GULF of ALASKA

Navy Training Activities

SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT/ OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

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Gulf of Alaska Navy Training Activities Supplemental Draft Environmental Impact Statement/ Overseas Environmental Impact Statement

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SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT for GULF OF ALASKA NAVY TRAINING ACTIVITIES

Lead Agency:	United States Department of the Navy
Cooperating Agency:	National Marine Fisheries Service
Title of the Proposed Action:	Gulf of Alaska Navy Training Activities
Designation:	Supplemental Draft Environmental Impact Statement/Overseas Environmental Impact Statement

Abstract

The United States (U.S.) Department of the Navy (Navy) prepared this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S. Code §4321 et seq.); the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [C.F.R.] §§1500 et seq.); Navy Procedures for Implementing NEPA (32 C.F.R. §775); and Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*. The Navy identified its need to continue to support and conduct current, emerging, and future training activities in the Gulf of Alaska in order to support U.S. Pacific Command, Northern Command and Joint Task Force commander training requirements to achieve and maintain Fleet readiness, as required by Title 10 of the U.S. Code.

The Navy is not substantially changing the proposed action alternative selected in the May 2011 Record of Decision. The purpose of this Supplemental EIS/OEIS is to supplement the environmental information and analysis contained in the 2011 GOA Final EIS/OEIS with the best available scientific data and analysis techniques. Subsequently, the alternatives analyzed in this Supplemental EIS/OEIS are the same alternatives analyzed in the 2011 GOA Final EIS/OEIS, as follows:

- The No Action Alternative is to continue baseline training activities of the types and levels of training intensity conducted prior to 2011, which did not include Anti-submarine Warfare (ASW) training activities involving the use of active sonar.
- Alternative 1 includes adjustments to the types and levels of activities from the baseline, as necessary, to support current and planned Navy training requirements, including:
  - All training activities addressed in the No Action Alternative and an increase in training activities
  - Conducting one large-scale carrier strike group (CSG) exercise, plus ASW training activities and the use of active sonar, occurring over a maximum time period of up to 21 consecutive days during the April–October timeframe.
  - Training required by force structure changes for new weapons systems, instrumentation, and technology as well as new classes of ships, submarines, and types of aircraft
  - Development and use of the portable undersea tracking range
- Alternative 2 includes all elements of Alternative 1 plus one additional CSG exercise during the summer months (April–October). Additionally, Alternative 2 includes conducting one sinking exercise per CSG exercise for a total of two per year.

In this Supplemental EIS/OEIS, the Navy analyzes potential environmental impacts that result or could result from activities occurring in the Temporary Maritime Activities Area under the Proposed Action. Resource areas of marine mammals and threatened and endangered species are addressed in this supplement due to new information and analytical methods relevant to the potential effects upon those resources. The following resources were considered, but not carried forward for alternatives re-analysis

because there were no new circumstances or information relevant to those environmental concerns from the 2011 GOA Final EIS/OEIS that would require re-analysis in this Supplemental EIS/OEIS: air quality, expended materials, water resources, acoustic environment (airborne), marine plants and invertebrates, fish, sea turtles, birds, cultural resources, transportation and circulation, socioeconomics, environmental justice and protection of children, and public safety.

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Executive Summary

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1

ES.1 INTRODUCTION ES-1
ES.2 PURPOSE OF AND NEED FOR PROPOSED MILITARY READINESS TRAINING ACTIVITIES ES-1
ES.3 SCOPE AND CONTENT OF THE SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT ES-3
ES.4 PUBLIC INVOLVEMENT ES-3
ES.4.1 SCOPING PROCESS ES-3
ES.4.2 DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT ES-4
ES.4.3 FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT/RECORD OF DECISION ES-4
ES.5 PROPOSED ACTION AND ALTERNATIVES ES-4
ES.6 SUMMARY OF ENVIRONMENTAL EFFECTS ES-5
ES.7 CUMULATIVE IMPACTS ES-5
ES.8 STANDARD OPERATING PROCEDURES, MITIGATION, MONITORING, AND REPORTING ES-7
ES.8.1 STANDARD OPERATING PROCEDURES ES-7
ES.8.2 MITIGATION ES-7
ES.8.3 MONITORING ES-8
ES.8.4 REPORTING ES-8
ES.8.5 OTHER CONSIDERATIONS ES-8
ES.8.5.1 Consistency with Other Federal, State, and Local Plans, Policies and Regulations ES-8
ES.8.5.2 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity ES-8
ES.8.5.3 Irreversible or Irretrievable Commitment of Resources ES-8
ES.8.5.4 Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures ES-9

LIST OF TABLES

TABLE ES-1: SUMMARY OF ENVIRONMENTAL IMPACTS FOR THE PROPOSED ACTION ES-6

LIST OF FIGURES

FIGURE ES-1: GULF OF ALASKA TEMPORARY MARITIME ACTIVITIES AREA ES-2

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The United States (U.S.) Department of the Navy (Navy) prepared this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) to supplement the impact analysis contained in the *Final Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy 2011a), hereinafter referred to as the 2011 GOA Final EIS/OEIS, pursuant to 40 Code of Federal Regulations (C.F.R.) §1502.9(c), states that agencies:

> (1) Shall prepare supplements to either draft or final environmental impact statements if:
>
> > (i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
> > (ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.
>
> (2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.
>
> (3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.
>
> (4) Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council.

In accordance with 40 C.F.R. §1502.9(c), this Supplemental EIS/OEIS is being conducted because new information and analytical methods have emerged since the 2011 GOA Final EIS/OEIS relevant to environmental concerns and bearing on the Proposed Action or its impacts. Additionally, this Supplement is being prepared because the National Marine Fisheries Service (NMFS) issued Marine Mammal Protection Act (MMPA) Letters of Authorization (LOAs) for Navy training activities in the GOA will expire in 2016. As such, this Supplemental EIS/OEIS supports issuance of a new LOA.

The at-sea training area in this Supplemental EIS/OEIS is referred to as the Gulf of Alaska (GOA) Temporary Maritime Activities Area (TMAA) Study Area (Study Area) (Figure ES-1) and is the same at-sea training area analyzed in the 2011 GOA Final EIS/OEIS. Additionally, no new or additional Navy training activities are being proposed in the Study Area in this Supplemental EIS/OEIS. Furthermore, no increases to training activity levels, from that stated in the 2011 Record of Decision (ROD), are being proposed in this Supplemental EIS/OEIS.

ES.2 PURPOSE OF AND NEED FOR PROPOSED MILITARY READINESS TRAINING ACTIVITIES

As identified in the 2011 GOA Final EIS/OEIS, the purpose of the Navy's Proposed Action is to achieve and maintain fleet readiness using the Alaska Training Areas[1] (now termed the Joint Pacific Alaska Range Complex) to support and conduct current, emerging, and future training activities.

[1] In the 2011 Final EIS/OEIS, the Navy defined these three training areas as the Alaska Training Areas (ATAs). After the publication of the ROD for the 2011 Final EIS/OEIS, the U.S. Departments of the Army and Air Force published a Final EIS, titled *Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex (JPARC)* (June 2013), for which a ROD was approved and signed on 6 August 2013. The JPARC EIS included the ATAs, and other training areas, and labeled them the JPARC. As such, the Navy has adopted the term "JPARC" when referring to the ATAs.

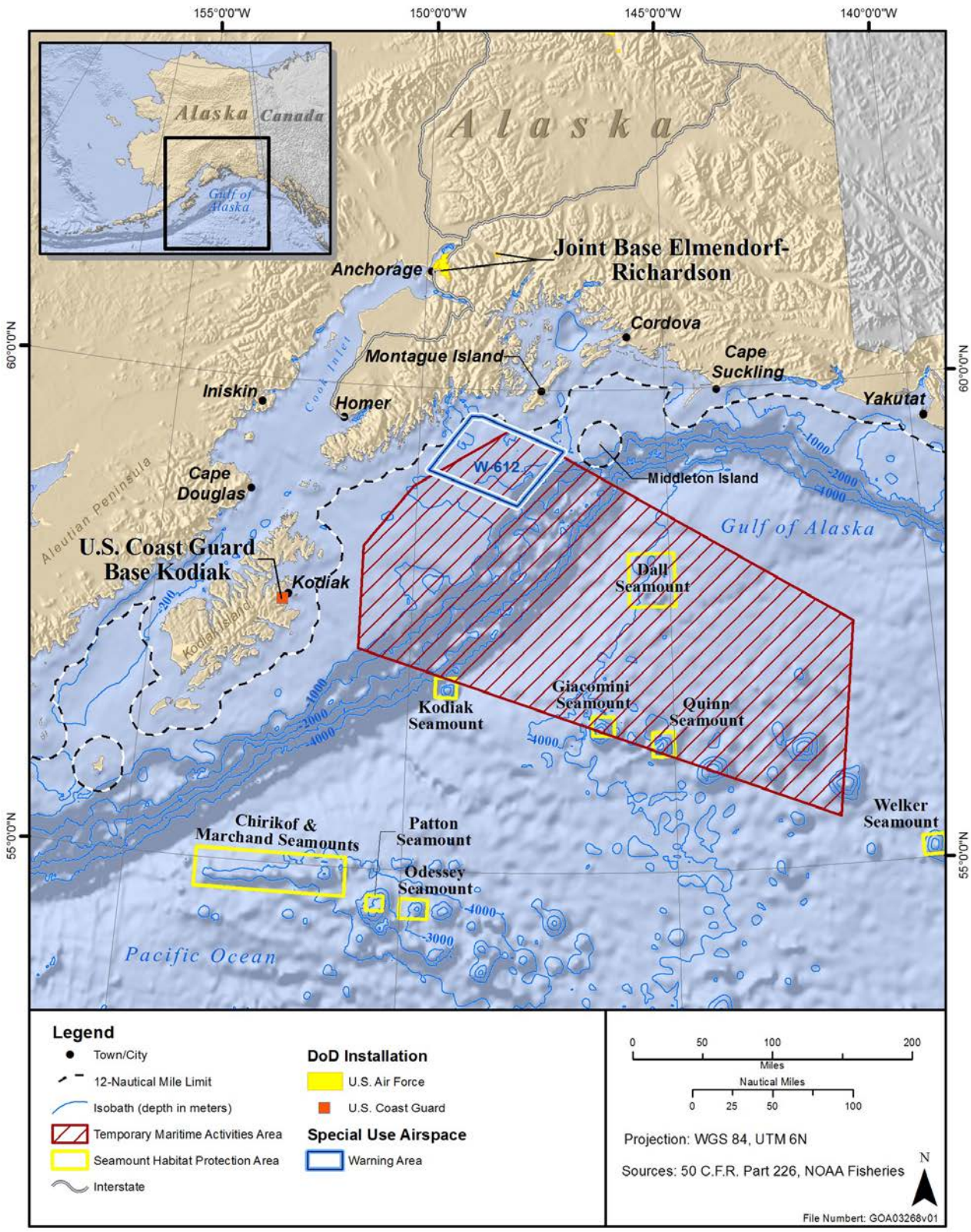

Figure ES-1: Gulf of Alaska Temporary Maritime Activities Area

ES.3 Scope and Content of the Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

