39 miles of new fence would be needed. Fencing would be necessary to address landownership patterns, and the Proposed Plan minimizes fencing and uses existing allotment fences. Implementation-level details of Key RNA fencing would be addressed in the future. The BLM identified areas that could be fenced in the most efficient manner (minimize fencing). Monitoring protocols for the RNAs and other vegetation are implementation procedures; these were described in the monitoring appendix in the Draft EIS, and additional clarifying information has been added to **Appendix G**.

Section 8.2 - Best Available Information Baseline Data

Summary

Commenters asserted that a number of proposed RNAs are not suitable as GRSG habitat.

Response

The priority RNAs listed in **Table I-2**, Existing Priority RNAs for Long-Term Monitoring, in the Draft EIS have been reviewed for their applicability as RNAs important for GRSG conservation. Of the RNAs that were reviewed, some were determined to meet the criteria and to be crucial for long-term monitoring; they have been reclassified as Key RNAs in the Final EIS. Those that did not meet the criteria were not identified as KEY ACECs or RNAs.

Section 10 - Climate Change

Section 10.2 - Best Available Information Baseline Data

Summary
Commenters questioned the suitability of GRSG habitat in Mormon Basin and the inconsistencies and lack of information in Chapter 3.

Response
Mormon Basin is at a suitable elevation for GRSG. Additional information regarding climate change has been added to several sections in **Chapter 3**.

Section 10.3 - Impact Analysis

Summary
The BLM needs to estimate carbon storage and greenhouse gas emissions from grazing in relation to climate change, and discuss implications to vegetation.

Response
Assessing the impacts of grazing on carbon storage and greenhouse gas emissions is outside the scope of this document. This amendment pertains to reducing identified threats as identified by the COT Report on GRSG and GRSG habitat within the planning area and is not about grazing generally.

Section 11 - Cultural Resources

Section 11.2 - Range of Alternatives

Summary
The BLM must consider the impacts of proposed livestock grazing throughout the planning area on the important cultural and historic resources found on these public lands.

Response
Assessing the impacts of grazing on cultural resources is outside the scope of this document, except as it pertains to reducing impacts on GRSG and GRSG habitat within the planning area and in consideration of valid existing rights and the BLM's multiple-use mandate under FLPMA. The Draft EIS evaluated alternatives that would incorporate GRSG habitat objectives into BLM grazing allotments and permit renewals (Alternatives D and E) and that would modify livestock grazing from allotments in priority and general habitat (Alternative C and, to a lesser extent, Alternative F), and the associated effects these alternatives would have on GRSG and GRSG habitat. The BLM considered a reasonable range of alternatives as relates to grazing during the GRSG planning process in full compliance with NEPA. The CEQ regulations (40 CFR 1502.1) require that the BLM consider reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment.

The analysis presented in the EIS will allow decision makers to make an informed decision pertaining to the effects of differing livestock grazing scenarios on GRSG and its habitat. Therefore, impacts of livestock grazing on the cultural and historic resources within the planning area are not analyzed in this planning effort. However, reductions in grazing would equate to reduced threats to cultural resources. Also, the Proposed Plan for livestock grazing does not include an authorization or approval of specific on-the-ground actions. When such actions are proposed (e.g., after approval of the plan), they would be subject to separate NEPA and NHPA review.

Section 12 - Fire and Fuels

Section 12 - Fire and Fuels

Summary

1. The BLM needs to conduct a NEPA analysis complete with impacts and cumulative effects analysis of the GRSG Wildfire and Invasive Species Habitat Assessments that was cited in Appendix H.
2. The BLM should not use prescribed fire in low-elevation areas where there is the potential for cheatgrass invasion.
3. The Draft RMPA/EIS does not analyze wildfire management in a manner that fulfills the purpose and need of the document. The GRSG Wildland Fire and Invasive Species Assessment noted in the Preferred Alternative needs to be completed and included in the RMPA/EIS.
4. The BLM failed to analyze the role of Rangeland Fire Protection Districts. According to FLPMA, the BLM needs to coordinate with these associations and the BLM should better evaluate the benefits of this coordination. The BLM should also share wildfire risk assessment information with cooperating agencies and Rangeland Fire Protection Associations.
5. The BLM needs to ensure fire response time is minimized and needs to be careful not to close or restrict the construction of new roads that could enable firefighters to have the quickest response time. The Draft RMPA/EIS needs to include decision-making priorities for fires that extend across BLM districts and jurisdictions.
6. The BLM should ensure consistency and coordination between wildfire and noxious weeds programs, particularly in regards to juniper encroachment. The BLM should include mechanisms in the RMPA/DEIS that will allow the BLM to adjust invasive and fire management as new technology is developed.
7. The BLM should improve, clarify, and modify actions describing the design and location of fuel breaks. The BLM should also clarify where fuel breaks will and will not be permitted, include more

details on fuel treatments and invasive species management, and re-consider the use of prescribed fire and grazing as fire prevention techniques. Consider potential changes in climate when proposing post-fire seed sources.

Response

1. **Appendix H** has been revised for the Final EIS. Site assessments and NEPA review will be conducted for specific projects during implementation. The appendix describes a minimal framework example and suggested approach for this assessment. The appendix will include the FIAT methodology but the assessment itself is done outside of the EIS.
2. Before using prescribed fire, the BLM assesses local conditions for potential invasive plant invasion. **Section 4.7.2**, Nature and Type of Effects, notes that while prescribed fire does have beneficial uses, the presence of invasive plants and the potential for invasive plants to spread after a prescribed fire would need to be evaluated on a site-specific basis. Alternatives B and E specifically note that prescribed burns should occur at higher elevations in the absence of cheatgrass. If the BLM were to use prescribed fire, the area would be evaluated on a site-specific basis with the intention of meeting the objectives of the prescribed fire project while preventing expansion of invasive annual grasses.
3. As noted in **Section 4.3**, NEPA Range of Alternatives, of this appendix, the alternatives, including the management actions for the fire program, meet the purpose and need for the EIS. Additionally, **Appendix H** in the Final EIS was updated and provides a framework for site assessments. The assessments have been conducted and planning is underway for site-specific NEPA analysis to develop and implement projects that were identified during the FIAT process.
4. Coordination with RFPAs does not require NEPA, however, it is addressed in **Appendix C** as a required design feature. Interagency coordination is a required component of the FIAT assessment process, which is detailed in **Appendix H.**
5. Response time is one component of fire management, and roads are a subset of that. Closing roads is part of implementation-level travel management (outside the scope of this RMPA/EIS), and potential impacts on response time will be considered during that process. Roads fragment habitat and there is a trade-off; this will be dealt with during travel management planning. A process is already in place for prioritization. The Final EIS includes prioritization at the strategic level. Additional tactical prioritization is handled in the fire

management plan and dispatch run cards, which are out of the scope of the RMPA/EIS.

6. Coordination - FIAT assessment. Use of new tools is outside the scope of this RMPA/EIS. Coordination already occurs between programs and through ES&R. The ability to adjust fire and invasive management to new technologies is facilitated by keeping the Proposed RMPA/ Final EIS strategic rather than being too tactical and specific. Incorporating new technology for the treatment of invasive plants is subject to programmatic and project-level environmental analysis under NEPA. Conducting such NEPA analysis is not possible until the new technology has been developed so that BLM knows what to analyze. Western juniper is not a state- or federally listed noxious weed and is not included in the invasive plant management program; the invasive plant management program concerns nonnative plant species only.
7. Details on the design and location of fuel breaks and fuels treatments will be developed as part of the FIAT Assessment process (see **Appendix H**) and then through site-specific project planning. Site-specific project planning is also subject to NEPA.

Section 12.2 - Best Available Information Baseline Data

Summary
The Draft RMPA/EIS does not address or analyze the significant role that ranchers and Rangeland Fire Protection Associations (RFPAs) play in wildfire control. Also, grazing should be recognized in the Draft RMPA/EIS as a primary tool in the prevention of wildfire and invasive weed reduction.

Response
Coordination results in changes at the implementation level. The role of RFPAs in fire management cannot be effectively analyzed due to lack of consistent data regarding the numbers, locations, and sizes of fires suppressed by RFPAs. Coordination with RFPAs and other cooperators does not require NEPA. RFPA Coordination is addressed in **Appendix C** as a required design feature for Fire Management.

The DEIS and FEIS both recognize grazing as a potential tool for managing wildfire risks and controlling some invasive plants. However, the available science does not support the claim that grazing is a primary tool.

Section 12.3 - Impact Analysis

Summary
Commenters noted that BLM and Forest Service did not provided adequate analysis for how the disturbance cap could hamper wildfire response and the

impacts from BLM coordination with the Rangeland Fire Protection Associations.

Response
Responding to a wildfire is unrelated to a disturbance cap; as noted in **Appendix I** of the Final EIS, fire-burned and habitat treatment areas would not be included in the project-scale degradation disturbance calculation for managing GRSG habitat under a disturbance cap. The role of RFPAs in fire management cannot be effectively analyzed due to lack of consistent data regarding the numbers, locations, and sizes of fires suppressed by RFPAs. RFPA coordination is addressed in **Appendix C** as a required design feature for Fire Management.

Section 12.4 - Cumulative Impact Analysis

Summary
The BLM failed to complete the fire and invasive species assessment for each district as outlined in Volume 3 of the Draft RMPA, in **Appendix H**.

The cumulative impact analysis did not discuss fine-fuel buildup or increased weeds from reduced grazing, the potential impacts of the Holloway and Miller Homestead ES&R, or the possibility of fires that burned across the Nevada border and the potential impacts fire management in Nevada could have on Oregon fire management.

Response
The assessments in **Appendix H** have been analyzed in the Final EIS. Site assessments and NEPA review will be conducted for specific projects. **Appendix H** in the Final EIS describes a minimal framework example and suggested approach for this assessment.

The cumulative impacts section for Alternative B briefly touched on fuel buildup due to reduced grazing in noting the restrictions could result in higher fuel loads and more intense fires. Wording has been revised in **Section 4.6.2**, and Davies et al. 2010 has been cited to more clearly describe the impacts of reduced grazing on the potential to increase fine-fuel loading. Alternatives C (see **Section 4.6.6**) and F (see **Section 4.6.9**) have been revised to discuss the cumulative impacts of reducing grazing. The impacts of some reasonably foreseeable future actions, such as the Holloway and Miller Homestead ES&R, may be speculative, as ES&R successes and failures take 5 to 10 years to determine.

Section 12.5 - Mitigation Measures

Summary
The fuel and fire management RDFs need to be more specific.

Response
The RDFs are mostly general so that they can be applied more widely to various situations. The flexibility would be lost were they made more specific. The RDFs have been revised for the Final EIS, however, and additional specificity has been added where appropriate.

Section 13 – Fish and Wildlife

Section 13.3.1 - Range of Alternatives

Summary
Commenters requested clarification of disturbance cap in Chapter 2 and conifer removal.

Response
As discussed above under **Section 4.8**, Disturbance Cap, of this appendix and in the new Final EIS **Appendix I**, BLM has provided additional clarifications and information to explain how the disturbance threshold would be calculated and administered.

An additional discussion concerning the habitat disturbance cap was added to Chapter 2 of the Final EIS, which is supported by current research. This section confirms that 3 percent human disturbance is a threshold and not a target and that lek abandonment can occur at levels of less than 1 percent human disturbance. Consideration and analysis of disturbance caps less than 3 percent, including 0 percent, is reasonable when considering a full range of alternatives.

No site-specific actions are authorized by this EIS. All project-level work will be analyzed in subsequent NEPA documents and subject to applicable laws, acts, policies, and regulations. Conifers targeted for removal to improve GRSG habitat are predominantly western juniper. The bald eagle does not use western juniper to any great extent. In general, the western junipers targeted for removal are phase 1 (early successional) and phase 2 (mid-successional) and do not normally reach 30 feet in height.

Section 13.3.3 - Impact Analysis

Summary
Commenter requests clarification of impacts on wildlife from increased WHB riparian use, resulting from removal of water developments under Alternative C.

Response
As stated, Alternative C is not the same as Alternative A in regards to the proposed removal of water developments. It is likely that there would be additional impacts on riparian and aquatic vegetation, soils, and water quality resulting from yearlong utilization by wild horses. The effects on wildlife and

other resources affected by removing water developments would be further analyzed in site-specific NEPA documents if Alternative C were selected.

Section 14 - Lands and Realty

Section 14.1 - Range of Alternatives

Summary

Commenters suggested additions to the range of alternatives considered and provided information on the feasibility of the alternatives (e.g., alternatives did not provide enough/too many protections for GRSG and ROW avoidance areas, would be too restrictive for developers, and did not adequately provide the requirements for burying existing power lines).