In this Supplemental EIS/OEIS, the Navy reevaluated potential impacts from the ongoing military training activities in the TMAA. The alternative analysis presented in the 2011 GOA Final EIS/OEIS and ROD remains relevant for the majority of the resource areas, and as such, those resource areas are not carried forward for full reanalysis in this Supplemental EIS/OEIS. Through the application of new scientific information and Navy Acoustics Effects Model NAEMO, the Navy reanalyzed direct, indirect, cumulative, short-term, long-term, irreversible, and irretrievable impacts that result from the Navy's training activities upon marine mammal resources in this Supplemental EIS/OEIS. The Proposed Action is the continuation of the training as described in the Preferred Alternative in the 2011 GOA Final EIS/OEIS. In this Supplemental EIS/OEIS, all three alternatives—the No Action Alternative, Alternative 1, and Alternative 2—were re-analyzed for their impacts to marine mammals. The Navy is the lead agency for the Proposed Action and is responsible for the scope and content of this Supplemental EIS/OEIS. The NMFS is a cooperating agency pursuant to 40 C.F.R. §1501.6 because of its expertise and regulatory authority over marine resources. Additionally, this document will serve as NMFS' environmental planning documentation for the rule-making process under the MMPA.

In accordance with the Council on Environmental Quality (CEQ) Regulations, 40 C.F.R. §1505.2, upon completion of the Final Supplemental EIS/OEIS, the Navy will issue a ROD that will present the Navy's decision on which alternative to choose in light of the new information. The decision will be based on factors analyzed in this Supplemental EIS/OEIS, including military training objectives, best available science and modeling data, potential environmental impacts, and public input.

ES.4 Public Involvement

The first step in the National Environmental Policy Act (NEPA) process for an EIS is to prepare a Notice of Intent (NOI) to develop an EIS. The Navy published an NOI in the *Federal Register* (Volume 78, No. 11) on 16 January 2013, and ran five NOI display advertisements in five separate newspapers starting on 16 January 2013 through 8 March 2013. In addition, NOI/Notice of Scoping Meeting Letters were distributed to more than 590 federal, state, and local elected officials, Native American Tribes, and government agencies. The NOI provided an overview of the Proposed Action and the scope of the Supplemental EIS, and initiated the scoping process.

ES.4.1 Scoping Process

In accordance with the CEQ regulations for implementing the requirements of NEPA, scoping is not required for a Supplemental EIS (40 C.F.R. §1502.9(c)(4)). However, in an effort to maximize public participation and ensure the public's concerns are addressed, the Navy chose to conduct a scoping period for this Supplemental EIS.

Given that the Navy's Proposed Action and Alternatives have not changed, public scoping meetings were not held, but public comments were accepted during the scoping period from 16 January 2013 to 18 March 2013. In total, the Navy received 13 comment submissions from individuals, groups, agencies, and elected officials. The Navy considered all scoping comments in preparing this Supplemental EIS/OEIS.

ES.4.2 Draft Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

This Draft Supplemental EIS/OEIS has been prepared to assess potential impacts of the Proposed Action on the environment. The Proposed Action is the same as the Proposed Action presented in the 2011 GOA Final EIS/OEIS, for which a ROD was issued, and entails the military continuing training activities previously conducted and as described in the 2011 GOA Final EIS/OEIS. The Draft Supplemental EIS/OEIS assesses potential impacts of all the alternatives (Alternative 1, Alternative 2, and the No Action Alternative). A Notice of Availability was published in the *Federal Register*, and notices were placed in local and regional newspapers announcing the availability of the Draft Supplemental EIS/OEIS. This Draft Supplemental EIS/OEIS is being circulated for review and comment, and five public meetings will be held in Alaska.

ES.4.3 Final Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement/Record of Decision

The Final Supplemental EIS/OEIS (scheduled for completion in early 2016) will address all public comments received on the Draft Supplemental EIS/OEIS. Responses to public comments may include correction of data, clarifications of and modifications to analytical approaches, and inclusion of new or additional data or analyses. Finally, the decision-maker will issue a ROD at least 30 days after the Final Supplemental EIS/OEIS is made available to the public.

ES.5 Proposed Action and Alternatives

Through this Supplemental EIS/OEIS, the Navy will:

- Present the results of the evaluation of relevant new information, which has been incorporated into revised analyses where appropriate. Each resource area discussed within the 2011 GOA Final EIS/OEIS has been evaluated to determine the need for discussion within the Supplemental EIS/OEIS.
- Update environmental analyses with the best available science and most current acoustic analysis methods to evaluate the potential effects of training activities on the marine environment.
- Support authorization of incidental takes of marine mammals under the MMPA and incidental takes of threatened and endangered marine species under the ESA.

The three alternatives re-analyzed in this Supplemental EIS/OEIS are the same alternatives analyzed in the 2011 GOA Final EIS/OEIS, which are:

- **No Action Alternative:** Baseline training activities of the types and levels of training intensity as conducted prior to 2011, which did not include Anti-Submarine Warfare training activities involving the use of active sonar.
- **Alternative 1:** Adjustments to types and levels of activities, from the baseline as necessary to support current and planned Navy training requirements. This alternative included:
    - all training activities addressed in the No Action Alternative and an increase in training activities.
    - conducting one large-scale carrier strike group (CSG) exercise, as well as the inclusion of Anti-Submarine Warfare activities and the use of active sonar, occurring over a maximum time period of up to 21 consecutive days during the summer months (April–October).

  - training required by force structure changes for new weapons systems, instrumentation, and technology as well as new classes of ships, submarines, and new types of aircraft.
  - development and use of the portable undersea tracking range.
- **Alternative 2 (Preferred Alternative):** Included all elements of Alternative 1 plus:
  - one additional CSG exercise during the summer months (April–October).
  - one sinking exercise (SINKEX) to be conducted during each CSG exercise for a total of two per year.[2]

ES.6 Summary of Environmental Effects

Environmental effects which might result from the implementation of the Navy's Proposed Action have been analyzed in this Supplemental EIS/OEIS. Physical resources that were considered for re-evaluation in this Supplemental EIS/OEIS are those that were analyzed in the 2011 GOA Final EIS/OEIS and include air quality, expended materials, water resources, and acoustic environment (airborne). Biological resources (including threatened and endangered species) considered include marine plants and invertebrates, fish, sea turtles, marine mammals, and birds. Human resources considered in this Supplemental EIS/OEIS include cultural resources, transportation and circulation, socioeconomics, environmental justice and protection of children, public safety, and cumulative impacts.

However, as stated previously, this Supplemental EIS/OEIS is being conducted because there is new information and analytical methods relevant to environmental concerns and bearing on the Proposed Action or its impacts. Subsequently, this Supplemental EIS/OEIS presents a re-analysis of training activities involving the use of sonar and other active acoustic sources and underwater explosives using the best available science and analytical methodologies. Since training activities involving sonar and other active acoustic sources and underwater explosives occur in the TMAA, this Supplemental EIS/OEIS analyzes impacts associated with these acoustic stressors to marine mammals within the TMAA. Other potential activities beyond those that cause underwater acoustic impacts are not being fully reevaluated as those impacts are expected to remain the same as described in the 2011 GOA Final EIS/OEIS.

Table ES-1 provides a listing of the potential environmental impacts of the Proposed Action.

ES.7 Cumulative Impacts

Marine mammals are the primary resource of concern for the cumulative impacts analysis. Marine mammal species occurring in the Study Area may be impacted by multiple ongoing and future actions. Explosive detonations and non-impulse sources such as sonar under the No Action Alternative, Alternative 1, and Alternative 2 have the potential to disturb, injure, or kill marine mammals; however, there are very few injuries and no mortalities expected or predicted by the acoustic effect modeling.

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[2] *See* U.S. Department of the Navy, Chief, Naval Operations Instr. 1541.5, General Policy for Sinking Exercise Approval (29 Jul. 2001) (hereinafter OPNAVINST 1541.5). "The Chief of Naval Operations shall approve or disapprove all valid SINKEX requests contingent upon availability of funding to complete environmental preparations." OPNAVINST 1541.5 para. 4a. "Further, SINKEX events are limited to those required to satisfy requirements for ship survivability or weapons lethality evaluation, major joint or multi-national exercises, or the evaluation of significant new multi-unit tactics or tactics and weapons combinations." OPNAVINST 1541.5 para. 2. The Navy recognizes that the likelihood of there being two SINKEX events in any one year in the TMAA is presently unlikely. In order to ensure flexibility to meet potential Fleet training requirements, however, this Supplemental EIS/OEIS conservatively analyzes the potential impacts of conducting up to two SINKEX events per year in the TMAA.

Table ES-1: Summary of Environmental Impacts for the Proposed Action

Resource Category	Alternatives	Summary of Impacts
Air Quality	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Expended Materials	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Water Resources	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Acoustic Environment (Airborne)	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Marine plants and Invertebrates	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Fish	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Sea Turtles	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Marine Mammals	NAA	Impacts from sonar and other active acoustic sources: • Not Applicable Impacts from explosives: • The acoustic modeling and post-modeling analyses predicts an estimated 22 exposures to Dall's porpoises from explosives resulting in Level B harassment and no exposures resulting in Level A harassment
	Alt 1	Impacts from sonar and other active acoustic sources: • The acoustic modeling and post-modeling analyses predict 18,217 marine mammal exposures to sonar and other active acoustic sources resulting in Level B harassment and 1 exposure resulting in Level A harassment. Impacts from explosives: • The acoustic modeling and post-modeling analyses predicts 36 exposures to Dall's porpoises from explosives resulting in Level B harassment and 1 exposure resulting in Level A harassment
	Alt 2	Impacts from sonar and other active acoustic sources: • The acoustic modeling and post-modeling analyses predict 36,453 marine mammal exposures to sonar and other active acoustic sources resulting in Level B harassment and 3 exposures resulting in Level A harassment. Impacts from explosives: • The acoustic modeling and post-modeling analyses predicts 112 exposures to Dall's porpoises from explosives resulting in Level B harassment and 3 exposures resulting in Level A harassment
Birds	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Cultural Resources	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Transportation and Circulation	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Socioeconomics	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Environmental Justice and Protection of Children	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS
Public Safety	NAA/Alt 1/Alt 2	No change from the 2011 GOA Final EIS/OEIS

Notes: Alt = Alternative, EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, NAA = No Action Alternative

The impact on marine mammal species of the Navy's proposed activities is small (see Summary of Impacts on marine mammals in Table ES-1 above). The No Action Alternative, Alternative 1, and Alternative 2 would contribute to cumulative impacts, but the relative contribution would be small compared to other actions. Compared to the potential mortality, stranding, and injury resulting from commercial ship strikes, bycatch, entanglement, ocean pollution and other human causes, the maximum of three potential predicted injuries (a permanent loss of hearing sensitivity) to Dall's porpoises will have no measurable population-level effects.

Because of the negligible impacts of the Proposed Action on the remaining resource categories, cumulative impacts would likewise be negligible.

ES.8 Standard Operating Procedures, Mitigation, Monitoring, and Reporting

Within the Study Area, the Navy implements standard operating procedures, mitigation measures, and marine species monitoring and reporting. Navy standard operating procedures have the indirect benefit of reducing potential impacts on marine resources. Navy recognizes these measures will not eliminate all potential impacts. These measures have been developed as the best balance between effective measures that protect resources while still maintaining the Navy's ability to meet training mission requirements. Mitigation measures are designed to reduce or avoid potential impacts on marine resources. Marine species reporting efforts are designed to track compliance with take authorizations, evaluate the effectiveness of mitigation measures, and improve understanding of the impacts of training and testing activities on marine resources.

ES.8.1 Standard Operating Procedures

The Navy currently employs standard operating procedures to provide for the safety of personnel and equipment, including ships and aircraft, as well as the success of the training (and testing) activities. In many cases there are incidental environmental, socioeconomic, and cultural benefits resulting from standard operating procedures. Standard operating procedures serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits. Because of their importance for maintaining safety and mission success, standard operating procedures have been considered as part of the Proposed Action, and therefore are included in the environmental analyses for each resource.

ES.8.2 Mitigation

The Navy recognizes that the Proposed Action has the potential to impact the environment. Unlike standard operating procedures, which are established for reasons other than environmental benefit, mitigation measures are modifications to the Proposed Action that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. These measures are being coordinated with NMFS through the consultation and permitting processes for this Supplemental EIS/OEIS, although the mitigation measures presented have been previously and recently analyzed and approved in consultation pursuant to the Endangered Species Act and via the rulemaking process pursuant to the Marine Mammal Protection Act (see for example National Marine Fisheries Service 2013; National Oceanic and Atmospheric Administration 2013) for identical Navy training activities in other locations. The Final Supplemental EIS/OEIS and ROD will address any additional mitigation measures that may result from ongoing regulatory processes.

ES.8.3 MONITORING

The Navy is committed to demonstrating environmental stewardship while executing its National Defense Mission and complying with the suite of federal environmental laws and regulations. Since 2006 across all Navy Range Complexes (in the Pacific, Atlantic, Gulf of Mexico, and Gulf of Alaska), there have been over 80 reports (Major Exercise Reports, Annual Exercise Reports, and Monitoring Reports) submitted to National Marine Fisheries Service to further research goals aimed at understanding the Navy's impact on the environment as it carries out its mission to train and test. As a complement to the Navy's commitment to avoiding and reducing impacts of the Proposed Action through mitigation, the Navy will continue to undertake exercise monitoring efforts to track compliance with take authorizations, help investigate the effectiveness of implemented mitigation measures, and better understand the impacts of the Proposed Action on marine resources. Taken together, mitigation and monitoring comprise the Navy's integrated approach for reducing environmental impacts from the Proposed Action. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

ES.8.4 REPORTING

The Navy is committed to documenting and reporting relevant aspects of training activities in order to reduce environmental impacts and improve future environmental assessments. Initiatives include exercise and monitoring reporting, which informs stranding response planning, and bird strike reporting.

ES.8.5 OTHER CONSIDERATIONS

ES.8.5.1 Consistency with Other Federal, State, and Local Plans, Policies and Regulations

Based on an evaluation of consistency with statutory obligations, the Navy's proposed training activities would not conflict with the objectives or requirements of applicable federal, state, regional, or local plans, policies, or legal requirements. The Navy is consulting and will continue to consult with regulatory agencies as appropriate during the planning process and prior to implementation of the Proposed Action to ensure all legal requirements are met.

ES.8.5.2 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity

In accordance with NEPA, this Supplemental EIS/OEIS provides an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. The Proposed Action may result in both short- and long-term environmental effects. However, the Proposed Action would not be expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or the general welfare of the public.

ES.8.5.3 Irreversible or Irretrievable Commitment of Resources

For the Proposed Action, most resource commitments are neither irreversible nor irretrievable. Most impacts are short-term and temporary or, if long lasting, are negligible. No habitat associated with threatened or endangered species would be lost as a result of implementation of the Proposed Action. No commitment of resources to construction is proposed as part of this action.

Implementation of the Proposed Action would require fuels used by aircraft and vessels. However, since the Navy is not proposing any new or increased activities for fixed- and rotary-wing aircraft or ship

activities, total fuel use would not increase relative to the baseline. Therefore, total fuel consumption would not increase under the Proposed Action, and this nonrenewable resource would not be considered irretrievably lost. Additionally, the Navy has initiated programs that are expected to greatly reduce consumption of fossil fuels and reduce greenhouse gas emissions. Included among these are Navy plans to deploy by 2016 a green strike group (a "great green fleet") composed of nuclear vessels and ships powered by biofuel in local operations and with aircraft flying only with biofuels.

ES.8.5.4 Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not result in significant environmental impacts or the unnecessary, inefficient, or wasteful use of resources. Prevention of the introduction of potential contaminants is an important component of mitigation of the Proposed Action's adverse impacts. To the extent practicable, considerations in the prevention of introduction of potential contaminants are included.

Sustainable range management practices are in place that protect and conserve natural and cultural resources and preserve access to training areas for current and future training requirements while addressing potential encroachments that threaten to impact range and training area capabilities.

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TABLE OF CONTENTS

1 PURPOSE AND NEED 1-1

1.1 INTRODUCTION 1-1
1.2 THE NAVY'S ENVIRONMENTAL COMPLIANCE 1-2
1.3 PROPOSED ACTION 1-4
1.4 PURPOSE OF AND NEED FOR PROPOSED MILITARY READINESS TRAINING ACTIVITIES 1-4
1.4.1 WHY THE NAVY TRAINS 1-4
1.5 OVERVIEW AND STRATEGIC IMPORTANCE OF THE JOINT PACIFIC ALASKA RANGE COMPLEX 1-5
1.6 THE ENVIRONMENTAL PLANNING PROCESS 1-6
1.6.1 NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS 1-6
1.6.2 EXECUTIVE ORDER 12114 1-7
1.6.3 OTHER ENVIRONMENTAL REQUIREMENTS CONSIDERED 1-7
1.7 SCOPE AND CONTENT 1-7
1.8 ORGANIZATION OF THIS SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT 1-8
1.9 RELATED ENVIRONMENTAL DOCUMENTS 1-8

2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES 2-1

2.1 DESCRIPTION OF THE JOINT PACIFIC ALASKA RANGE COMPLEX 2-1
2.1.1 GULF OF ALASKA TEMPORARY MARITIME ACTIVITIES AREA 2-2
2.2 DESCRIPTIONS OF ACOUSTIC AND EXPLOSIVE SOURCES EMPLOYED IN THE TEMPORARY MARITIME ACTIVITIES AREA 2-2
2.2.1 CLASSIFICATION OF NON-IMPULSE AND IMPULSE SOURCES 2-2
2.2.1.1 Sources Qualitatively Analyzed 2-5
2.2.1.2 Source Classes Qualitatively Analyzed 2-6
2.3 PROPOSED ACTION AND ALTERNATIVES 2-8

3 GENERAL APPROACH TO ANALYSIS 3-1

3.0 INTRODUCTION 3.0-1
3.0.1 APPROACH TO ANALYSIS 3.0-2
3.0.2 REGULATORY FRAMEWORK 3.0-2
3.0.2.1 Applicable Federal Statutes 3.0-2
3.0.2.2 Guidance 3.0-3
3.0.3 DATA SOURCES AND BEST AVAILABLE DATA 3.0-4
3.0.4 RESOURCES AND ISSUES CONSIDERED FOR RE-EVALUATION IN THIS DOCUMENT 3.0-4
3.0.4.1 Resources Carried Forward for Alternatives Re-Analysis 3.0-5
3.0.5 STRESSORS-BASED ANALYSIS 3.0-6
3.0.5.1 Introduction to Acoustics 3.0-6
3.0.5.2 Stressors 3.0-6
3.0.5.3 Marine Mammal Resource-Specific Impacts Analysis for Acoustic Stressors 3.0-11
3.0.5.4 Cumulative Impacts 3.0-11