The Draft EIS did not provide sufficient information in the range of alternatives to support analysis, particularly related to new ROWs under Alternative C, the location where seasonal restrictions would be applied for construction or operation and maintenance of transmission and distribution infrastructure under Alternative D, and detail on the terms and conditions that would be included for issuance of a ROW.

Commenters noted that the BLM did not consider a full range of management options as part of the Draft EIS range of alternatives (e.g., distance from leks, adaptive management triggers, and disturbance areas).

Response

As noted above in the response in **Section 4.3**, Range of Alternatives in this appendix, **Section 2.3** of the Draft EIS described how the Oregon GRSG RMPA/EIS planning team employed the planning process to develop a reasonable range of alternatives for the RMPA. The BLM complied with NEPA and the CEQ implementing regulations at 40 CFR 1500 in the development of alternatives for the Draft RMPA/EIS, including seeking public input and analyzing reasonable alternatives. The alternatives include management options for the planning area that would modify or amend decisions made in the field office RMPs, as amended, to meet the planning criteria, to address issues and comments from cooperating agencies and the public, or to provide a reasonable range of alternatives. The EIS affected environment section provides the appropriate information for the scope and scale of the project (see **Section 4.3**, Range of Alternatives of this appendix, for additional details). However, upon BLM review, and public comment suggestions, **Chapters 2** and **3** have been updated and revised to include clarifications or new information. Examples are provided in the paragraphs below.

Proposed avoidance and exclusion area designations vary by alternative, as explained in the Draft EIS in **Table 2-5**. Under Alternative D, all new ROWs, unless specifically excluded, would be avoided, whenever possible (e.g., wind facilities). In the Proposed RMPA, PHMAs and GHMAs would be designated as

avoidance areas for high-voltage transmission line ROWs. All authorizations in these areas, other than excepted projects, must comply with the conservation measures outlined in the Proposed RMPA, including the required design features and avoidance criteria presented in the Final EIS (see **Section 2.6** of the Final EIS). For current or future applications, the BLM would analyze GRSG mitigation measures through the project's NEPA review process. Required design features that would apply to specific types of facilities in GRSG habitat are in **Appendix C**, including reclamation of lands.

The Final EIS provides objectives for the conservation of GRSG habitat in **Table 2-2**, which contains objectives related to distance from leks.

The BLM will use the information collected during monitoring to identify any changes in habitat conditions related to the goals and objectives of the plan. The BLM will use this information to determine when adaptive management triggers are met. These triggers are described in **Section 2.7** of the Final EIS.

The Final EIS provides information related to the management of activities and mitigation measures in priority habitat where the 3 percent disturbance cap applies. The process for determining existing disturbance is described in **Appendix I**. Mitigation is further addressed in **Appendix E**.

Section 14.3 - Impact Analysis

Summary
Commenters stated that the Draft EIS failed to accurately analyze the impacts on private lands from ROW avoidance areas.

Response
The Draft RMPA/EIS provides an adequate discussion of the environmental consequences of the presented alternatives. As required by 40 CFR 1502.16, the Draft RMPA/EIS provides a discussion of the environmental impacts of the alternatives, including the proposed action, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented. The Draft RMPA/EIS provided sufficiently detailed information to aid in determining whether to proceed with the preferred alternative or make a reasoned choice among the other alternatives in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1.

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The Draft RMPA/EIS contains only planning actions and does not include any

implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

Impacts were considered on private lands from land use authorizations in **Sections 4.10.4** through **4.10.9** of the Draft EIS). In addition, the Cumulative Effects section states, "By not allowing ROWs on BLM land within PPMA, all infrastructure in GRSG habitat areas would be forced onto private lands. This could cause increased fragmentation to private lands and may result in a more widespread loss of GRSG habitat to infrastructure." The BLM did acknowledge these effects but didn't analyze them in detail because implementation of the actions would be speculative. The NEPA handbook (pages 58 and 59) states that the BLM is not required to speculate about future actions.

Section 14.5 - Mitigation Measures

Summary
Commenters stated that the Draft EIS failed to provide a comprehensive list of required mitigation measures for ROW development.

Response
The BLM complied with NEPA by including a discussion of measures that may mitigate adverse environmental impacts of the alternatives in the Draft RMPA/EIS. See 40 CFR 1502.14(f), 1502.16(h). Potential forms of mitigation include: (1) avoiding the impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20). The BLM must include mitigation measures in an EIS pursuant to NEPA; however, the BLM has full discretion in selecting which mitigation measures are most appropriate, including which forms of mitigation are inappropriate.

Mitigation has been further defined in the Final EIS as a Regional Mitigation Framework and is detailed in **Appendix E**. The framework is incorporated in the Proposed RMPA and was developed to achieve a net conservation gain to GRSG by implementing conservation actions. Regional mitigation is a landscape-scale approach to mitigating impacts on resources. This involves anticipating

future mitigation needs and strategically identifying mitigation sites and measures that can help achieve the greatest conservation benefit for GRSG and its habitats.

If impacts on GRSG or its habitat from authorized land uses remain after applying avoidance and minimization measures, then compensatory mitigation projects will be used to fully offset impacts to achieve conservation benefits. Any compensatory mitigation will be durable, timely, and in addition to that which would have resulted without the compensatory mitigation.

The Required Design Features (**Appendix C**) have added a Common to All and a Lands and Realty section in the Final EIS, and these are also considered mitigation measures. In addition, when an application is filed with BLM, site-specific NEPA is required. Mitigation measures in the site-specific NEPA is carried forward into the Terms and Conditions of the ROW grant.

Specific mitigation strategies, based on the framework, will be developed by regional teams within one year of the issuance of the Record of Decision and be consistent with the BLM's Regional Mitigation Manual MS-1794, Forest Service Handbook FSH 1909.15, and CEQ regulations at 40 CFR 1508.20.

Section 15 - Leasable Minerals

Section 15.1 - Range of Alternatives

Summary

Consider new management actions for minerals and energy development. The actions proposed that are not currently considered are:

1. Pursue buy outs or exchanges of leases in order to direct leasing and development toward areas with low or no habitat conflicts.
2. Only allowing fluid mineral leasing in connectivity habitat subject to no surface occupancy stipulations (for SGCAs [10 kilometers ~ 6 miles].
3. In existing leased and permitted areas, apply a 10-kilometer non-surface occupancy around active leks and limit permitted disturbance to 1 per section and no more than 3 percent surface disturbance per section.
4. Implement courtship, nesting, early brood-rearing, and winter seasonal and timing restrictions for all human activities.
5. Avoid the surface disposal of produced water unless it can be proven to be beneficial to GRSG and includes measures to preclude the spread of West Nile virus.

6. For GRSG habitat outside of SGCAs:
    - Apply a 10-kilometer non-surface occupancy around active leks and limit permitted disturbance to 1 per section and no more than 3 percent surface disturbance per section.
    - Implement courtship, nesting, early brood-rearing, and winter seasonal and timing restrictions for all human activities, including exploration.
    - Avoid the surface disposal of produced water unless it can be proven to be beneficial to GRSG and includes measures to preclude the spread of West Nile virus.
    - Use phased leasing (not to exceed 1/3 of planning area)

Response

1. As Oregon is a pioneering region in context of fluid mineral development, including geothermal, fluid mineral resource targets and potentials have not been delineated. Therefore, it is unknown if resources exist inside or outside identified habitat. Exchange of leases for land outside of habitat may not contain resources and therefore may not be economically viable.

2. Differing alternatives range from closure of all PHMA and GHMA to NSO in PHMA. This range of alternatives already incorporates the action proposed by the commenter.

3. In the Proposed Plan, the BLM would apply NSO in PHMA and a 1-mile buffer around leks in GHMA. Permitted disturbance is defined and described in the Proposed Plan.

4. CSU consideration is considered in Alternative D, discussing NSO buffers and water closures. Additionally, the Proposed RMPA includes a conservation objective to prioritize leasing and development of fluid mineral resources, including geothermal, outside of PHMA and GHMA. For areas already under lease, where a proposed fluid mineral development project could adversely affect GRSG populations or habitat, the BLM will work with the lessees, operators, or other project proponents to avoid, reduce, and mitigate adverse impacts to the extent compatible with lessees' rights to drill and produce fluid mineral resources.

5. Mitigation measures to avoid or minimize potential for West Nile virus are listed in Required Design Features (**Appendix C**).

6. Application of 10-kilometer impacts are covered within differing alternatives of PHMA and GHMA closures. Permitted disturbance is defined and described in the Proposed Plan. Buffers and seasonal

restrictions in **Table 2-8** in the Final EIS would be applied to all occupied or pending leks in PHMA and GHMA to avoid direct disturbance to GRSG. Action SSS 9 would apply lek buffer-distances identified in the USGS Report Conservation Buffer Distance Estimates for Greater Sage-Grouse – A Review (Open File Report 2014-1239). Mitigation measures to avoid or minimize potential for West Nile virus are listed in Required Design Features (**Appendix C**).

Section 15.2 - Best Available Information Baseline Data

Summary
Consider additional studies and information. The BLM should disclose the split mineral estate for the State of Oregon and the legal constraints that might impose on some activities. There are discrepancies between Chapter 3 and Appendix O in the acres of leased lands in the planning area.

Response
The BLM reviewed the additional studies and information and incorporated it into the document as appropriate.

As stated on page ES-4 of the Draft RMPA/EIS, "…the management directions and actions outlined in this RMPA/EIS will apply only to BLM-administered surface lands in the planning area and BLM-administered federal mineral estate that may lie beneath other surface ownership, often referred to as split-estate lands. These two areas are collectively referred to as the decision area."

The BLM has corrected the inconsistency in leased acres.

Section 16 - Livestock Grazing

Section 16- Livestock Grazing

Summary
The BLM has no authority to retire or terminate grazing permits.

Response
FLPMA grants the Interior Secretary the authority to make land use planning decisions, taking into consideration multiple use and sustained yield, areas of critical environmental concern, present and potential uses of the land, relative scarcity of values, and long-term and short-term benefits, among other resource values (43 USC 1711 Sec 201 (a)). 43 CFR § 4100.0-8 provides that the BLM shall manage livestock grazing on public lands in accordance with applicable land use plans. Further, the BLM may designate lands as "available" or "unavailable" for livestock grazing through the land use planning process (H-1601, Land Use Planning Handbook, Appendix C).

A "chiefly-valuable-for-grazing" determination is required only when the Secretary is considering creating or changing grazing district boundaries. Such a determination is neither required nor appropriate when establishing grazing levels within a district. This RMP is not considering creating or changing grazing district boundaries. Although lands have been identified as "chiefly-valuable-for-grazing" per the Taylor Grazing Act for purposes of establishing grazing districts within the public domain (see, 43 USC § 315), this does not negate the BLM's authority or responsibility to manage those lands to achieve resource condition goals and objectives under the principals of multiple use and sustained yield as required by FLPMA and its implementing regulations.

Section 16.1 - Range of Alternatives

Summary

1. Some commenters stated that the Draft EIS should have included a no grazing alternative as well as a 50 percent reduction from actual use in order to comply with NEPA requirements for a reasonable range of alternatives.
2. Commenters questioned the need for additional restrictions on grazing management, citing that existing regulations and rangeland health standards protect GRSG habitat. They also question how the prioritization of rangeland health standard assessments would impact other species in the area.
3. Commenters requested clarification on the use of the HAF in the preferred alternative and how it correlates to rangeland health assessments. In particular, they noted the need to use local ecological site conditions and provided suggested details for implementation.
4. Commenters also requested clarification on the requirements for fences.
5. Commenters questioned the rationale for closing RNAs to livestock grazing and how it would be accomplished.

Response

1. The EIS planning team employed the BLM planning process to develop a reasonable range of alternatives for the RMPA, as described in **Section 4.3**, NEPA Range of Alternatives, in this appendix. The Draft EIS considered a full range of alternatives for grazing levels, including Alternative A, which proposed no reduction in grazing levels, Alternative C, which analyzed no grazing in the planning area, and Alternative F, which analyzed a reduced grazing level of 62.5 percent. See **Section 2.9** in the Final EIS for a complete comparison of alternatives.