3.1 AIR QUALITY 3.1-1
3.1.1 AFFECTED ENVIRONMENT 3.1-1
3.1.1.1 Existing Conditions 3.1-1
3.1.1.2 Current Requirements and Practices 3.1-2
3.1.2 ALTERNATIVES ANALYSIS 3.1-2
3.1.3 CONCLUSIONS 3.1-2

3.2 EXPENDED MATERIALS 3.2-1
3.2.1 AFFECTED ENVIRONMENT 3.2-1
3.2.1.1 Existing Conditions 3.2-1
3.2.1.2 Current Requirements and Practices 3.2-1
3.2.2 ALTERNATIVES ANALYSIS 3.2-2
3.2.3 CONCLUSION 3.2-2

3.3 WATER RESOURCES 3.3-1
3.3.1 AFFECTED ENVIRONMENT 3.3-1
3.3.1.1 Existing Conditions 3.3-1
3.3.1.2 Current Requirements and Practices 3.3-1
3.3.2 ALTERNATIVES ANALYSIS 3.3-3
3.3.3 CONCLUSION 3.3-3

3.4 ACOUSTIC ENVIRONMENT (AIRBORNE) 3.4-1
3.4.1 AFFECTED ENVIRONMENT 3.4-1
3.4.1.1 Existing Conditions 3.4-1
3.4.1.2 Current Requirements and Practices 3.4-1
3.4.2 ALTERNATIVES ANALYSIS 3.4-1
3.4.3 CONCLUSION 3.4-2

3.5 MARINE PLANTS AND INVERTEBRATES 3.5-1
3.5.1 AFFECTED ENVIRONMENT 3.5-1
3.5.1.1 Existing Conditions 3.5-1
3.5.1.2 Current Requirements and Practices 3.5-2
3.5.2 ALTERNATIVES ANALYSIS 3.5-2
3.5.3 CONCLUSION 3.5-3

3.6 FISH 3.6-1
3.6.1 AFFECTED ENVIRONMENT 3.6-1
3.6.1.1 Existing Conditions 3.6-1
3.6.1.2 Essential Fish Habitat 3.6-2
3.6.1.3 Threatened and Endangered Species 3.6-3
3.6.1.4 Hearing in Fish 3.6-5
3.6.1.5 Current Requirements and Practices 3.6-5
3.6.2 ALTERNATIVES ANALYSIS 3.6-5
3.6.3 CONCLUSION 3.6-6

3.7 SEA TURTLES 3.7-1
3.7.1 AFFECTED ENVIRONMENT 3.7-1
3.7.1.1 Existing Conditions 3.7-1

3.7.1.2 Current Requirements and Practices 3.7-3
3.7.2 ALTERNATIVES ANALYSIS 3.7-3
3.7.3 CONCLUSION 3.7-3

3.8 MARINE MAMMALS 3.8-1
3.8.1 INTRODUCTION 3.8-1
3.8.1.1 Species Unlikely to Be Present in the Study Area 3.8-7
3.8.2 AFFECTED ENVIRONMENT 3.8-8
3.8.2.1 Group Size 3.8-9
3.8.2.2 Diving 3.8-9
3.8.2.3 Vocalization and Hearing of Marine Mammals 3.8-10
3.8.2.4 General Threats 3.8-14
3.8.2.5 Marine Mammal Density Estimates 3.8-17
3.8.2.6 North Pacific Right Whale (*Eubalaena japonica*) 3.8-18
3.8.2.7 Humpback Whale (*Megaptera novaeangliae*) 3.8-21
3.8.2.8 Blue Whale (*Balaenoptera musculus*) 3.8-24
3.8.2.9 Fin Whale (*Balaenoptera physalus*) 3.8-25
3.8.2.10 Sei Whale (*Balaenoptera borealis*) 3.8-27
3.8.2.11 Minke Whale (*Balaenoptera acutorostrata*) 3.8-28
3.8.2.12 Gray Whale (*Eschrichtius robustus*) 3.8-29
3.8.2.13 Sperm Whale (*Physeter macrocephalus*) 3.8-31
3.8.2.14 Killer Whale (*Orcinus orca*) 3.8-32
3.8.2.15 Harbor Porpoise (*Phocoena phocoena*) 3.8-35
3.8.2.16 Dall's Porpoise (*Phocoenoides dalli*) 3.8-36
3.8.2.17 Cuvier's Beaked Whale (*Ziphius cavirostris*) 3.8-38
3.8.2.18 Baird's Beaked Whale (*Berardius bairdii*) 3.8-38
3.8.2.19 Stejneger's Beaked Whale (*Mesoplodon stejnegeri*) 3.8-39
3.8.2.20 Steller Sea Lion (*Eumetopias jubatus*) 3.8-40
3.8.2.21 California Sea Lion (*Zalophus californianus*) 3.8-43
3.8.2.22 Northern Fur Seal (*Callorhinus ursinus*) 3.8-44
3.8.2.23 Northern Elephant Seal (*Mirounga angustirostris*) 3.8-45
3.8.2.24 Harbor Seal (*Phoca vitulina*) 3.8-45
3.8.2.25 Ribbon Seal (*Histriophoca fasciata*) 3.8-46
3.8.2.26 Northern Sea Otter (*Enhydra lutris kenyoni*) 3.8-47
3.8.3 ENVIRONMENTAL CONSEQUENCES 3.8-49
3.8.3.1 Acoustic Stressors 3.8-52
3.8.3.2 Application of the Marine Mammal Protection Act to Potential Acoustic Effects 3.8-109
3.8.3.3 Analysis of Effects on Marine Mammals 3.8-112
3.8.4 SUMMARY OF IMPACTS (COMBINED IMPACTS OF ALL STRESSORS) ON MARINE MAMMALS 3.8-181
3.8.5 SUMMARY OF OBSERVATIONS DURING PREVIOUS NAVY ACTIVITIES 3.8-182
3.8.5.1 Alaska Specific Monitoring and Research 3.8-182
3.8.5.2 U.S. West Coast Baleen Whale Tagging 3.8-183
3.8.5.3 Monitoring and Research at Other Pacific Navy Range Complexes 3.8-184
3.8.6 MARINE MAMMAL PROTECTION ACT DETERMINATIONS 3.8-189
3.8.7 ENDANGERED SPECIES ACT DETERMINATIONS 3.8-189

3.9 BIRDS 3.9-1
3.9.1 AFFECTED ENVIRONMENT 3.9-1
3.9.1.1 Existing Conditions 3.9-1
3.9.1.2 Current Requirements and Practices 3.9-4
3.9.2 ALTERNATIVES ANALYSIS 3.9-4
3.9.3 CONCLUSION 3.9-4

3.10 CULTURAL RESOURCES 3.10-1
3.10.1 AFFECTED ENVIRONMENT 3.10-1
3.10.1.1 Existing Conditions 3.10-1
3.10.1.2 Current Requirements and Practices 3.10-1
3.10.2 ALTERNATIVES ANALYSIS 3.10-1
3.10.3 CONCLUSION 3.10-1

3.11 TRANSPORTATION AND CIRCULATION 3.11-1
3.11.1 AFFECTED ENVIRONMENT 3.11-1
3.11.1.1 Existing Conditions 3.11-1
3.11.1.2 Current Requirements and Practices 3.11-1
3.11.2 ALTERNATIVES ANALYSIS 3.11-1
3.11.3 CONCLUSION 3.11-2

3.12 SOCIOECONOMICS 3.12-1
3.12.1 AFFECTED ENVIRONMENT 3.12-1
3.12.1.1 Existing Conditions 3.12-1
3.12.1.2 Current Requirements and Practices 3.12-2
3.12.2 ALTERNATIVES ANALYSIS 3.12-2
3.12.3 CONCLUSION 3.12-3

3.13 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN 3.13-1
3.13.1 AFFECTED ENVIRONMENT 3.13-1
3.13.1.1 Existing Conditions 3.13-1
3.13.2 ALTERNATIVES ANALYSIS 3.13-1
3.13.3 CONCLUSION 3.13-1

3.14 PUBLIC SAFETY 3.14-1
3.14.1 AFFECTED ENVIRONMENT 3.14-1
3.14.1.1 Existing Conditions 3.14-1
3.14.1.2 Current Requirements and Practices 3.14-2
3.14.2 ALTERNATIVES ANALYSIS 3.14-2
3.14.3 CONCLUSION 3.14-2