2. Livestock grazing is identified by USFWS as a threat to GRSG in the March 23, 2010, Federal Register notice, and therefore it is addressed in this RMPA. Existing regulatory mechanisms, including the fundamentals for rangeland health, would continue to provide the basis for managing grazing in GRSG habitat. However, the preferred alternative would provide additional consistency in application of standards for rangeland health relative to GRSG habitat, and would provide additional guidance for prioritizing land health assessments and review of grazing permits to ensure that grazing management is compatible with attainment of GRSG habitat objectives within the planning area. In addition, best management practices would be adopted to reduce effects of range improvements and livestock trailing across public lands. Prioritization of rangeland health assessments related to other threatened and endangered species have also been updated in **Chapter 2** in the Final EIS.
3. Language has been added to the Final EIS (**Section 2.8**) clarifying the use of HAF indicators.
4. Impacts from any additional fencing required in Key RNAs have been updated in **Chapters 4** and **5**. Language related to replacement water and fencing for livestock has also been clarified in **Section 4.8** in the Final EIS.

5. All or part of Key RNAs identified in the Final EIS would be closed under the Proposed Plan to all disturbance types, including livestock grazing, OHV, minerals development, and lands and realty actions. The reason for these closures would be for research-related activities, including studying vegetative communities that do not contain land-disturbing activities that are important to GRSG, as well as studying the effects of climate change on these vegetative communities. For all remaining ACECs and RNAs, for areas not meeting the standards for rangeland health where livestock grazing is a contributing factor, or areas not meeting the management goals of the ACEC/RNA, grazing would be modified before the next grazing season. The intent of the land use plan amendment is to change management under all resource programs, where necessary, to benefit GRSG habitat. The document has been updated to remove the ACEC/RNA voluntary relinquishment clause because BLM has a policy currently in place pertaining to voluntary relinquishment. Objectives and actions from DEIS **Appendix I** have been moved into the body of the document for the Final EIS for better clarification for the reader. Changes have been made to **Chapters 2, 3,** and **4** to clarify the Proposed RMPA and its effects. The Proposed RMPA/Final EIS has also been updated by removing the 20 percent PHMA and 50 percent GHMA habitat thresholds for RNAs. This was a method used in the Draft EIS as a way to filter out potential areas of critical GRSG habitat. The Final EIS focuses on areas with leks

and high levels of PHMA and the array of sagebrush plant communities that are important for GRSG survival. The objectives and action items related to livestock grazing and range management have been updated in **Chapter 2** in the Final EIS and have been presented as the Proposed Plan.

Section 16.2 - Best Available Information Baseline Data

Summary

1. Multiple commenters presented citations supporting their position that grazing benefits GRSG and helps prevent fires. Other commenters presented citations supporting the position that grazing damages GRSG habitat and other environmental resources. Some commenters stated that there are no studies that tie appropriately managed livestock grazing to population changes in GRSG.

2. Multiple commenters request clarification of the data presented in Appendix N and Section 3.7, including dates for which LHA were conducted.

Response

1. As noted in **Section 4.4** of this appendix, before beginning the Oregon GRSG RMPA/EIS and throughout the planning effort, the BLM considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. The BLM used the most recent and best information available that was relevant to a land use planning-level analysis, including the report Summary of Science, Activities, Programs, and Policies that Influence the Rangewide Conservation of GRSG (*Centrocercus urophasianus*) (Manier et al. 2013). The report assisted the BLM in summarizing the effect of its planning efforts at a range-wide scale, particularly in the affected environment and cumulative impacts sections. The report looked at each of the threats to GRSG identified in the USFWS's "warranted but precluded" finding for the species. For these threats, the report summarized the current scientific understanding, as of report publication date (June 2013), of various impacts on GRSG populations and habitats. The report also quantitatively measured the location, magnitude, and extent of each threat. These data were used in the planning process to describe threats at other levels, such as the sub-regional boundary and WAFWA Management Zone scale, to facilitate comparison between sub-regions. The report provided data and information to show how management under different alternatives may meet specific plans, goals, and objectives. The BLM has reviewed references provided in public comments and incorporated them as appropriate.

   The Draft EIS analyzed the effects of no grazing and reduced grazing on components of GRSG habitat, including changes in wildfire risk and

cheatgrass incursion. The livestock grazing objectives in the RMPA/EIS contain methods to correct improper grazing management. As noted in the 2010 Federal Register notice, there is little direct evidence linking grazing practices to population levels of GRSG; however, given the widespread nature of grazing, the potential for population-level impacts cannot be ignored. **Section 2.4**, Resulting Range of Alternatives, contains a definition of improper livestock grazing. For any allotment that fails to meet the standards for rangeland health as a result of livestock grazing, management would be modified to make progress toward attainment of land health standards.

2. **Section 3.8** in the Final EIS has been reviewed for consistency with **Appendix N** and updated as needed. **Appendix N** and **Tables 3-28** and **3-29** in the Final EIS identify the name and number of the allotments within GRSG habitat, authorized AUMs, acres within GHMA and PHMA, management categories, and ratings for each of the five standards for rangeland health. Allotments that have not completed rangeland health assessments to date have been added to **Appendix N**. The information contained in these sections is appropriate for a land use planning amendment. Additional details for these allotments may be required at a project-level scale and will be assessed at that time. **Section 2.12** in the Final EIS has also been updated to add clarification to impacts under Alternative A.

Section 16.3 - Impact Analysis

Summary

1. Commenters stated that the impacts analysis did not fully account for the indirect changes related to loss of public AUMs, including related changes to private lands and overall reduction in ranch herd size.
2. Other comments requested additional analysis of the impacts of current management on grazing to allow for a more complete comparison between alternatives.
3. Some commenters requested that additional information be included in cumulative impacts analysis.
4. One commenter noted that limitations on water developments can have impacts on grazing management and need to be clarified and analyzed in greater detail.

Response

Impacts on livestock grazing from current livestock grazing management are addressed in **Section 4.8**, Livestock Grazing/Range Management, in the Final EIS. Impacts on the social and economic aspect of livestock grazing are discussed in **Section 4.20**, Social and Economic Impacts (Including Environmental Justice)

in the Final EIS. Cumulative impacts on livestock grazing are addressed in **Chapter 5**. All of these sections have been updated to include a more thorough discussion of impacts based on issues brought up by commenters.

Impacts on grazing from limitations on water developments are discussed in **Section 4.8**.

Section 17 - Locatable Minerals

Section 17.1 - Range of Alternatives

Summary
Commenters noted that the BLM does not have authority to manage mining operations on split-estate lands (neither where the surface is BLM-administered land and the underlying mineral estate is private nor where the surface is private and the underlying mineral estate is administered by the BLM). Commenters recommend withdrawal from PPMA and PGMA.

Commenters requested that BLM establish limitations on surface disturbance from mining operations consistent with overall disturbance caps in PGMA and in connectivity habitat; require habitat mitigation for all plans of operation and mining notices and put in place other mine plan requirements such as timing limitations as appropriate; and specify which mitigation practices could be applied to mine plans and notices.

Response
As stated on page 1-9 of the Draft RMPA/EIS, "Although the entire planning area includes various land management entities, the management directions and actions outlined in this RMPA/EIS will apply only to BLM-administered surface lands in the planning area (**Table 1-1**) and BLM-administered federal mineral estate that may lie beneath other surface ownership, often referred to as split-estate lands. **Table 1-4** shows BLM-administered mineral split-estate. The acreage of BLM-administered surface lands in the planning area and the acreage of BLM-administered federal mineral split-estate in the planning area are collectively referred to as the decision area." In other words, the BLM is not proposing, under any alternative, to make decisions for private lands where the surface owner is also the owner of the mineral estate.

The BLM has the authority to petition the Secretary of the Interior to withdraw federal mineral estate from entry under the General Mining Law of 1872, as amended, whether the surface ownership is administered by the BLM or any other non-BLM entity per 43 CFR 2300.

For lands where the BLM administers the locatable mineral estate but not the overlying surface, except for those lands patented under the Stock Raising Homestead Act, the operator must file a Plan of Operations or Notice for all proposed operations (43 CFR 3809.31(e)). For lands patented under the Stock

Raising Homestead Act, the operator must file a Plan of Operations or Notice only if they do not have agreement with the surface over (43 CFR (43 CFR 3809.31 (d)). The regulations at 43 CFR 3809 apply to those activities within lands being explored, mined, or used for placement of facilities that are reasonably incident to exploration, development, or mining. The regulations also apply to the access roads and facilities across split-estate lands to and from the project area.

Where the mineral estate is private and the surface is administered by the BLM, the 3809 regulations do not apply because the non-federal minerals are not subject to the 1872 Mining Law, as amended. The BLM is not proposing, under any alternative, to apply restrictions on this type of holdings. Because the BLM still has an obligation under 43 USC 1732(b) to prevent unnecessary and undue degradation, the owner or operator must obtain a special use lease, permit, or easement under 43 CFR 2920 before using the public lands to develop the private mineral estate, and may be required to provide a financial guarantee before commencing surface-disturbing activities. The BLM will review each proposed authorization under the regulations at 43 CFR 2920 to ensure compliance with the unnecessary and undue degradation requirement as required by Section 302 of FLPMA (43 USC 1732(b)). The proponent is required to submit certain information concerning the proposed action (43 CFR 2920.2-4). This information requirement is similar to those required under 43 CFR 3809.301 and 3809.401. Appropriate NEPA analysis must be conducted on any special use lease, permit, or easement before it is granted.

Commenters' concerns were further addressed in the FEIS resulting in the Proposed Plan. Management actions involving split estate are defined in Actions MSE 1 and MSE 2 as found in **Table 2-3**. Required design features will be applied to locatable minerals to the extent consistent with applicable law as defined in Action SSS 12, as found in **Table 2-3**, which states that "(a)ll authorized actions in Greater Sage-Grouse habitat are subject to RDFs and BMPs in Appendix C". Similarly, 3% caps with 1% decadal limits are applied to all anthropogenic disturbances, as defined in Action SSS 3, found in **Table 2-3**.

Multiple alternatives (**Table 2-13**, **Chapter 2**) analyzed withdrawals of varying sizes, ranging from all of PHMA and GHMA to just PHMA to none. The Proposed Plan implements recommendations for withdrawals of the SFAs, as defined in Action MLM 2 of **Table 2-3**, following the recommendation of the October 27, 2014 USFWS memorandum entitled Greater Sage-Grouse: Additional Recommendation to Refine Land Use Allocations in Highly Important Landscapes (discussed in **Section 2.6.2**).

Multiple alternatives (**Table 2-13**, **Chapter 2**) also analyzed areas closed and opened for mineral materials. Commenters also addressed concerns of impacts to infrastructure materials needed by county maintenance and the Department of Transportation. As such the Proposed Plan applies a closure of PHMA to

mineral materials with the exception of Free Use Permits (used by the counties). Department of Transportation sites are managed under the Federal Highways Act (FHWA) and, as such, are a ROW. The Proposed Plan addresses these issues in Actions MSM 1, MSM 2, and LR 7 in **Table 2-3**.

Closure of GHMA to all mineral material and locatable mineral entry was considered in this planning effort under Alternative C. As noted above in the response in **Section 4.3**, Range of Alternatives, of this comment report, **Section 2.3** of the Draft EIS described how the Oregon GRSG RMPA/EIS planning team employed the BLM planning process to develop a reasonable range of alternatives for the RMPA. The BLM complied with NEPA and CEQ implementing regulations at 40 CFR 1500 in the development of alternatives for the RMPA/EIS, including seeking public input and analyzing reasonable alternatives. The alternatives include management options for the planning area that would modify or amend decisions made in the field office RMPs, as amended, to meet the planning criteria, to address issues and comments from cooperating agencies and the public, or to provide a reasonable range of alternatives. Mineral development will be mitigated to the extent allowed in 43 CFR 3809.

The DEIS considered a broad range of alternatives that considers variations in PHMA and GHMA as well as different restrictions on saleable mineral development as described in **Table 2-13**, **Chapter 2**.

Section 17.2 - Best Available Information Baseline Data

Summary

There are some inaccuracies regarding the locatable minerals being mined in the planning area and the potential for new exploration and development under the different alternatives. The Mormon Basin Mining Operation has been left out of the plan.

Response

Information regarding existing and pending operations within the planning area was obtained from the BLM's LR2000 system. Anticipation of future mining projects can only be assessed for pending notices and pending plans of operations. Trends analysis attempts to capture future possibilities beyond pending status but cannot place likelihood as given by pending notices and pending plans of operations. As required by NEPA, the baseline information used in the Draft EIS, including mineral potential data, was based on the best available information and followed an agency accepted process. Mineral documentation is based on current plans of operations and interest. GRSG is a landscape-level species accompanied by a programmatic EIS for all of Eastern Oregon. Additionally, documentation of minerals is based on observed trends. Proposed mining operations would be analyzed and permitted in accordance with BLM surface management regulations on a site-specific basis.