4 CUMULATIVE IMPACTS 4-1

4.1 INTRODUCTION 4-1
4.2 APPROACH TO ANALYSIS 4-1
4.2.1 OVERVIEW 4-1
4.2.2 IDENTIFY APPROPRIATE LEVEL OF ANALYSIS FOR EACH RESOURCE 4-2
4.2.3 DEFINE THE GEOGRAPHIC BOUNDARIES AND TIMEFRAME FOR ANALYSIS 4-2
4.2.4 DESCRIBE CURRENT RESOURCE CONDITIONS AND TRENDS 4-2
4.2.5 IDENTIFY POTENTIAL IMPACTS OF THE PROPOSED ACTION THAT MIGHT CONTRIBUTE TO CUMULATIVE IMPACTS 4-3
4.2.6 IDENTIFY OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS THAT AFFECT EACH RESOURCE 4-3
4.2.7 ANALYZE POTENTIAL CUMULATIVE IMPACTS 4-4
4.3 OTHER ACTIONS ANALYZED IN THE CUMULATIVE IMPACTS ANALYSIS 4-4
4.3.1 OVERVIEW 4-4
4.3.2 ACTIONS CONSIDERED BUT DISMISSED 4-9
4.3.2.1 Offshore Power Generation 4-9
4.3.2.2 Restoration, Research, and Conservation Projects and Programs 4-9
4.3.2.3 Other Military Activities 4-10
4.3.2.4 United States Coast Guard 4-11
4.3.2.5 Environmental Regulations and Planning 4-12
4.3.2.6 Other Environmental Considerations 4-12
4.3.3 ACTIONS CONSIDERED AND RETAINED 4-13
4.3.3.1 Restoration, Research, and Conservation Projects and Programs 4-13
4.3.3.2 Other Military Activities 4-13
4.3.3.3 Other Environmental Considerations 4-14
4.4 RESOURCE-SPECIFIC CUMULATIVE IMPACTS 4-20
4.4.1 RESOURCE AREAS DISMISSED FROM CUMULATIVE IMPACTS ANALYSIS 4-20
4.4.2 MARINE MAMMALS 4-20
4.4.2.1 Impacts of The Proposed Action That May Contribute to Cumulative Impacts 4-20
4.4.2.2 Impacts of Other Actions 4-21
4.4.2.3 Coastal Development 4-24
4.4.2.4 Cumulative Impacts on Marine Mammals 4-24
4.5 SUMMARY OF CUMULATIVE IMPACTS 4-25

5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING 5-1

5.1 STANDARD OPERATING PROCEDURES 5-1
5.1.1 GENERAL SAFETY 5-2
5.1.2 VESSEL SAFETY 5-2
5.1.3 AIRCRAFT SAFETY 5-3
5.1.4 LASER PROCEDURES 5-3
5.1.4.1 Laser Operators 5-3
5.1.4.2 Laser Activity Clearance 5-3
5.1.5 WEAPONS FIRING PROCEDURES 5-3
5.1.5.1 Notice to Mariners 5-3
5.1.5.2 Weapons Firing Range Clearance 5-3
5.1.6 UNMANNED AERIAL AND UNDERWATER VEHICLE PROCEDURES 5-4

5.1.7 TOWED IN-WATER DEVICE PROCEDURES 5-4
5.1.8 BEST MANAGEMENT PRACTICES 5-4
5.2 INTRODUCTION TO MITIGATION 5-5
5.2.1 REGULATORY REQUIREMENTS FOR MITIGATION 5-5
5.2.2 OVERVIEW OF MITIGATION APPROACH 5-6
5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements 5-6
5.2.2.2 Protective Measures Assessment Protocol 5-7
5.2.3 ASSESSMENT METHOD 5-7
5.2.3.1 Effectiveness Assessment 5-8
5.2.3.2 Operational Assessment 5-9
5.3 MITIGATION ASSESSMENT 5-10
5.3.1 LOOKOUT PROCEDURAL MEASURES 5-10
5.3.1.1 Specialized Training 5-11
5.3.1.2 Lookouts 5-12
5.3.2 MITIGATION ZONE PROCEDURAL MEASURES 5-20
5.3.2.1 Acoustic Stressors 5-23
5.3.2.2 Physical Disturbance and Strike 5-37
5.3.3 MITIGATION MEASURES CONSIDERED BUT ELIMINATED 5-41
5.3.3.1 Previously Considered But Eliminated 5-41
5.4 MITIGATION SUMMARY 5-50
5.5 MONITORING AND REPORTING 5-55
5.5.1 APPROACH TO MONITORING 5-55
5.5.1.1 Integrated Comprehensive Monitoring Program 5-55
5.5.1.2 Scientific Advisory Group Recommendations 5-56
5.5.2 REPORTING 5-57
5.5.2.1 Exercise and Monitoring Reporting 5-57
5.5.2.2 Additional Reporting Requirements 5-57
5.5.2.3 Stranding Response Plan 5-58
5.5.2.4 Bird Strikes 5-58

6 ADDITIONAL REGULATORY CONSIDERATIONS 6-1

6.1 CONSISTENCY WITH OTHER APPLICABLE FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS 6-1
6.1.1 NATIONAL SYSTEM OF MARINE PROTECTED AREAS 6-8
6.2 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 6-12
6.3 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES 6-13
6.4 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF THE PROPOSED ACTION AND MITIGATION MEASURES 6-13

7 LIST OF PREPARERS 7-1

7.1 GOVERNMENT PREPARERS 7-1
7.2 CONTRACTOR PREPARERS 7-2

APPENDIX A FEDERAL REGISTER NOTICES A-1

APPENDIX B AGENCY CORRESPONDENCE B-1

B.1 COOPERATING AGENCY CORRESPONDENCE BETWEEN NAVY AND NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS B-1
B.2 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION, AND NAVY B-6
B.3 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS, AND NAVY B-8
B.4 NAVY CORRESPONDENCE WITH U.S. FISH AND WILDLIFE SERVICE, ANCHORAGE FISH AND WILDLIFE OFFICE B-9
B.5 NAVY CORRESPONDENCE WITH NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION B-11
B.6 NAVY CORRESPONDENCE WITH CHIEF, OFFICE OF HISTORY AND ARCHAEOLOGY, AND STATE HISTORIC PRESERVATION OFFICER B-14

APPENDIX C PUBLIC PARTICIPATION C-1

C.1 PROJECT WEBSITE C-1
C.2 GENERAL SUMMARY OF THE SCOPING PERIOD C-1
C.2.1 TRIBAL NOTIFICATION LETTERS C-1
C.2.2 PUBLIC SCOPING NOTIFICATION C-2
C.2.2.1 Scoping Notification Letters C-2
C.2.2.2 Postcard Mailers C-4
C.2.2.3 Press Releases C-4
C.2.2.4 Newspaper Display Advertisements C-5
C.2.3 SCOPING MEETINGS C-5
C.2.4 PUBLIC SCOPING COMMENTS C-5
C.2.4.1 Impacts on Marine Species C-6
C.2.4.2 Impacts on Airspace C-6
C.2.4.3 Impacts on Fisheries C-6
C.2.4.4 Issues Regarding the 2011 Gulf of Alaska Final Environmental Impact Statement/Overseas Environmental Impact Statement C-6
C.2.4.5 General C-6

APPENDIX D ACOUSTIC PRIMER D-1

D.1 TERMINOLOGY/GLOSSARY D-1
D.1.1 PARTICLE MOTION AND SOUND PRESSURE D-1
D.1.2 FREQUENCY D-1
D.1.3 DUTY CYCLE D-2
D.1.4 LOUDNESS D-2
D.2 PREDICTING HOW SOUND TRAVELS D-3
D.2.1 SOUND ATTENUATION AND TRANSMISSION LOSS D-4
D.2.1.1 Spreading Loss D-4
D.2.1.2 Reflection and Refraction D-5
D.2.1.3 Diffraction, Scattering, and Reverberation D-6
D.2.1.4 Multipath Propagation D-6
D.2.1.5 Surface and Bottom Effects D-6
D.2.1.6 Air-Water Interface D-6

D.3 SOURCES OF SOUND D-8
D.3.1 UNDERWATER SOUNDS D-10
D.3.2 PHYSICAL SOURCES OF UNDERWATER SOUND D-10
D.3.3 BIOLOGICAL SOURCES OF UNDERWATER SOUND D-10
D.3.4 ANTHROPOGENIC SOURCES OF UNDERWATER SOUND D-11
D.3.5 AERIAL SOUNDS D-11
D.3.6 NAVY SOURCES OF SOUND IN THE WATER D-11
D.4 SOUND METRICS D-12
D.4.1 PRESSURE D-12
D.4.1.1 Sound Pressure Level D-13
D.4.1.2 Sound Exposure Level D-13
D.4.2 LOUDNESS AND AUDITORY WEIGHTING FUNCTIONS D-15

LIST OF TABLES

CHAPTER 1 Purpose and Need

There are no tables in this section.

CHAPTER 2 Description of Proposed Action and Alternatives

Table 2.2-1: Non-Impulsive Acoustic Source Classes Analyzed 2-4
Table 2.2-2: Explosive Source Classes Analyzed 2-5
Table 2.2-3: Source Classes Excluded from Quantitative Analysis 2-7
Table 2.3-1: Current and Proposed Training Activities 2-11

CHAPTER 3 General Approach to Analysis

Section 3.0 Introduction

Table 3.0-1: Resource Area Re-Evaluation in the Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement 3.0-5
Table 3.0-2: Acoustic Stressors Associated with Training Activities 3.0-7
Table 3.0-3: Sonar and Other Active Acoustic Sources Quantitatively Analyzed in the Gulf of Alaska Navy Training Activities Study Area 3.0-8
Table 3.0-4: Explosive Sources Used during Training in the Gulf of Alaska Study Area 3.0-10

Section 3.1 Air Quality

There are no tables in this section.

Section 3.2 Expended Materials

There are no tables in this section.

Section 3.3 Water Resources

Table 3.3-1: Waste Discharge Restrictions for Navy Vessels 3.3-2

Section 3.4 Acoustic Environment (Airborne)

There are no tables in this section.

Section 3.5 Marine Plants and Invertebrates

There are no tables in this section.

Section 3.6 Fish

Table 3.6-1: Pacific Salmonid Evolutionarily Significant Units and Distinct Population Segments in the Temporary Maritime Activities Area and Vicinity 3.6-3

Section 3.7 Sea Turtles

There are no tables in this section.

Section 3.8 Marine Mammals

Table 3.8-1: Marine Mammals with Possible or Confirmed Presence within the Gulf of Alaska Study Area 3.8-3

Table 3.8-2: Hearing and Vocalization Ranges for All Marine Mammal Functional Hearing Groups and Species Potentially Occurring within the Study Area 3.8-11
Table 3.8-3: Hearing and Vocalization Ranges for All Marine Mammal Functional Hearing Groups and Species Potentially Occurring within the Study Area 3.8-11
Table 3.8-4: Acoustic Criteria and Thresholds for Predicting Physiological Effects to Marine Mammals Underwater from Sonar and Other Active Acoustic Sources 3.8-85
Table 3.8-5: Criteria and Thresholds for Physiological Effects to Marine Mammals Underwater for Explosives....3.8-89
Table 3.8-6: Summary of Behavioral Thresholds for Marine Mammals....3.8-93
Table 3.8-7: Ratios Used to Prorate Modeling Results on Species to Individual Stocks of Marine Mammals in the Study Area....3.8-98
Table 3.8-8: Lower and Upper Cutoff Frequencies for Marine Mammal Functional Hearing Groups Used in this Acoustic Analysis....3.8-99
Table 3.8-9: Sightability Based on g(0) Values for Marine Mammal Species in Temporary Maritime Activities Area 3.8-108
Table 3.8-10: Post-Model Acoustic Effects Quantification Process....3.8-110
Table 3.8-11: Approximate Ranges to Permanent Threshold Shift Criteria for Each Functional Hearing Group for a Single Ping from Three of the Most Powerful Sonar Systems within Representative Ocean Acoustic Environments 3.8-115
Table 3.8-12: Approximate Maximum Ranges to the Onset of Temporary Threshold Shift for Three Representative Sonar Over a Representative Range of Ocean Environments....3.8-116
Table 3.8-13: Range to Received Sound Pressure Level in 6-Decibel Increments and Percentage of Behavioral Harassments for Low-Frequency Cetaceans under the Mysticete Behavioral Response Function for Three Representative Source Bins for the Study Area....3.8-117
Table 3.8-14: Range to Received Sound Pressure Level in 6-Decibel Increments and Percentage of Behavioral Harassments under the Odontocete* Response Function for Three Representative Source Bins....3.8-118
Table 3.8-15: Marine Mammals Sightings from the Gulf of Alaska Line-Transect Survey (GOALS) II (Rone et al. 2013) 3.8-120
Table 3.8-16: Annual Predicted Effects to Marine Mammals from Use of Sonar and Other Active Acoustic Sources under Alternative 1 ....3.8-123
Table 3.8-17: Annual Predicted Effects to Marine Mammals from Use of Sonar and Other Active Acoustic Sources under Alternative 2 ....3.8-140
Table 3.8-18: Average Approximate Range to Effects from Explosions for Marine Mammals within the Study Area....3.8-160
Table 3.8-19: Impulse Activities Adjustment Factors Integrating Implementation of Mitigation into Modeling Analyses for the Study Area 3.8-162
Table 3.8-20: Activities during the Carrier Strike Group Exercise with Multiple Non-Concurrent Impulse or Explosions....3.8-162
Table 3.8-21: Annual Predicted Effects to Marine Mammals from Use of Explosives under the No Action Alternative 3.8-164
Table 3.8-22: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 1 ....3.8-170
Table 3.8-23: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 2 ....3.8-176
Table 3.8-24: Navy Exercise and Monitoring Report Submissions for the Pacific from 2011 through 1 December 2013....3.8-185
Table 3.8-25: Endangered Species Act Effects Determinations for Acoustic Stressors....3.8-190

Section 3.9 Birds

There are no tables in this section.

Section 3.10 Cultural Resources

There are no tables in this section.

Section 3.11 Transportation and Circulation

There are no tables in this section.

Section 3.12 Socioeconomics

There are no tables in this section.

Section 3.13 Environmental Justice and Protection of Children

There are no tables in this section.

Section 3.14 Public Safety

There are no tables in this section.

Chapter 4 Cumulative Impacts

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis....4-5

Chapter 5 Standard Operating Procedures, Mitigation, and Monitoring

Table 5.3-1: Sightability Based on g(0) Values for Marine Mammal Species in the Study Area....5-18
Table 5.3-2: Predicted Range to Effects and Recommended Mitigation Zones....5-22
Table 5.4-1: Summary of Recommended Mitigation Measures....5-51
Table 5.4-2: Mitigation Identification and Implementation....5-53

Chapter 6 Additional Regulatory Considerations

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action....6-2
Table 6.1-2: Marine Protected Areas Near the Gulf of Alaska Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement Study Area....6-12

Chapter 7 List of Preparers

There are no tables in this section.

APPENDIX A Federal Register Notices

There are no tables in this section.

APPENDIX B Agency Correspondence

There are no tables in this section.

APPENDIX C Public Participation

Table C-1: Public Scoping Comment Summary....C-6

APPENDIX D Acoustic Primer

Table D-1: Common In-Air Sounds and Their Approximate Decibel Ratings D-3
Table D-2: Source Levels of Common Underwater Sounds D-10

LIST OF FIGURES

CHAPTER 1 Purpose and Need
Figure 1.2-1: Gulf of Alaska Navy Training Activities Study Area 1-3
Figure 1.6-1: National Environmental Policy Act Process 1-6

CHAPTER 2 Description of Proposed Action and Alternatives
Figure 2.2-1: Gulf of Alaska Temporary Maritime Activities Area 2-3

CHAPTER 3 General Approach to Analysis
Section 3.0 Introduction
There are no figures in this section.

Section 3.1 Air Quality
There are no figures in this section.

Section 3.2 Expended Materials
There are no figures in this section.

Section 3.3 Water Resources
There are no figures in this section.

Section 3.4 Acoustic Environment (Airborne)
There are no figures in this section.

Section 3.5 Marine Plants and Invertebrates
There are no figures in this section.

Section 3.6 Fish
There are no figures in this section.

Section 3.7 Sea Turtles
There are no figures in this section.

Section 3.8 Marine Mammals
Figure 3.8-1: North Pacific Right Whale Critical Habitat in the Vicinity of the Temporary Maritime Activities Area 3.8-20
Figure 3.8-2: Steller Sea Lion Western Distinct Population Segment Critical Habitat in the Vicinity of the Temporary Maritime Activities Area 3.8-42
Figure 3.8-3: Southwest Alaska Stock Sea Otter Designated Critical Habitat in the Vicinity of the Temporary Maritime Activities Area 3.8-48
Figure 3.8-4: Two Hypothetical Threshold Shifts, Temporary and Permanent 3.8-57
Figure 3.8-5: Commercial Vessel Density Involving the Study Area in 2011 ..... 3.8-70
Figure 3.8-6: Type I Auditory Weighting Functions Modified from the Southall et al. (2007) M-Weighting Functions 3.8-83
Figure 3.8-7: Type II Weighting Functions for Low-, Mid-, and High-Frequency Cetaceans 3.8-84

Figure 3.8-8: Behavioral Response Function Applied to Mysticetes 3.8-92
Figure 3.8-9: Behavioral Response Function Applied to Odontocetes, Pinnipeds, and Sea Otters.....3.8-92
Figure 3.8-10: Hypothetical Range to Specified Effects for a Sonar Source 3.8-114
Figure 3.8-11: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 0.5-Pound Net Explosive Weight Charge (Bin E2) Detonated at 1-Meter Depth 3.8-157
Figure 3.8-12: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 10-Pound Net Explosive Weight Charge (Bin E5) Detonated at 1-Meter Depth 3.8-158
Figure 3.8-13: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 250-Pound Net Explosive Weight Charge (Bin E9) Detonated at 1-Meter Depth 3.8-158
Figure 3.8-14: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 1,000-Pound Net Explosive Weight Charge (Bin E12) Detonated at 1-Meter Depth 3.8-159

Section 3.9 Birds

There are no figures in this section.

Section 3.10 Cultural Resources

There are no figures in this section.

Section 3.11 Transportation and Circulation

There are no figures in this section.

Section 3.12 Socioeconomics

There are no figures in this section.

Section 3.13 Environmental Justice and Protection of Children

There are no figures in this section.

Section 3.14 Public Safety

There are no figures in this section.

Chapter 4 Cumulative Impacts

Figure 4-1: Commercial Vessel Density Involving the Study Area in 2011 4-15

Chapter 5 Standard Operating Procedures, Mitigation, and Monitoring

Figure 5.2-1: Flowchart of Process for Determining Recommended Mitigation Measures.....5-8

Chapter 6 Additional Regulatory Considerations

Figure 6.1-1: Map of Marine Protected Areas Near the Study Area 6-11

Chapter 7 List of Preparers

There are no figures in this section.

APPENDIX A Federal Register Notices

There are no figures in this section.

APPENDIX B Agency Correspondence

There are no figures in this section.

APPENDIX C Public Participation

There are no figures in this section.