The Mormon Basin Mining Project is accounted for in the discussion of existing mining claims, notices, and plans of operations in **Section 3.13** in the Final EIS because it is already under development The Mormon Basin Mining Operation was addressed in a project-specific NEPA analysis per its Plan of Operations.

Section 17.4 - Cumulative Impact Analysis

Summary
The Mormon Basin Mining project has been left out of the past, present, and reasonably foreseeable future projects making up the cumulative effects scenario.

Response
The Mormon Basin Mining Project is accounted for in the discussion of existing mining claims, notices, and plans of operations in **Section 3.13** in the Final EIS because it is already under development The Mormon Basin Mining Operation was addressed in a project-specific NEPA analysis as per its Plan of Operations.

Section 20 – Recreation

Section 20.1 - Range of Alternatives

Summary
The BLM should consider using seasonal and temporal closures and/or noise regulations to reduce impacts of recreation on GRSG. Furthermore, the BLM should address the issue of hunting of GRSG. Travel management plans should be prioritized for GRSG.

Response
During subsequent implementation-level travel management planning, new travel management plans would evaluate vehicle routes and determine the need for permanent or seasonal restrictions for roads and trails by season of use, road and trail closures, and type of vehicle use (e.g., motorcycle, ATV, and UTV).

Seasonal and temporal closures have been proposed in Oregon for this planning effort (see Proposed Plan), and seasonal restrictions will diminish noise near leks.

For the GRSG planning effort, travel management plan prioritization has been addressed in the Final EIS and is addressed in **Section 4.10**.

Oregon Department of Fish and Wildlife manages hunting; therefore, hunting is not addressed in this planning effort because it is outside the scope of the EIS.

Section 20.2 - Best Available Information Baseline Data

Summary
The use level numbers and the expenditure data do not correspond to the commenter's knowledge of recreational use.

Response
In accordance with NEPA, the information presented in the Draft EIS is based upon the best scientific information available at the time the document was being written. The BLM uses the best data available based on the metrics the agency has developed in the Recreation Management Information System (RMIS). **Section 22** of this appendix addresses socioeconomics. The BLM expanded the discussion of the economic contribution of recreation in the study area in **Section 3.21**, Social and Economic Conditions (Including Environmental Justice).

Section 21 - Saleable Minerals

Section 21.3 - Impact Analysis

Summary
The document is unclear on how rock quarries on private land would be affected. The closure of rock and fill sources on private and/or public lands could adversely affect the availability of the material and cost of maintaining roads.

Closure of mineral material sites and lack of ability to open new mineral material sites will impact Oregon Department of Transportation maintenance responsibilities and cost.

Response
As stated on page 4-207 of the Draft RMPA/EIS, "Management actions also apply to mineral material development on lands with federal mineral estate, which includes federal mineral estate with BLM-administered surface lands and surface lands not administered by the BLM." As such, mineral operations on private land with federal mineral estate would be impacted in the same way as described in **Section 4.13** of the Draft RMPA/EIS. The BLM has no jurisdiction over non-federal surface and mineral lands. As such, no private lands without federal interest will be closed under this action.

The Draft EIS considered a broad range of alternatives that considers variations in PHMA and GHMA and different restrictions on saleable mineral development, as well as their impacts.

Section 22 - Socioeconomics and Environmental Justice

Section 22.2 - Best Available Information Baseline Data

Summary

Commenters recommend that the BLM review the following data in the Draft EIS for accuracy and consider the recommended sources and data:

- typical impacts of BLM permit reduction at the ranch level
- mineral production employment estimates
- numbers for recreation/tourism employment
- Recreational visits
- Visitor spending by recreational visitors
- Income and employment data and comparison areas
- Social and nonmarket values associated with ranching
- Environmental justice

In general, commenters stated that it would be accurate to use more specific regional data. Commenters question the use of data from 2010, stating that more recent data could be more accurate. Commenters also question the accuracy of trends data from 2000-2010, stating that a longer period would be more informative.

Response

Before beginning the RMPA/EIS and throughout the planning effort, the BLM considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. The BLM used the best available data at the time the Draft EIS was prepared. Most data are from 2010 and provide a snapshot of data at the time. BLM does not expect the difference in impacts across alternatives to be meaningfully altered by updating the baseline data. However, in response to public comments, BLM reviewed the data used for accuracy and revised or updated data when this was found to better support the impact analysis. In particular, the BLM revised the estimates used in the baseline for recreational visits to BLM lands, visitor spending, and billed AUMs. BLM also updated the data on mining employment and inserted additional clarification on baseline recreation data and regional employment data to ensure proper understanding by the public. Potential impacts of permit reductions at the ranch level vary from case to case. Discussion of the potential impacts of management alternatives is found in **Section 4.20**, Social and Economic Impacts (Including Environmental Justice).

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning

Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The BLM will conduct subsequent project-specific NEPA analyses for projects proposed for implementation under the land use plan, which may include but are not limited to fuels treatment, habitat restoration, mineral leasing, livestock grazing permitting, and granting rights-of-way. The subsequent NEPA analyses for project-specific actions will tier to the land use planning analysis and evaluate project impacts at the appropriate site-specific level (40 CFR 1502.20, 40 CFR 1508.28). As required by NEPA, the public will have the opportunity to participate in the NEPA process for site-specific actions.

Of the suggested studies and references put forth by the commenters, the BLM reviewed them to determine if they presented new information that would need to be incorporated into the Final EIS, were references already included in the Draft EIS, or if the references provided the same information as already used or described in the Draft EIS. The BLM determined that the relevant information contained in most references was already reflected in the Draft EIS baseline data. However, BLM added information from Dean Runyan Associates (2014) in **Section 3.21**.

Section 22.3 - Impact Analysis

Summary

Commenters state that the Draft EIS does not include sufficient analysis on the impacts of management actions related to livestock, and suggest that analysis of the following be included in the Final EIS:

- Cost of replacement pasture
- Cost of transport of livestock to replacement pasture
- Downsizing of herds and subsequent loss in income
- Cost of changes to water developments
- Cost of drought management changes to grazing
- Cost in changes to seasons and timing of grazing
- Cost of changes to kind of livestock
- Impacts to property value of ranches resulting from changes to grazing permits
- Impacts to full and part time employees of ranches and the impacts to the community
- Context and intensity of the loss of ranching jobs in small rural communities
- Social aspects of loss of lifeways, traditions, skills with reduction/elimination of grazing

- Changes in cost for wildfire and invasive weed treatment as a result in changes to grazing
- Economic benefits of grazing as a method to maintain GRSG habitat
- The assumed value of an AUM used in the IMPLAN analysis should be reassessed

BLM should review literature cited to consider socioeconomic impacts. Furthermore, commenters state that economic impacts analysis needs to be expanded or reviewed for the following:

- Economic impacts of ROW limitations/exclusions as well as impacts to transmission line limitations such as buried transmission lines
- Impact to future economic opportunities related to locatable, saleable, and leasable minerals and impacts to split-estate lands mineral development
- Cost to state and counties of transporting mineral materials (salable minerals) for road construction and maintenance if pits cannot be accessed at appropriate locations
- Impacts of jobs in the energy sector, including indirect and induced jobs
- Impacts of wind energy development
- Estimates of tourism/recreation
- Impacts from the 3 percent disturbance cap
- Costs to BLM of proposed management actions
- Impacts to community fiscal conditions, including local taxes
- Social/public service changes resulting from economic impacts (i.e., impacts to school enrollment)
- Effects on environmental justice, including Harney County restrictions on wind development and Baker County from restrictions on grazing

Commenters also suggest that the analysis be expanded to include additional details on impacts at the local, county, or community scale and by sector. Commenters also recommend that a high and low scenario be presented for both market and non-market impacts analysis. Finally commenters request additional details of the IMPLAN analysis methods and data, including an explanation of limitations such as the static nature of the model.

Commenters request that a full accounting of all costs and benefits should be completed, including a quantification of non-market values and comparison to market values.

Analysis should include a comparison of the economic impacts resulting for the spotted owl listing.

Response

The requisite level of information necessary to provide an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives is to aid in determining whether to proceed with the preferred alternative or to make a reasoned choice among the other alternatives in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1. The discussion of the environmental consequences should include the proposed action, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented (40 CFR 1502.16).

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The Draft RMPA/EIS contains only planning actions and does not include any implementation actions. As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

In response to comments, BLM revised the impact analysis as follows:

a. The analysis of the high impact scenario for economic impacts of management alternatives through livestock grazing was revised. The high impact scenario now incorporates the possibility of additional AUM losses due to seasonal restrictions as well as closures of livestock operations. The additional losses were estimated based on Torell et al (2014).

b. The analysis of the economic impacts of management alternatives through livestock grazing was revised to recognize the possibility of additional costs associated with fencing and water developments and changes in livestock rotation or season of grazing, although quantitative estimates were not possible at this planning level of analysis.

c. The social impact analysis was expanded to recognize the potential of broad social impacts on small rural communities.

d. The discussion of economic impacts was expanded to include discussion of the relationship between grazing and wild fires and consequent risks to communities.

e. The discussion of the economic implications of restrictions on ROW development, renewable energy development, and mining were expanded, including the IMPLAN calculation of impacts from geothermal development and localized IMPLAN calculation of impacts of wind energy development in Harney County.

f. An explanation of why costs of management actions to BLM were not discussed in detail was inserted in **Section 4.20.1**, Methods and Assumptions.

g. The discussion of potential impacts on county tax collections was expanded.

h. Additional discussion of the impacts of the disturbance cap was included where possible and appropriate.

i. Additional discussion of impacts to counties was included where possible and appropriate.

j. Additional explanation of the IMPLAN analysis was included in **Appendix R**, Economic Impact Analysis Methodology.

BLM considers that several aspects commented on are appropriately addressed in the Draft EIS. In particular:

a. The assumed value of an AUM was based on USDA research and was not modified from the Draft EIS.

b. The treatment of non-market values in this RMPA/EIS is consistent with BLM guidance (see BLM IM 2013-131). Only those non-market values that could reasonably be expected to be meaningfully affected by the choice of management alternatives were discussed.

c. The environmental justice analysis was conducted following CEQ guidance (CEQ 1997), complies with Executive Order 12898, and identifies minority and low-income populations as well as disproportionately high and adverse human health or environmental effects.

d. Although local concern with the economic effect of management alternatives based on previous experience with the listing of the

spotted owl was recognized, an in-depth analysis was not included. As noted in 40 CFR 1508.27, impacts depend on context and intensity, and these are expected to be particular to each case and locality.

Section 22.4 - Cumulative Impact Analysis

Summary
Commenters state that the BLM needs to consider cumulative impacts on changes to grazing level on both private and public lands as a result of proposed actions.

Commenters also state that cumulative impacts on changes to jobs and employment may be underestimated since impacts are more than additive and do not sufficiently recognize/incorporate the historical downward trends in the economy of Eastern Oregon, and BLM should review methods and data.

Commenters stated the cumulative effects on social conditions are understated and should be considered separately from and in addition to economic impacts.

Cumulative impacts associated with wind energy development should be addressed.

Response
As discussed in the response for **Section 22.3** in this appendix, cumulative analysis for the Draft EIS was at the appropriate scale for this planning level effort. The cumulative analysis used Oregon Office of Economic Analysis earnings projections as basis for analysis of cumulative impacts over time. The analysis was revised to incorporate the expanded analysis of impacts through effects on livestock grazing and geothermal development. The cumulative analysis was also expanded to include discussion of impacts across the GRSG range. Because of limitations of availability of quantitative analyses for the various resources affected in the various GRSG habitat sub-regions, the discussion was limited to impacts through oil and gas development.

Section 23 – Soil

Section 23.3 - Impact Analysis

Summary
Additional information pertaining to biological soil crusts was requested for Chapter 3.

Also, commenters requested clarification of impacts on soil resources from livestock.

Response

Additional biological soil crust information has been added to **Section 3.17** in the Final EIS. Impacts on soil resources from livestock have been clarified in **Section 4.17** in the Final EIS. Alternatives were reviewed and rewritten to reflect short-term impacts for vegetation but long-term impacts for biological soil crusts. A detailed analysis of impacts on biological soil crusts is not appropriate at the land use plan scale, and further impacts will be analyzed on a site-specific basis during project implementation.

Section 24 – Travel

Section 24.1 - Range of Alternatives

Summary

1. Commenters expressed concern that proposed travel management actions in the Draft EIS would restrict administrative access to permitted activities such as livestock grazing and ROW development and inhibit the ongoing maintenance of existing infrastructure. Commenters noted that limitations on access should not override the need for timely and efficient responses to emergencies.
2. Commenters were divided between advocating for more or less travel restrictions. Some noted that the BLM should not close or restrict any access or travel throughout the planning area, while others suggest that more routes should be closed through important habitat areas pending BLM's inventory and subsequent travel and transportation analysis. Commenters also requested more clarification or provided input as to the types of management that would (or should) apply once routes are designated.
3. Commenters also had concerns regarding management actions that would limit new road construction or hinder the ability to maintain existing routes (e.g., through restrictions on mineral material disposal).

Response

1. The proposed RMPA would continue to allow access to valid existing rights within the planning area. Upon renewal of a livestock grazing permit, ROW authorization, or similar permitted use, the BLM would work with the permittee/ROW holder to adjust the appropriate level of access based on documented effects of that access on GRSG. Under administrative access in 43 CFR 8340.0-5 (official use), military, law enforcement, municipal use, fire, and permittee access is included (citation below):

a. Off-road vehicle means any motorized vehicle capable of, or designed for, travel on or immediately over land, water, or other natural terrain, excluding:

   i. Any nonamphibious registered motorboat;

   ii. Any military, fire, emergency, or law enforcement vehicle while being used for emergency purposes;

   iii. Any vehicle whose use is expressly authorized by the authorized officer, or otherwise officially approved;

   iv. Vehicles in official use; and

   v. Any combat or combat support vehicle when used in times of national defense emergencies.

Official use means use by an employee, agent, or designated representative of the federal government or one of its contractors, in the course of his employment, agency, or representation.

Under SRP guidelines in the Draft EIS, as well as BLM regulation, SRPs are discretionary with decisions made at the field office line officer level. In terms of area closures, see alternatives considered but eliminated.

2. During subsequent implementation-level travel management planning, travel management plans would evaluate individual routes (roads primitive roads and trails) and determine the need for permanent or seasonal road restrictions or road additions, mode of travel (e.g., motorcycle, ATV, and UTV), and season of use.

   In accordance with NEPA, subsequent travel management planning per the Proposed RMPA will include public involvement, including, but not limited to, the following route selection criteria and goals and objectives respectively.

- During travel management planning, avoid designating roads and trails within 0.6 mile of occupied or pending leks when road traffic volume is greater than 8 vehicles per 24-hour period in accordance with the ODFW mitigation framework.
- When an existing high traffic road is closer than 1 mile to an occupied or pending lek and is the only access, consider a seasonal restriction from March 1 to June 30.
- When an existing road is found to have an effect on GRSG population trends, work with the interdisciplinary team and ODFW to determine the best reroute or closure point for a section of an existing road.

- In addition, implementation-level travel planning efforts would be guided by the goals, objectives, and guidelines outlined in the GRSG section, relevant national and Oregon specific guidance.
- A timeline to complete travel planning efforts would be identified, prioritized, and updated annually in all relevant planning areas to accelerate the accomplishment of data collection, route evaluation and selection, and on-the-ground implementation efforts, including signing, monitoring, and rehabilitation.
- During subsequent travel management planning, consultation "with interested user groups, Federal, State, county, and local agencies, local landowners, and other parties in a manner that provides an opportunity for the public to express itself and have its views given consideration." Consequently, a public outreach plan to fully engage all interested stakeholders will be incorporated into future travel management plans.
- Among other designation criteria from "areas and trails shall be located to minimize harassment of wildlife or significant disruption of wildlife habitats. Special attention will be given to protect endangered or threatened species and their habitats."
- During subsequent travel management planning, all routes would undergo a route evaluation to determine its purpose and need and the potential resource and/or user conflicts from motorized travel. Where resource and/or user conflicts outweigh the purpose and need for the route, the route would be considered for closure or considered for relocation outside of sensitive GRSG habitat.
- During subsequent travel planning, threats to GRSG and their habitat would be considered when evaluating route designations and/or route closures.
- During subsequent travel management planning, routes that do not have a purpose or need would be considered for closure.
- During subsequent travel management planning, routes that are duplicative, parallel, or redundant would be considered for closure.
- During subsequent travel management planning, seasonal restrictions on OHV use would be considered in important seasonal habitats where OHV use is a threat. During subsequent travel management planning, consider limiting over-snow vehicles (OSV) designed for use over snow and that run on a track or tracks and/or a ski or skis, while in use over snow to designated routes or consider seasonal closures in GRSG wintering areas from November 1 through March 31.

- During subsequent travel management planning, routes not required for public access or recreation with a current administrative/agency purpose or need would be evaluated for administrative access only.
- During subsequent travel management planning, consider prioritizing restoration of routes not designated in a travel management plan.
- During subsequent travel management plan implementation, consider using seed mixes or transplant techniques that will maintain or enhance GRSG habitat when rehabilitating linear disturbances.

In the Proposed Plan, all OHV allocations are Limited in PHMA and GHMA unless previously Closed. Limited, in this case, refers to limited to existing, (roads-primitive roads and trails) as described in 43 CFR 8340.0 (definitions) (g) "use on existing roads and trails". In addition, this is a planning document intended to conserve GRSG and GRSG habitat. As noted on page 1-6 of the Draft RMPA/EIS, the purpose of the national GRSG planning effort is limited to making land use planning decisions specific to the conservation, enhancement, and/or restoration of GRSG habitat specifically by reducing, eliminating, or minimizing the threats to that habitat. No decisions related to the management of Wilderness, WSAs, or lands with wilderness characteristics will be made as part of this planning effort; therefore, management of Wilderness, WSAs, and lands with wilderness characteristics is considered outside the scope of this plan amendment process. Impacts on lands with wilderness characteristics from the alternatives being analyzed in this planning effort are presented in **Section 4.19** in the Final EIS.

Minimization criteria have been clarified in the document in accordance with 43 CFR 8342. See **Sections 3.10** and **4.10.2** (Travel Management) in the Final EIS. In addition, an explanation has been added regarding minimization criteria and how those criteria are used.

3. New ROW applications would be evaluated on a case-by-case basis. If an application for a new road ROW is requested, site-specific NEPA analysis would need to be completed as well as adherence to existing resource management plans, including the GRSG amendment.

   Commenter concerns are addressed within the analysis of **Section 4.13**, Mineral Materials (Salable Minerals) in the Draft EIS. Under the alternatives analyzed in the Draft EIS, differing amounts of restrictions/closures could occur, potentially limiting access to free use permit pits used in county maintenance or limiting access to commercial sale. FHWA pits are ROWs but still face differing restrictions, resulting in differing degrees of accessibility.

Exceptions include permittees, human health and safety (fire, SAR, EMS, utility, municipal) will be exceptions to travel restrictions in the planning area.

Section 24.2 - Best Available Information Baseline Data

Summary

1. Commenters asserted that the baseline route information used as a basis for analysis in the Draft EIS is not accurate or not complete, and the process used to develop the inventory is based on false assumptions. Further, most routes predate the establishment of the BLM and should therefore be managed under the jurisdiction of the counties.

2. Commenters questioned the scientific accuracy and references supporting the impact analysis and requested additional site-specific studies to support the analysis in the Draft EIS.

Response

1. As required by NEPA, the baseline information used in the Draft EIS, including GIS-based route inventory data, is based on the best available information and follows an agency-accepted process. More specific route inventories and the designation of travel management for those routes will be carried out as part of a subsequent implementation-level travel management process. Additional data, including ground-truthed inventories, will be gathered to further analyze future route designations. Additionally, the EIS includes a range of alternatives considering seasonal restrictions on roads within discrete areas. Action B-TM 3: In PPMA, travel management should evaluate the need for permanent or seasonal road or area closures.

2. As described in **Section 4.6** of this comment appendix, the Proposed RMPA/Final EIS provides an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives. Further, as described in **Section 4.4** of this comment report, the BLM used the most recent and best available information that was relevant to a land use planning-level analysis.

   Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The Draft RMPA/EIS contains only planning actions and does not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required

by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

Section 24.5 - Mitigation Measures

Summary
The Draft EIS does not include additional definition of ratios of mitigation, who is responsible for mitigation, and how the mitigation will be carried out.

Response
As described in **Section 4.9** of this comment appendix and **Appendix E** of the Final EIS, mitigation will be applied to all implementation actions/decisions that take place on federal lands within GRSG habitat during the life of this plan. Specific mitigation strategies, based on the framework, will be developed by regional teams (at the WAFWA Management Zone level) within one year of the issuance of the Record of Decision. These strategies will guide the application of the mitigation hierarchy to address GRSG impacts within that WAFWA Management Zone.

Section 25 - Tribal Interest

Section 25.1 - Consultation Requirements

Summary
The Fort McDermitt Paiute and Shoshone Tribe requests meaningful consultation during this process.

Response
Chapter 6, Consultation and Coordination in the Proposed RMPA/Final EIS has been updated with additional tribal consultation information.

Section 25.4 - Impact Analysis

Summary
Tribes are concerned that climate change, fire, and drought have not been addressed in the EIS and GRSG have important spiritual and cultural values.

Response
The BLM has revised Chapter 3 to state that Fort McDermitt Paiute and Shoshone Tribe of Nevada and Oregon and Burns Paiute have identified GRSG as important to their culture. Management decisions related to fire, climate change, and drought are discussed in Chapter 2. Land management on tribal reservations is not within the scope of the project.

Section 26 - Vegetation Sagebrush

Section 26.1 - Range of Alternatives

Summary

Commenters were concerned about several issues regarding the alternatives, including prioritization, different management actions, and more detail on certain management actions. Several commenters requested additional details about how much treatment would occur using what methods and what would occur afterwards in terms of subsequent management. Some commenters had specific suggestions about the conduct of vegetation treatments.

Commenters question the prioritization of vegetation treatments and how BLM management would slow conifer encroachment given existing trends.

Response

The Proposed Plan made some adjustments based on the comments, such as developing new vegetation treatment objectives centered on leks and protection measures for old juniper trees and old-growth juniper stands (**Chapter 2**). Other suggestions are not land management plan decisions. All the relevant actions were considered in the range of alternatives. The Draft EIS already included some requests concerning allowable treatment methods, priority juniper phases to treat, and use of native species in restoration efforts in Alternative D; these were carried into the Proposed Plan. Other suggestions were contained in other alternatives in the Draft EIS, such as establishing sagebrush "reserves" (Alternatives C and F) and limiting the use of fire in low-elevation sagebrush (Alternatives B, C, E, and F). Some recommendations are project-level decisions, such as specific locations for vegetation treatments, whether to use prescribed fire, and the length of rest from grazing following treatment. Specifics concerning the use of herbicides are already covered by BLM's 2010 Final EIS and Record of Decision concerning use of herbicides, with site-specific analysis underway on each BLM District in Oregon. Some suggestions were not feasible or too vague to address. For example, defining "dominance" for invasive plant species depends on the species and ecological site under consideration.

More detail about the rate of conifer encroachment was added to **Chapter 3**. Juniper and sagebrush objectives in the Proposed Plan were refined to be more lek-centric in **Chapter 2**.

Section 26.2 - Best Available Information Baseline Data

Summary

The Draft EIS fails to provide adequate baseline information related to invasive species spread and juniper establishment. Commenters requested assumptions for the VDDT modeling and references for statements regarding climate change and spread of invasive species.

More specific comments requested that the expansion rate of juniper needs to be identified.

Response
As described in **Section 4.4** of this appendix, the BLM considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level.

The estimated expansion rate of juniper was included in **Chapter 3** of the Draft EIS on page 3-34. In the Proposed Plan, the BLM compared the expected treatment rate for each alternative to the estimated expansion rate. The juniper treatment discussion in Chapter 4 was moved from the Vegetation section to the GRSG and GRSG Habitat section under COT Report Threat - Conifer Expansion. Details on the VDDT modeling are part of the administrative record instead

Section 26.3 - Impact Analysis

Summary
Commenters request more detailed analysis of the objectives and impacts of vegetation treatment on GRSG, and parameters on allowable treatments to reduce impacts, including limits on allowable methods during lekking and nesting season, and buffers around nesting areas. Commenters state that juniper treatment and invasive plant control efforts have been ineffective and request further analysis.

More specific comments focused on:

1. The use of only native seeds.
2. Post planting evaluations.
3. Objective to treat approximately 30 percent of GRSG habitat over the next 10 years.
4. Effects of mowing on bunchgrass.

Commenters noted the treatment rate of 1 percent is inadequate.

Response
As described in **Section 4.6** of this appendix, the Draft RMPA/EIS provides an adequate discussion of the environmental consequences of the presented alternatives.

Additional detail was added to the discussions concerning juniper treatment, invasive plant treatment, sagebrush treatment, and crested wheatgrass seeding treatment. Discussions on juniper and invasive plant treatments moved from the Vegetation section to the relevant COT Report Threat subsections. Post

treatment monitoring, including after planting or seeding desired species, is already required by BLM vegetation management policy in handbook H-1740-2.