APPENDIX D Acoustic Primer

Figure D-1: Graphical Representation of the Inverse Square Relationship in Spherical Spreading D-4
Figure D-2: Characteristics of Sound Transmission through the Air-Water Interface D-7
Figure D-3: Oceanic Ambient Noise Levels from 1 Hertz to 100,000 Hertz, Including Frequency Ranges for Prevalent Noise Sources D-9
Figure D-4: Examples of Impulse and Non-Impulse Sound Sources D-12
Figure D-5: Various Sound Pressure Metrics for a Hypothetical (a) Pure Tone (Non-Impulse) and (b) Impulse Sound D-13
Figure D-6: Summation of Acoustic Energy (Cumulative Exposure Level, or Sound Exposure Level) from a Hypothetical, Intermittently Pinging, Stationary Sound Source D-14
Figure D-7: Cumulative Sound Exposure Level under Realistic Conditions with a Moving, Intermittently Pinging Sound Source (Cumulative Exposure Level = Sound Exposure Level)..... D-15

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ACRONYMS AND ABBREVIATIONS

(r_0)	charge radius
µg	micrograms(s)
µg/g	microgram(s)/gram
µg/L	microgram(s) per liter
µm	micrometers
µPa	micropascal(s)
µPa-m	micropascal-meter
μPa^2-s	micropascal squared seconds
°	degrees
AAW	Anti-Air Warfare
ac.	acre(s)
ACM	Air Combat Maneuver
ACMP	Alaska Coastal Management Program
ADFG	Alaska Department of Fish and Game
AGM	Air-to-Ground Missile
AIM	Air Intercept Missile
Air Force	United States Department of the Air Force
ALTRV	Altitude Reservation
AOE	Fast Combat Support Ship
Army	United States Department of the Army
ARTCC	Air Route Traffic Control Center
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATAs	Alaska Training Areas
ATCAA	Air Traffic Control Assigned Airspace
AtoN	Aids to Navigation
AUTEC	Atlantic Undersea Test and Evaluation Center
AUV	Autonomous Underwater Vehicle
BA	Biological Assessment
BDU	Bomb Dummy Unit
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BOMBEX	Bombing Exercise
BQM	Aerial Target Drone Designation
BRF	Behavioral Risk Function
BWPT	Bilge Water Processing Tank
C	Celsius
CAA	Clean Air Act
cal	Caliber
CATM	Captive Air Training Missile
Ce_{HF}	High-Frequency Cetacean Weighting Function
Ce_{LF}	Low Frequency Cetacean Weighting Function
Ce_{MF}	Mid-Frequency Cetacean Weighting Function
CEQ	Council on Environmental Quality
C.F.R.	Code of Federal Regulations
CG	Cruiser
CH_4	methane
CIWS	Close-in Weapons System
cm	centimeter(s)
CMP	Coastal Management Program
CO	carbon monoxide
CO_2	carbon dioxide
CO_2Eq	carbon dioxide equivalent
CSG	Carrier Strike Group
CV	Coefficient of Variation
CVN	Aircraft Carrier (Nuclear)
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibel(s)
dB re 1 µPa	decibels referenced to 1 micropascal
dBA	A-weighted decibels
DDG	Destroyer
DDT	dichlorodiphenlytrichlorethane
DEIS	Draft Environmental Impact Statement
DICASS	Directional Command Activated Sonobuoy
DIFAR	Directional Frequency and Ranging
DOC	Department of Commerce
DoD	Department of Defense
DOI	Department of Interior
DPS	Distinct Population Segments
D_{Rm}	depth of receiver (animal) in meters
DS	Doppler Sonar
EA	Electronic Attack
EC	Electronic Combat
EER	Extended Echo Ranging
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EL	Exposure Level
EMATT	Expendable Mobile Anti-Submarine Warfare Training Target
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ERL	effects range – low
ERM	effects range – median
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
EW	Electronic Warfare
F	Fahrenheit
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control Surveillance Facility
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FFG	Frigate
FL	flight level
FMP	Fishery Management Plan
FR	Federal Register
FRR&DP	Fleet Readiness Research and

	Development Program
ft.	feet
$ft.^2$	square feet
FY	Fiscal Year
g	gram(s)
g(0)	Detection Probability
G	gauss
gal.	gallon(s)
GI	gastrointestinal
GOA	Gulf of Alaska
GOALS	Gulf of Alaska Line-Transect Survey
GUNEX	Gunnery Exercise
h	depth
ha	hectare(s)
HARM	High Speed Anti-Radiation Missile
HARP	High-Frequency Acoustic Recording Package
HDC	High Duty Cycle
HF	high-frequency
HRC	Hawaii Range Complex
HSMST	High-Speed Maneuverable Surface Target
Hz	Hertz
IEER	Improved Extended Echo Ranging
i-ENCON	Incentivized Energy Conservation
IFR	Instrument Flight Rules
in.	inch(es)
ISR	Intelligence, Surveillance, Reconnaissance
JPARC	Joint Pacific Alaska Range Complex
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kW	kilowatt(s)
L	liter(s)
lb.	pound(s)
LCAC	Landing Craft, Air Cushion
LF	low-frequency
LFA	low-frequency active
Lmax	maximum peak sound level
LOA	Letter of Authorization
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
M	acoustic modems
MAC	Multistatic Active Coherent
MARPOL	International Convention for the Prevention of Pollution from Ships
MBTA	Migratory Bird Treaty Act
MF	mid-frequency
MFA	Mid-Frequency Active
MFAS	Mid-Frequency Active Sonar
mg	milligram(s)
mg/L	milligram(s) per liter
mi.	mile(s)
$mi.^2$	square mile(s)
min.	minute(s)
ml	milliliter(s)
mm	millimeter(s)
MMA	Multi-mission Aircraft
MMPA	Marine Mammal Protection Act
MOA	Military Operations Area
MPA (1)	Maritime Patrol Aircraft
MPA (2)	Marine Protected Area
msec	millisecond(s)
MSL	mean sea level
MW	mine warfare
MIW	Mine Warfare
N	North
N_2O	nitrous oxide
N/A	not applicable
NAEMO	Navy Acoustics Effects Model
NAS	Naval Air Station
NAVSEA	Naval Sea Systems Command
Navy	United States Department of the Navy
NEPA	National Environmental Policy Act
NEPM	Non-explosive Practice Munition
NEW	Net Explosive Weight
NHPA	National Historic Preservation Act
nm	nautical mile(s)
nm^2	square nautical mile(s)
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Lab
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NOTAM	Notice to Airmen
NRHP	National Register of Historic Places
NSW	Naval Special Warfare
NTM	Notice to Mariners
O_3	ozone
OBIS-SEAMAP	Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate
OCE	Officer Conducting the Exercise
OCM	Oil Content Monitor
OEIS	Overseas Environmental Impact Statement
OPAREA	Operating Area
OPNAVINST	Chief of Naval Operations Instruction
OPNAV M	Chief of Naval Operations Manual
OWS	Oil/Water Separator
oz.	ounce(s)

P	Pinger
Pa	Pascal
Pb	lead
Pa-s	Pascal-seconds
PCAD	Population Consequences of Acoustic Disturbance
PCBs	polychlorinated biphenyls
PCE	Primary Constituent Element
PM	particulate matter
PM_{10}	PM ≤10 microns in diameter
$PM_{2.5}$	PM ≤2.5 microns in diameter
PMAP	Protective Measures Assessment Protocol
PMRF	Pacific Missile Range Facility
P_O	Otariid Pinniped Weighting Function
POPS	Project Operations
P_P	Phocid Pinniped Weighting Function
ppb	parts per billion
ppm	parts per million
PRST	Post Refit Sea Trial
PSA	Post Shakedown Availability
psi	pounds per square inch
PTS	permanent threshold shift
R	Restricted Area
RAM	Rolling Airframe Missile
RDT&E	Research, Development, Testing and Evaluation
RDX	royal demolition explosive
re	referenced to
RHIB	Rigid Hull Inflatable Boat
RL	Received Level
rms	root mean square
RMMV	Remote Multi-Mission Vehicle
ROD	Record of Decision
ROI	Region of Influence
ROP	Range Operating Policies and Procedures Manual
ROV	Remotely Operated Vehicle
S	south
SAR	Stock Assessment Report
SAS	Synthetic Aperture Sonar
SD	Swimmer Detection Sonar
SDV	SEAL Delivery Vehicle
SEAL	Sea, Air, Land
sec	second(s)
SEL	Sound Exposure Level
SINKEX	Sinking Exercise
SIP	State Implementation Plan
SL	source level
SO_2	sulfur dioxide
SOCAL	Southern California
Sonar	SOund Navigation and Ranging
SOP	Standard Operating Procedure
SPL	Sound Pressure Level
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SQT	SEAL Qualification Training
SSN	Navy submarine
Study Area	GOA (TMAA) Study Area
STW	Strike Warfare
SUA	Special Use Airspace
SURTASS	Surveillance Towed Array Sensor System
SUS	Signal Underwater Sound
SWAG	Shock Wave Action Generator
SWFSC	Southwest Fisheries Science Center
TALD	Tactical Air Launched Decoy
TDU	Target Drone Unit
Tg	tetragram(s)
TL	transmission loss
TMAA	Temporary Maritime Activities Area
TNT	trinitrotoluene
TOC	total organic carbon
TORP	torpedoes
TRACKEX	tracking exercise
TTS	temporary threshold shift
T-weighting	turtle-weighting
UAS	Unmanned Aerial System
UEWS	Underwater Emergency Warning System
U.S.	United States
U.S.C.	United States Code
USCG	United States Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USSOCOM	U.S. Special Operations Command
USV	Unmanned Surface Vehicle
UUV	Unmanned Underwater Vehicle
VDS	Variable Depth Sonar
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	volatile organic compounds
W (1)	Warning Area
W (2)	west
yd.	yard(s)

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MASTER GLOSSARY OF TERMS

Term	Definition
Acoustics	The scientific study of sound, especially of its generation, transmission, and reception.
Action proponent	The commander, commanding officer, or civilian director of a unit, activity, or organization who initiates a proposal for action, as defined in 40 Code of Federal Regulations (C.F.R.) 1508.23, and who has command and control authority over the action once it is authorized. Commander, United States (U.S.) Pacific Fleet is the action proponent for the Gulf of Alaska Navy Training Activities Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS).
Active sonar	A system that detects objects by creating a sound pulse, or ping, that transmits through the water and reflects off the target, returning in the form of an echo. This is a two-way transmission (source to reflector to receiver).
Alternative	A different method for accomplishing the Proposed Action. An action alternative modifies some combination of factors affecting the location, timing, or scope of the activity while still accomplishing the purpose of the Proposed Action. The No Action Alternative provides a baseline (existing condition or historic condition) against which to compare the action alternatives, but may not necessarily fulfill the purpose of the Proposed Action.
Ambient sound	The typical or persistent environmental background sound present in the ocean.
Anadromous	Species of fish that are born in freshwater, migrate to the ocean to grow into adults, and return to freshwater to spawn.
Anthropogenic sound	Acoustic energy emitted from human activities.
Anti-Submarine Warfare	Naval operations that involve detecting, tracking, and potential engagement with submarines, their supporting forces, and operating bases that demonstrate hostile intent or are declared hostile by appropriate authority.
Baleen	In some whales (see Mysticete below), the parallel rows of fibrous plates that hang from the upper jaw and are used for filter feeding.
Bathymetry	The measurement of water depth at various places in a body of water; the information derived from such measurements.
Behavioral effect	Defined in this Supplemental EIS/OEIS as a variation in an animal's behavior or behavior patterns that results from an anthropogenic acoustic exposure and exceeds the normal daily variation in behavior, but which arises through normal physiological process (it occurs without an accompanying physiological effect).
Benthic	Referring to the bottom-dwelling community of organisms (i.e., plants and animals) that creep, crawl, burrow, or attach themselves to either the sea bottom or such structures as ships, buoys, and wharf pilings (e.g., crabs, clams, worms).
Biologically important activities/behaviors	Those activities or behaviors essential to the continued existence of a species, such as migration, breeding/calving, or feeding.
Biologically important area	For cetacean species with distinct migrations, areas, and time periods where they are known to concentrate for specific behaviors such as reproducing, feeding, or migrating. For other cetacean species, areas and months within which small and resident populations occupy a limited geographic extent.
Biological Opinion	A document that is the result of Endangered Species Act, Section 7 formal consultation. This document states the opinion of the Service (National Marine Fisheries Service or U.S. Fish and Wildlife Service) on whether or not a Federal action is likely to adversely affect or jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat and, if so, the Service provides recommendations to minimize or avoid adverse impacts.
Cetacean	An order of aquatic mammals such as whales, dolphins, and porpoises.