1. The Proposed Plan uses native and non-native seeds.
2. The Proposed Plan will conduct post planting evaluations.
3. The Proposed Plan does not contain 30 percent target, instead it is lek-centric.
4. Mowing to a stubble height that would be similar to the effects of grazing would not provide an adequate fuelbreak. Effective fuelbreaks need a stubble height more similar to that produced under very high utilization. More effective fuelbreaks are created by using forbs and subshrubs that are drought tolerant, very grazing tolerant, and have low flammability instead of using grasses.

The analysis shows a treatment rate of 1 percent is inadequate. Vegetation management objectives were revised while still taking into consideration GRSG.

Section 27 - Vegetation Riparian

Section 27.1 - Range of Alternatives

Summary
Commenter asked about tamarisk and GRSG brood-rearing habitat.

Response
Tamarisk is invading tree-dominated riparian areas. Tree-dominated riparian areas are not associated with GRSG brood-rearing habitat. This is outside the scope of the EIS.

Section 27.2 - Best Available Information Baseline Data

Summary
Commenters noted concerns about inconsistencies in Draft EIS about riparian area baseline information.

Response
BLM revised **Chapter 3** in the EIS to reconcile and remove inconsistencies.

Section 27.4 - Cumulative Impact Analysis

Summary
The benefits to riparian vegetative communities are not discussed in the cumulative impacts section in the Draft EIS.

Response
Reasonably foreseeable actions are not likely to affect riparian areas. No additional analysis is warranted.

Section 29 – Water

Section 29.1 - Range of Alternatives

Summary
Commenter noted concerns pertaining to probability of impacts versus certainty of impacts.

Commenters were also looking for assurance that water sources to be removed in Alternative C would have replacements built before removal occurs.

Response
Because management actions are applied to natural systems where a number of environmental factors are beyond BLM's control, impacts can be discussed in terms of the probability of given outcomes. Certainty in outcomes is not possible.

The percent of streams assessed meeting proper functioning condition is correct as stated in the environmental effects analysis. BLM added wording to **Section 3.4** in the Final EIS clarifying that only a small number of streams have actually had a proper functioning condition assessment. In the Riparian and Wetland section, the reference to the PFC numbers should have stated: "Of the 1.6 percent of the planning area stream miles assessed, 83 percent within designated PPH were rated as properly functioning or on an upward trend."

An Action item in the Proposed Plan states that new water sources will be in place before the old sources are removed.

Section 29.2 - Best Available Information Baseline Data

Summary
Commenters noted concerns pertaining to inaccurate water quality, water quantity, and water rights information, and recommended literature to review.

Response
Oregon Water rights information has been corrected in **Section 3.17.1** to reflect that the state apportions the water. BLM was removed as an agency that can apply for instream rights.

Newer planning area literature examples were added to strengthen the riparian section discussion. BLM moved the vegetation and shade section to **Chapter 4**, as it was analysis rather than current conditions.

Water resource information and available literature were reviewed and applicable changes were made to **Section 3.18** of the Final EIS.

Section 29.3 - Impact Analysis

Summary
Commenters noted concerns about accuracy of impact analysis on water resources from livestock grazing and vehicle travel.

Response
Waste matter was included as one of many listed factors that can degrade water quality, none of which were used to define impacts between alternatives. Travel by any means can disturb biotic crusts in particular, and trails produced by grazing can contribute sediment to streams. This was a listing of potential sources, and management of these disturbances can eliminate the impacts.

The alternatives section was rewritten to describe those impacts that would be considered short or long term as well as put into context across the planning area. Severity was based on allotments (14 percent) not meeting standards (**Table 3-30** in the Final EIS).

The commenter provided several citations for methods to study and quantify sediment into streams, but BLM will not be conducting studies to determine sediment delivery from actions that influence GRSG. No changes to baseline sediment data have been made.

Section 30 - Wild Horse and Burros

Section 30- Wild Horse and Burros

Summary
The BLM did not consider alternatives that adequately limited or managed wild horses in the planning area. The BLM should include greater justification for increasing or decreasing AUMs for wild horse. In addition, the BLM should provide details on how HAF will be used in management of WHB.

Response
The BLM considered a reasonable range of alternatives during the GRSG planning process in full compliance with NEPA. See **Section 4.3**, NEPA Range of Alternatives, in this appendix for an expanded explanation of what constitutes a reasonable range of alternatives.

The BLM protects, manages, and controls wild horses in accordance with the Wild Free-Roaming Horses and Burros Act of 1971 (Public Law 92-195, as amended), the purpose of which is to "manage wild horses and burros within herd management areas (HMAs) designated for their long-term maintenance, in a manner designed to achieve and maintain a thriving natural ecological balance

(TNEB) and multiple use relationships." The FLPMA directs the BLM to manage wild horses and burros as one of numerous multiple uses, including mining, recreation, domestic grazing, and fish and wildlife. It also requires a current inventory of wild horses and burros. Additional guidance is found in 43 CFR 4700, Protection, Management, and Control of Wild Free-roaming Horses and Burros. The BLM does not manage for feral horses. Funding and priority for management and removal of wild horses and burros are determined by national level priorities and land health considerations.

Adjusting AML does fall within the legal mandate of the BLM to protect WHB and other resources. Through the BLM's program of monitoring and analysis of data, AMLs have been established and will continue to be adjusted based on the analysis of data. AMLs can be adjusted based on the limitations and capability of the range, including the four habitat components (forage, water, cover, and space), while managing for healthy populations of WHBs in balance with other uses and resources (including GRSG). Alternative F proposes a 25 percent reduction in AMLs in HMAs that contain GRSG habitat. An explanation of the relationship between AMLs and AUMs has been included in the Final EIS in **Section 3.8**.

The goals and objectives for wild horse and burro management have been updated in **Chapter 2**. **Chapter 4** has been updated with the priorities for removals. **Chapters 3** and **5** have been updated to include more detailed discussions on the impact of wild horses and burros on sagebrush habitat and population estimates. **Chapter 3** has been updated to reflect ongoing and future collaborative efforts with communities located close to HMAs. Additional language on how HAF will be used in management of WHB has been included in the discussion of Management Common to All Alternatives in **Chapter 2**.

Section 30.1 - Best Available Information Baseline Data

Summary
Commenters state that the BLM should consider the findings and recommendations of the National Academy of Sciences (NAS) report and that the BLM should provide information on current wild horse and burro populations and clarify if populations exceed AML.

Response
The NAS report has been considered in the development of the Final EIS and action appropriate to the land management planning level. When reviewing and amending herd management area plans, findings in the NAS report pertaining to fertility control, AML, genetic diversity, and population estimation methods will be analyzed under separate site-specific NEPA actions.

Table 3-22 in the Final EIS has also been updated to include the estimated wild horse and burro population in each HMA.

Section 30.3 - Cumulative Impact Analysis

Summary
Commenters state that the cumulative impacts of removing water developments on wild horse and burro populations was not discussed in the Draft EIS.

Response
Authorization of new or modification of existing livestock watering sites that benefit or conserve PHMA and GHMA habitats would be expected to benefit wild horses and burros. Elimination or fencing of existing water sources that may be identified as impacting PHMA and GHMA habitats could reduce or eliminate water availability, resulting in the potential need for reduction of wild horse and burro numbers within an HMA. In addition, without the availability of water, horses and burro would be expected to move outside HMAs, increasing the cost of gathers for removal of nuisance animals outside HMAs or that occupy private land.

Section 31 - Wilderness Areas/Wilderness Study Areas

Section 31- Wilderness Areas/Wilderness Study Areas

Summary
The BLM should identify actions to maintain lands with wilderness characteristics in PPMA, connectivity, and PGMA habitat areas and analyze the impacts of proposed management on lands with wilderness characteristics. The BLM did not adhere to Manual 6320 by not adequately considering lands with wilderness characteristics in the land use planning process.

Response
BLM Manual 6320, Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process, requires the BLM to update and maintain a wilderness inventory consistent with BLM wilderness characteristics inventory guidance. It also directs the BLM to use the land use planning process to determine how to manage lands with wilderness characteristics as part of the BLM's multiple-use mandate. However, BLM Manual 6320 also states, "In some circumstances, consideration of management alternatives for lands with wilderness characteristics may be outside the scope of a particular planning process (As dictated by the statement of purpose and need for the planning effort). For example, a targeted amendment to address a specific project or proposal may not in all circumstances require consideration of an alternative that would protect wilderness characteristics. In these situations, the NEPA document associated with the plan amendment must still analyze effects of the alternatives on lands with wilderness characteristics."

Section 31.1 - Range of Alternatives

Summary

1. The BLM did not consider actions within Wilderness and WSAs to benefit GRSG, such as native seed planting, removal of structures, and changes to recreation management.

2. Identification and discussion in the Draft EIS of positive and negative effects on lands with wilderness characteristics is lacking in detail. The Draft EIS fails to include any discussion of impacts on areas identified by members of the public as having wilderness characteristics.

Response

1. As noted on page 1-6 of the Draft RMPA/EIS, the purpose of the national GRSG planning effort is limited to making land use planning decisions specific to the conservation, enhancement, and/or restoration of GRSG habitat specifically by reducing, eliminating, or minimizing the threats to that habitat. No decisions related to the management of Wilderness, WSAs, or lands with wilderness characteristics will be made as part of this planning effort; therefore, management of Wilderness, WSAs, and lands with wilderness characteristics is considered outside the scope of this plan amendment process. Impacts on lands with wilderness characteristics from the alternatives being analyzed in this planning effort are presented in **Section 4.19** of the Final EIS.

   Actions such as native seed planting, removal of structures, and changes to recreation management are potentially viable management and restoration options within Wilderness and WSAs. Since these actions would be analyzed, when proposed, on a case-by-case basis for (1) appropriateness, (2) the need for further design modifications based on the individual sites, and (3) resulting environmental impacts, including impacts on wilderness values, it is neither timely nor necessary to consider them in this scale of analysis.

2. The RMPA/EIS contains only planning actions and does not include any implementation actions, such as specific juniper treatments. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM would conduct subsequent NEPA analyses, including wilderness inventories. Site-specific concerns and more detailed environmental descriptions would be addressed when project-level reviews are tiered to the analysis in this EIS (40 CFR 1502.20, 40 CFR 1508.28). In addition, as required by NEPA, the

public will be offered the opportunity to participate in the NEPA process for any site-specific actions.

Impact analysis cannot be more specific as there are no ground-level actions being proposed that will cause more specific impacts. As specific actions that may affect the area come under consideration, the BLM would conduct subsequent NEPA analyses, including any necessary wilderness inventory updates. Site-specific concerns and more detailed environmental descriptions would be addressed when project-level reviews are tiered to the analysis in this EIS (40 CFR 1502.20, 40 CFR 1508.28). In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for any site-specific actions.

Inventories for wilderness characteristics were conducted from 1979 to the present and reflect the most up-to-date lands with wilderness characteristics baseline information for this planning area. In addition to the inventories conducted for the purposes of land use planning, wilderness characteristics inventories will be updated for site-specific project NEPA analyses that are conducted in the planning area to determine if a project will have impacts on lands with wilderness characteristics identified through previous or updated inventory efforts.

Section 32.1 – Predation

Section 32.1- Predation

Summary
The Draft RMPA/EIS failed to adequately address impacts to GRSG from predation.

Response
The BLM describes the effects of predation on GRSG in **Section 4.3** of the Proposed RMPA/Final EIS; the information used here and in the affected environment was taken from the report Summary of Science, Activities, Programs, and Policies that Influence the Rangewide Conservation of GRSG (*Centrocercus urophasianus*) (Manier et al. 2013). The BLM has also updated the description of the threat of predation and provided additional references in **Section 3.3** of the Final EIS.

As stated in **Section 1.5.4** of the Draft EIS, adding management actions specifically to remove predators (i.e., predator control) is outside the scope of this amendment. The BLM has authority to manage habitat and has provided numerous management actions to address predation risk across the range of alternatives (see **Section 2.6** in the Final EIS).

Section 32.2 – Noise

Section 32.2- Noise

Summary
The BLM should correct inconsistencies in sections discussing evaluating the effects of noise on leks and should include new findings from Blickely and Patricelli 2012 in the Final EIS.

Response
The information in **Section 4.2.2** of Draft EIS has been corrected, and additional information and references have been added. Also, an appendix (**Appendix T**) was added to explain how noise levels would be measured and monitored.

Section 32.3 - Invasive Plants

Section 32.3- Invasive Plants

Summary

1. The BLM needs to conduct a NEPA analysis complete with impacts and cumulative effects analysis of the GRSG Wildfire and Invasive Species Habitat Assessments that was cited in Appendix H.
2. Cooperative weed agreements need to be discussed.
3. Commenters recommended literature to review.
4. Commenters requested revisions/clarifications pertaining to the use of nonnative species; the use of herbicides, biocides, and bio-controls; and prioritizing invasive species treatments.
5. The BLM should adopt the invasive species-related prevention/education program found at http://playcleango.org/.

Response

1. The GRSG Wildfire and Invasive Species Habitat Assessments summarize existing conditions and the implications to GRSG habitat and develop recommended actions, but make no decisions so are not subject to NEPA. Site assessments and NEPA review will be conducted for specific projects and are out of scope for this planning level document. **Appendix H** describes the process for this assessment and is not an assessment itself.
2. The BLM works cooperatively with other federal, state, and county agencies as well as private landowners to prevent and control the spread of invasive plants. Information was added to **Chapter 3** briefly describing BLM's participation in 12 Cooperative Weed Management Areas in the planning area. Information under the

trends subsection describes the recent past and current situation with BLM's ability to use herbicides to control invasive plant species.

3. BLM reviewed the suggested literature and incorporated it as needed into the Final EIS.

4. Management actions were clarified pertaining to the use of nonnative species; the use of herbicides, biocides, and biocontrols; and prioritizing invasive plant species treatments (see actions under Vegetation - Habitat Restoration Including Fuels Treatment and Vegetation - Integrated Invasive Species in **Section 2.6** of the Final EIS).

5. BLM reviewed the measures provided by commenters on and regarding playcleango.org. They were found to be the same as, or similar to, those already provided in **Appendix C** in the Final EIS. The BLM did not adopt the "playcleango" guidelines but did adopt other BMPs from the Center for Invasive Plant Management (The Invasive Plant Prevention Guidelines; CIPM 2003). These may be viewed at the following link: http://www.weedcenter.org/store/docs/CIPM_prevention.pdf

V.3 COMMENTER LISTS

Organizations, Conservation Groups, Business
12 Mile Ranch
Abbe Ranch
Adel School Dist. #21
Adel Water Improvement District
Allison Ranch
Alvord Ranch
American Bird Conservancy and Director, Bird Conservation Alliance
American Exploration & Mining Association
American Wild Horse Preservation Campaign
American Wind Energy Association
Animal Clinic of Baker Inc.
Association of Oregon Counties
Auburn Ranch and High Bar Mining,, LLC
Audubon Society of Corvallis
Audubon Society of Portland
Avian Powerline Interaction Committee
Baker County Planning Department
Baker County Soil and Water Conservation Districts
Bend Oregon Lawyers LLC
Bentz Solutions, LLC.
Blue Mountain RFPA
Blue Mountains Biodiversity Project
BlueRibbon Coalition, Inc.
Burns Paiute Tribe
Burns Times Herald
Cahill Ranch
Cahill Ranches Inc.
Capitol Trail Vehicle association (CTVA)
Center for Biological Diversity
Central Oregon LandWatch
Century Ranch
Chair, Harney County Sage-Grouse CCAA Steering Committee
City of Hines
CJ 4
Community Renewable Energy Association
Cottonwood Ranch
County Court of Grant County
Crane Supply & Tavern
Crook-Wheeler County Farm Bureau
Crow Camp Ranch

Organizations, Conservation Groups, Business
Cunningham Ranch
Dash
Defenders of Wildlife
Department of Environmental Quality
Deschutes County
Devil's Canyon Ranch
Dimari Enterprises, LLC
Diversified Land Management
Drewsey Field Ranch
East Cascades Audubon Society
Eastern Oregon Counties Association
Eastern Oregon Mining Association, Inc.
Emerald Trail Riders Association
Fort McDermitt Paiute and Shoshone Tribe of Nevada and Oregon
GJ Wilkinson LLC
Gourmet and Gadgets
Grant County
Grant County Court
Grant County Public Forest Commission, King Williams
Greeley Trust
Gutierrez Cattle Company
Habein Livestock Company/ Lamb Ranch (1879)
Harney County
Harney County Court
Harney County Farm Bureau
Harney County Veterans Office
Harney County Watershed Council
Harney Electric Cooperative
Harney Soil
Harney Soil and Water Conservation District
Haycreek Ranch
HC Stockgrowers
Hells Canyon Preservation Council
Hermreck Beaver Creek Ranch
Hotchkiss Company, Inc.
Howard Ranch LLC
Idaho Power
Jasper Ranch
Jefferson Mining District
Joan Davies Real Estate
Kethcher Cattle Co.
Kiely Brothers Ranch

Organizations, Conservation Groups, Business
Klages Ranch
Lake County
Lake County School District 18 Board of Directors
Lake County School District 7
Lake County Stock Growers
Lakeview Animal Hospital, Inc.
Lucky Creek Ranch
Mackay School of Earth Sciences and Engineering, UNR
Mackenzie Ranch
Malheur County
Malheur County Court
Malheur County Soil and Water District
Mann Lake Ranch
Marchek and Son, Inc.
Maxwell Cattle Inc.
McCormack Ranch, LLC
MidAmerican Energy Holdings Company
Midstate Electric Cooperative, Inc.
Mom and Pop Products Co.
Natural Resources Defense Council
North American Grouse Partnership
O'Leary Ranch, Inc.
OR House of Representatives
Oregon Association of Conservation Districts
Oregon Cattleman's Association
Oregon Chapter of the Sierra Club
Oregon End Ranch
Oregon Farm Bureau
Oregon Hunters Association
Oregon Idaho Utilities
Oregon Natural Desert Association
Oregon Outdoor Council
Oregon Rural Electric Cooperative Association
Oregon State University
Oregon Trail Electric Cooperative
Oregon Wild
Oregonians for Food & Shelter
Otley Bros. Inc. (Ranch)
Pacific Northwest Four Wheel Drive Association
Parsnip Peak Cattle Co.
Pine Valley Ranch
Public Lands Council/National Cattlemen's Beef Association

Organizations, Conservation Groups, Business
Queen Resources, LLC
Rattlesnake Creek Ranch
Renewable Northwest Project
Retail Merchants of Burns, Hines and Harney County
Roaring Spring Ranch
Robbins Farm Equipment
Rose Ranch
Rossi Ranches
Sagebrush Habitat Conservation Fund
Scientific Ecological Services
Sessler Ranches
Sharp Ranches, LLC
Simplot
Sitz Ranch Partnership
SmileyBuilt Offroad and Accessories, LLC
Soda Mountain Wilderness Council
Southeast Oregon Resource Advisory Council
Spurlock Ranch LLC
State of Oregon
Stevenson Intermountain Seed, Inc.
Sullivan Z Ranch, Inc.
Talbott Ranch
The Nature Conservancy in Oregon
The Wilderness Society
Theodore Roosevelt Conservation Partnership
Three Valleys Ranch
Tree Top Ranches, LLP
Triple E Land Holdings & Starlight Cattle Company
Umpqua Valley Timber Cruisers
Union County Cattlemen
Union County Commissioners
US Environmental Protection Agency Region 10 (EPA)
USFWS
VP Ranches
Warnock Ranches
Washington Federal
Western Watershed Project
Western Watersheds
Wheeler County
Whipple Spring, LLC
Wild Horse Education
WildEarth Guardians

Organizations, Conservation Groups, Business
Yamhill Soil and Water Conservation District

Individuals
Albright, Donald A.
Alderson, George and Frances
Alexander, Jan
Alexander, Ken
Allington, Leasa
Allison, Dana
Andersen, Linda
Arnold, Ken and Barbara
Arrien, Kory
Asmussen, Cliff
Averett, Rosalie
Baker, Heather
Baker, Joe
Baker, Leon
Baker, Linda
Baker, Mitch
Baldwin, Jim
Ball, Jeb
Ballance, Noah
Ballard, DeForest
Ballard, Wanda
Baltzor, Katie
Baltzor, Keith
Banch, Levi
Barger, Evan
Barnes, James
Barr, Andy
Bateman, Conrad
Bates, Christine
Bean, Shawn
Beaubien, Kurt
Beck, Richard
Belnap and Family, Raymond S.
Bentz, Jim
Bentz, Linda
Bentz, Mike
Bettman, Al and Melodee

Individuals
Black, Joan
Blake, John & Lacy
Blaylock, Wayne J.
Bloomer, Ted and Diane
Blount, Tim
Bodker, Greg
Booth, Juliet
Borror, Aaron
Borror, Rebecca
Boss, Allan S.
Breese, John and Lynne
Brooks, Mary E.
Brown, Vern I.
Browning, M. Ralph
Bryant, Josh
Buchanan, Chuck and Cheryl
Buchanan, Jim
Bunch, Jean L.
Bunch, Susan
Burris, Ron
Cagle, Charles H.
Cahill, Hugh
Camara, Dawn
Capozzelli, J.
Carnahan, James C.
Carson, Annette
Carson, Todd
Carter, Susan
Caywood, Glenn E.
Chambers, Sean
Chandler, Gary
Chapman, Laurene
Chase, Allan
Chase, Art
Chase, Chuck
Christy, Donn
Chu, Ted

Individuals
Clark, Cindy
Cleland, Bill
Clugston, Bonnie
Coleman, Carol
Coleman, Don and Sue
Colgrove, Tim
Collman, Kathy
Conlee, Dale
Corbet, Peggy
Cottrell, Karen
Cottrell, Larry
Cron, Dan and Laury
Cronin, Toby
Culley, Steve
Cunningham, Becky
Cunningham, Joanne
Dailey, Meb
Danser, D.A.
Davidson, Don
Defenbaugh, Gary
Defenbaugh, Marjorie
Devlin, Marybeth
Dickerson, Ray
Dietmeyer, Gretchen
Dinger, Larry
Dougal, Frank
Drake, Mona
Dryer, Donald A.
Dryer, Matt
Dunbar, Margaret
Dunbar, Margaret P.
Dunn, Larry
Dunten, Alfred
Dunten, Carol
Ebbers, Fran
Edison, Jim
Edmonds, Thomas H.
Elder, Bob

Individuals
Elder, Diane
Elshoff, Alice
Engeberg, Nathan
Fafonik, Abercrombie
Faris, Therone M.
Farris, Elaine
Faw, John
Feist, William
Ferns, Mark
Ferrioli, Mary
Ferrioli, Ted
Fine, Nancy
Finlayson, Stephan
Fitzgerald, Eleanor
Fleming, Dick
Fleming, Mark
Flower, Lee
Flynn, Dennis
Flynn, Joe and Julia
Flynn, John
Flynn, Kathleen
Forseps, Dan
Franklin, Scott and Nellie
Freeman, Dave
Freese, Ken
Frontz, Jeff
Gaston, Ellen
Geier, Joel
George, Don
George, John D.
Getty, Michael
Gheen, Edward
Goeller, Steve
Grady, Richard and Sherryl
Grasty, Steve
Grasty, Steven
Greenwald, Sandy
Gregg, Chris
Gregg, Kathleen
Guthridge, William and Selma
H, Jaime

Individuals
Haak, Barbara Ann
Haak, Daniel
Hale, John
Hammett, Jim and Frank
Hammond, Larry G.
Hampson, Blair
Harder, Ernest and Ellen
Harlan, Rod and Donna
Harper, Sheryll
Harris, Geraldine
Harris, Glenn
Harris, Robert
Hart, Kay
Harvey, Bill
Harvey, Mike
Hearst, Bob
Heaston, John A.
Heckman, Nellson
Hecter, Tim and Janice
Heid, Rochelle
Heid, William A.
Heiken, Doug
Heminger, Howard A.
Hennessy, Eileen
Henricks, Ty
Herkner, John
Herman, Craig J.
Herron, Douglas E.
Hess, Jurgen A.
Hiatt, Richard
Hill, Cyndee
Hoag, Sharron
Hoagland, Rodney
Hollan, Carmelita
Holtz, Tom
Horton, Jack
Howard, Chris
Howes, Stephanie
Huff, Ray
Hughes-Stull, Carla
Hummel, Bruce and Carol
Hussa, John and Linda

Individuals
Hussey, Del
Hussey, Jeff
Hussey, Sherri
Hutton, Mike
Hytrek, Lonny
Imholt, Richard
Isaacs, Barbara
Isaacs, Todd
Jackson, Perrry and Corinna
Jacobs, Curt
Jenkins, Renae
Jenkins, Rich
Jenkins, Richard "Dick"
Jensen, Sheri
Johnson, Cheryl
Johnson, Joe
Johnson, Rick & Sheryl
Johnson, Rodney & Debra
Johnston, Jeff
Joyce, Jack
Joyce, Tony
Kahle, Suzanne
Kaser, Sam
Kegel, Kerry
Keim, Terry
Kern, Robert
Kerns, Tim
Kittredge, Doris
Knapp, Alice
Kniesel, Matt
Konek, Malena
Krebs, Kip
Kull, Barbara
Kurgan, Linda
LaForest, Laura
Laird, Jeese E.
Landers, Gary
Langenfeld, Ann
Langenfeld, Ann
Langenfeld, Joe
Langenfeld, Joy

Individuals
Larson, Larry
Larson, Pat
Lay, Ray
Lee, Darren
Lee, Roland
Leggett, Daryl
Lindsay, Connie and Larry
Little, Matt
Longwell, James
Lovell, Maryanne
Luck, Diane
Lynch, Janet
Mackenzie, Sam
Maher, Joe
Maher, Steve
Mapleson, Larry
Marker, Steven
Markgraf, Kay
Markgraf, Peter
Marks, Jim
Marks, Kelli
Marlette, Gary
Marlette, JoAnn
Martin, Cheryl
Martin, Donald
Martin, T.C.
Maupin, Eric
Maupin, Jeffery
Maxwell, Clark
McAulay, Scott
McBride, LeRoy
McKay, Joe
McKim, Robert
McManus, Gary
McNamee, Runnisha
Meadows, Tara and George
Meeks, Fred
Meredith, Judy
Miller, Craig
Miller, Dana
Miller, Gary R.
Miller, Jerry and Linda

Individuals
Miller, Julie
Miller, Kail
Miller, Leeta
Miller, Norman and Deeann
Miller, Pat and Naida
Molony, Dave
Moore, William T.
Morga, Duanne
Morgan, Betty
Morgan, Brenda
Morgan, Krystal
Morgan, Ralph and Myrna
Morgan, Zak
Morton, Mark
Mosley, Lance
Musser, Richard
Myers, Jim
Myers, Jimmy
Naughton, Vince
Neal, Katherine
Needler, Janet
Nelson, Mark
Neuschwander, Leon
Newbold, Edward
Nicol, D.L. "Jack"
O'Connor, Barry
Oft, Terry and Susan
Ogilvie, Bruce
O'Keeffe, John
O'Leary, Thomas and Karmen
Orman, Valerie
Oster, Sherry
O'Sullivan, Jerry and Lezlie
O'Sullivan, Jerry and Lizlie
O'Sullivan, Mike
Oswald, Robert
Otley, Dan
Otley, Larry
Otley, Susan
Payne, Ted

Individuals
Pearson, Gary
Peila, Bill
Peila, Lori
Peila, Ryan
Petersen, Donald
Petersen, Susan
Phillips, Frederick
Phillips, Jeff
Phillips, Ryan
Pielstick, Leon
Pilkenton, Buck
Pimentel, Gerald
Ponte, Rick
Poole, Norman and Marolyn
Poole, Ralph
Porter, Dwight
Public, Jean
Quinn, Micahel
Radinovich, Jason
Ramer, Karen
Ramsay, Susan & Donald
Reynolds, Doug
Richardson, Kim
Riggs, Roseann
Roberts, Travis
Robertson, Les & Janice
Robinson, Derrin
Rocklein, Christian
Root, Andy
Roseberry, Bill
Rovner, Jeffrey
Rugg, Shirley
Russell, Steve
Ryan, Zola
Ryno, Patricia
Ryno, Ross
Sandersfeld, Dave
Sandrock, Pete
Schnitker, Mike
Scilacci, Kirk
Scott, David

Individuals
Scranton, Chris
Sendelbach, Barbara
Shelley, Jane
Shelman, Casey and Kristen
Shepardson, Stan
Shivell, Mary
Shively, Brenda
Shively, Tim
Siddoway, Bert
Silcocks, Mark
Simmons, John and Karen
Smith, Brandon
Smith, Hal
Smith, Margaret & Charlie
Smith, Tim K
Smith, Wayne & Michele
Smull, Dale
Snyder, Lawrence
Snyder, Lila & Herschel
Snyder, Sara
Spencer, Kurt
St., Dora
Starbuck, Janeen
Starbuck, Luke
Steen, Fred
Steitz, Jim
Stodart, John and Bobbi

Individuals
Stoddart, Dave and Tami
Stoddart, Harry
Stout, Loren
Stroy, Marty
Sturgill, Blair
Sword, John
Sword, Laura
Taug, Dick
Taylor, Buck and Linda
Taylor, Ken and Nancy
Taylor, Linda
Terrill, George
Thomas, Ken
Thomas, Larry
Thomlinson, John
Thompson, David
Toelle, Joe and Autumn
Tyner, Michael
Ugalde, Cathy
Ugalde, Darcy
Uglesich, Peter
Uhalde, Rena
Utley, Joseph
Vaughn, Frank
Vollmer, Timothy
Wagner, Patricia
Wallis, Peg

Individuals
Watts, Elma
Watts, Marilyn Louise
Waugh, Arthur
Weems, Sonja
White, Dean and Petrina
White, Jon
White, Margarita
Whitley, Phil
Wilber, William
Wilcox, Barbara
Williams, Cheryl
Williams, Kerry
Williams, Phil
Willis, Mitchell
Witham, Christia
Witham, Russel
Withers, Alan
Woodruff, Amy
Yanok, Yulee
Younger, Corey
Zgraggen, Amanda
Zimmerman, Ross
Zocco, Rachelle
Gorley
Kcgallery
Ray

Appendix W

Biological Assessment Summary

APPENDIX W
BIOLOGICAL ASSESSMENT SUMMARY

BACKGROUND

The Bureau of Land Management (BLM) has prepared an amendment to its Resource Management Plans (RMP), resulting in a Proposed RMP Amendment (RMPA) and Final Environmental Impact Statement (FEIS). Its purpose is to provide direction for the conservation of greater sage-grouse (Centrocercus urophasianus, GRSG) in the following plans in Oregon:

- Andrews RMP (Andrews Resource Area)
- Baker RMP (Baker Resource Area)
- Brothers/La Pine RMP (Central Oregon Resource Area)
- Lakeview RMP (Lakeview Resource Area)
- Southeastern Oregon RMP (Jordan and Malheur Resource Areas)
- Steens Mountain Cooperative Management and Protection Area RMP (Andrews Resource Area)
- Three Rivers RMP (Three Rivers Resource Area)
- Upper Deschutes RMP (Deschutes Resource Area)

Section 7(a)(2) of the US Endangered Species Act (ESA) of 1973, as amended (16 US Code, Section 1531 et seq.), requires each federal agency to consult with the US Fish and Wildlife Service (USFWS) on any action authorized, funded, or carried out by such agency that it has reason to believe will likely affect any endangered, threatened, or proposed species or designated or proposed critical habitat. Section 7(c) requires each federal agency to conduct a Biological Assessment (BA) for the purpose of identifying any listed or proposed species or designated or proposed critical habitat that is likely to be affected by such action.

The BLM in cooperation with USFWS and National Marine Fisheries Service (NMFS) conducted a BA for the Proposed Plan in the RMPA/FEIS. Because the RMPA is a planning document, the BA focuses on the effect of management actions to be implemented as a part of this planning. This appendix summarizes the findings from the BA (BLM 2015). For purposes of brevity, only the findings from the BA are presented in this appendix.

SUMMARY

The effects determinations from the BA are summarized in **Table W-1**. The BLM has determined the Proposed Plan will have no effect to any of these species or critical habitat. The BLM coordinated the determination with USFWS and NMFS. No consultation, formal or informal, was required.

Table W-1
Summary of the Species Analyzed in This RMPA/EIS and Their Determinations

Species	Status[1]	Determination[2]	Rationale
Gray wolf *Canis lupus*	E	No effect	There is no known overlap between the area occupied by the wolves where federally listed in Oregon and priority habitat management areas (PHMA) or general habitat management areas (GHMA). In the event that the gray wolf occupies the decision area, any effects would be addressed under project-specific National Environmental Policy Act (NEPA) analysis.
Canada lynx *Lynx canadensis*	T	No effect	There is currently no known occurrence of Canada lynx in the decision area. In addition, there is no overlap of habitat described as suitable for Canada lynx and GRSG PHMA and/or GHMA.
Western yellow-billed cuckoo *Coccyzus americanus*	T	No effect	The decision area may overlap with riparian habitat. However, the type or intensity of the activity in the Proposed Plan is expected to have no effect on this species or its habitat.
Western yellow-billed cuckoo Proposed critical Habitat	T	No effect	No critical habitat proposed for the yellow-billed cuckoo occurs in the decision area.
Oregon spotted frog *Rana pretiosa*	T	No effect	Potential habitat for the species does not occur in the decision area.
Oregon spotted frog Proposed critical habitat	T	No effect	Proposed critical habitat for the species does not occur in the decision area.

[1]E = Endangered; T = Threatened; P-T = Proposed threatened
[2]NE = No effect (will not affect the species)

Species	Status[1]	Determination[2]	Rationale
Borax Lake chub *Gila boraxobius*	E	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or cause water depletions in lakes, rivers, or streams occupied by this species.
Borax Lake chub Critical habitat	E	No effect	There are no actions within this RMPA decision that would impact aquatic habitat or cause water depletions in Borax Lake or aquatic environments associated with its outflow.
Bull trout *Salvelinus confluentus*	T	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in lakes, rivers, or streams occupied by bull trout.
Bull trout Critical habitat	T	No effect	There are no actions in this RMPA decision that would impact primary constituent elements described for bull trout.
Lahontan cutthroat trout *Oncorhynchus clarkii henshawi*	T	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in lakes, rivers, or streams occupied by Lahontan cutthroat trout.
Chinook salmon *O. tshawytscha*	T	No effect	Snake River spring/summer run—There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in chinook salmon habitat.
Chinook salmon Critical habitat	T	No effect	Snake River spring/summer run—There are no actions in this RMPA decision that would impact primary constituent elements described for this evolutionarily significant unit (ESU).
Foskett speckled dace *Rhinichthys osculus*	T	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in lakes, rivers, or streams occupied by this species.
Hutton tui chub *Gila bicolor* ssp.	T	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in lakes, rivers, or streams occupied by this species.
Steelhead trout *Oncorhynchus mykiss*	T	No effect	Middle Columbia River ESU—There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in steelhead trout habitat.
Steelhead trout Critical habitat	T	No effect	Middle Columbia River ESU—There are no actions in this RMPA decision that would impact primary constituent elements described for this ESU.
Steelhead trout *O. mykiss*	T	No effect	Snake River Basin ESU—There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in steelhead trout habitat.
Steelhead trout Critical Habitat	T	No effect	Snake River Basin ESU—There are no actions in this RMPA decision that would impact primary constituent elements described for this ESU.

Species	Status[1]	Determination[2]	Rationale
Warner sucker *Catostomus warnerensis*	T	No effect	There are no actions in this RMPA decision that would impact aquatic habitat or deplete water in lakes, rivers, or streams occupied by this species.
Warner sucker Critical habitat	T	No effect	There are no actions in this RMPA decision that would impact primary constituent elements described for this ESU.
Howell's spectacular thelypody *Thelypodium howellii* ssp. *spectabilis*	T	No effect	Howell's spectacular thelypody does not occur in PHMA or GHMA. Because the Proposed Plan would apply only to BLM-administered lands, and all known occurrences are on private lands, the proposed RMPA would not affect this species.
MacFarlane's four-o'clock *Mirabilis macfarlanei*	T	No effect	MacFarlane's four-o'clock habitat does not overlap with PHMA or GHMA, and no occurrences are known to exist on BLM-administered lands; therefore, the proposed RMPA would not affect this species.
Malheur wire-lettuce *Stephanomeria malheurensis*	E	No effect	Although GRSG habitats are nearby, Malheur wire-lettuce does not occur in PHMA or GHMA. Because the Proposed Plan would apply to PHMA and GHMA habitats only, and the South Narrows Area of Critical Environmental Concern (ACEC) already excludes livestock grazing and off-road vehicle use, the proposed RMPA would not affect this species.
Malheur wire-lettuce Critical habitat	E	No effect	Malheur wire-lettuce critical habitat does not exist in PHMA or GHMA. Because the Proposed Plan would apply to PHMA and GHMA habitats only, and the South Narrows ACEC already excludes livestock grazing, off-road vehicle use, and mining, the proposed RMPA would not affect the designated critical habitat for this species.
Spalding's catchfly *Silene spaldingii*	T	No effect	Spalding's catchfly occurrences and suitable habitat are found only to the north of PHMA and GHMA; therefore, the proposed RMPA would not affect this species.