Term	Definition
Critical habitat	The term "critical habitat" for a threatened or endangered species means (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Endangered Species Act, on which are found those physical or biological features (i) essential to the conservation of the species, and (ii) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.
Cumulative impact	The impact on the environment which results from adding the incremental impact of the Proposed Action to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes the other actions.
Decibel (dB)	A unit used to express the relative difference in power, usually between acoustic or electrical signals, equal to 10 times the common logarithm of the ratio of the two levels. Since the decibel scale is exponential and not linear, a 20 dB sound is 10 times louder than a 10 dB sound, and a 30 dB sound is 100 times louder than a 10 dB sound.
Demersal	Living at or near the bottom of a water body, but having the capacity for active swimming. Term used particularly when describing various fish species.
Distinct population segment (DPS)	A vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The Endangered Species Act provides for listing species, subspecies, or DPSs of vertebrate species.
Duty cycle	Duty cycle describes the portion of time that a sound source actually generates sound. It is defined as the percentage of the time during which a sound is generated over a total operational period.
Endangered species	Any species which is in danger of extinction throughout all or a significant portion of its range.
Essential fish habitat	Those waters and substrate that are defined within Fishery Management Plans for federally managed fish species as necessary to fish for spawning, breeding, feeding, or growth to maturity.
Exclusive Economic Zone	A maritime zone adjacent to the territorial sea that may not extend beyond 200 nautical miles (nm) from the baselines from which the breadth of the territorial sea is measured.
Federal Register	The official daily publication for actions taken by the federal government, such as Rules, Proposed Rules, and Notices of federal agencies and organizations, as well as Executive Orders and other Presidential documents.
Frequency	The number of oscillations or waves per second is called the frequency of the sound, and the metric is Hertz (Hz). One Hz is equal to one oscillation per second, and 1 kilohertz (kHz) is equal to 1,000 oscillations per second.
Harassment	Under the 1994 Amendments to the Marine Mammal Protection Act (MMPA) and as used in this document, harassment is statutorily defined as, any act of pursuit, torment, or annoyance which (Level A Harassment) "has the potential to injure a marine mammal or marine mammal stock in the wild," or (Level B Harassment) "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering," but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. Under the Endangered Species Act, the term "harass" is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering."
High-frequency	As defined by the U.S. Department of the Navy (Navy), frequencies greater than 10–100 kHz.

Term	Definition
Hydrophone	An underwater receiver used to detect the pressure change caused by sound in the water. That pressure is converted to electrical energy. It can then be translated to something that can be heard by the human ear. Sometimes the detected acoustic pressure is outside the human range of hearing.
Impulse sound	Impulse sounds are sounds defined as brief, broadband, atonal, transients (American National Standards Institute 1994; Jansen 1998, Chapter 12).[1] Examples of impulse sounds (at least at the source) are explosions, gunshots, sonic booms, seismic airgun pulses, and pile driving strikes. These sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a decay period that may include a period of diminishing oscillating maximal and minimal pressures. The rapid rise-time characteristic of these sounds ensures that they are also broadband in nature, with the higher-frequency components being related to the rapidity of the rise-time. Pulses, either as isolated events or repeated in some succession, generally have an increased capacity to induce physical injury as compared with sounds that lack these features (Southall et al. 2007).[2]
Infauna	Animals living within the sediment.
In-water devices	In-water devices as discussed in this analysis are unmanned vehicles, such as remotely operated vehicles, unmanned surface vehicles, unmanned undersea vehicles, and towed devices.
Isobath	A line on a chart or map connecting points of equal depths; bathymetric contour.
Letter of Authorization (LOA)	The Marine Mammal Protection Act (MMPA) provides for an "incidental take" authorization (i.e., LOA) for specified activities, provided the National Marine Fisheries Service finds that the takings will have a negligible impact on marine mammal species or stocks, will not have an "unmitigable adverse impact" on the availability of the species or stocks for subsistence uses, and promulgates the permissible methods of taking, other means of effecting the least practicable adverse impact on species or stocks and habitat, and requirements pertaining to monitoring and reporting of such "incidental takes." The small numbers requirement does not apply to military readiness activities.
Level A harassment	Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild.
Level B harassment	Level B harassment includes any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered. Unlike Level A harassment, which is solely associated with physiological effects, Level B harassment is associated with both physiological and behavioral effects.
Lookout	A person assigned to stand watch, whose specific duties include observing the air and surface of the water, visually searching for any object or disturbance that may be indicative of a threat to the ship and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance, or that may indicate the presence of biological resources.
Low-frequency	As defined by the Navy, frequencies less than 1 kHz.
Masking	The obscuring of sounds of interest by interfering sounds, generally at the same frequencies.
Mid-frequency	As defined by the Navy, frequencies between 1 and 10 kHz, inclusive.

[1] American National Standards Institute. (1994). ANSI S1.1-1994 (R 2004) American National Standard Acoustical Terminology (Vol. S1.1-1994 [R 2004]). New York, NY: Acoustical Society of America; Jansen, G. (1998). Physiological Effects of Noise. Handbook of Acoustical Measurements and Noise Control.

[2] Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R., Jr., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P.E., Richardson, W. J., Thomas, J.A, & Tyack, P. L. (2007). Marine mammal noise and exposure criteria: initial scientific recommendations. *Aquatic Mammals*, 33, 411-521.

Term	Definition
Military expended materials	Those munitions, items, devices, equipment and materials which are uniquely military in nature, and are used and expended in the conduct of the military training and testing mission, such as sonobuoys, flares, chaff, drones, targets, bathymetry measuring devices and other instrumentation, communications devices, and items used as training substitutes. This definition may also include materials expended (such as propellants, weights, guidance wires) from items typically recovered, such as aerial target drones and practice torpedoes.
Military Operations Area	Airspace with defined vertical and lateral limits established for the purpose of separating or segregating certain military training activities from instrument flight rules traffic and to identify visual flight rules traffic where these activities are conducted.
Mitigation measure	Measures that will minimize, avoid, rectify, reduce, eliminate, or compensate for significant environmental effects.
Monitoring	The Navy's efforts to track compliance with take authorizations help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the effects of the Proposed Action on marine resources.
Munitions (military)	All ammunition products and components produced or used by or for the U.S. Department of Defense (DoD), or the U.S. Armed Services for national defense and security, including military munitions under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, and the National Guard.
Mysticete	Any whale of the suborder Mysticeti having plates of whalebone (baleen plates) instead of teeth. Mysticetes are filter-feeding whales, also referred to as baleen whales, such as blue, fin, gray, and humpback whales.
Noise	Unintentional byproduct of acoustic emissions (waste) such as vessel or aircraft engine noise.
Non-impulse sound	Non-impulse sounds can be tonal, broadband, or both. Some of these non-impulse sounds can be transient signals of short duration but without the essential properties of impulse sounds (e.g., rapid rise-time). Examples of sources producing non-impulse sounds include vessels; aircraft; machinery operations, such as drilling or wind turbines; and many active sonar systems. The duration of such sounds, as received at a distance, can be greatly extended in highly reverberant environments. It is critical to note that a sound that has characteristics of an impulse sound at the source may, as a result of propagation effects, lose those characteristics at some (variable) distance, and could be characterized as non-impulse for certain receivers (Southall et al. 2007).[3]
Notice of Intent	A written notice published in the *Federal Register* that announces the intent to prepare an EIS. Also provides information about a proposed federal action, alternatives, the scoping process, and points of contact within the lead federal agency regarding the EIS.
Odontocete	Any toothed whale (without baleen plates) of the suborder Odontoceti such as sperm whales, killer whales, dolphins, and porpoises.
Onset permanent threshold shift (onset PTS)	In this Supplemental EIS/OEIS, the smallest amount of PTS (onset PTS) is taken to be the indicator for the smallest degree of injury that can be measured. The acoustic exposure associated with onset PTS is used to define the outer limit of the Level A harassment zone.
Onset temporary threshold shift (onset TTS)	In this Supplemental EIS/OEIS, the smallest measurable amount of TTS (onset TTS) is taken as the best indicator for slight temporary sensory impairment. The acoustic exposure associated with onset TTS is used to define the outer limit of the portion of the Level B harassment zone attributable to physiological effects.

[3] Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R., Jr., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P.E., Richardson, W. J., Thomas, J.A, & Tyack, P. L. (2007). Marine mammal noise and exposure criteria: initial scientific recommendations. *Aquatic Mammals*, 33, 411-521.

Term	Definition
Ordnance	Explosives, chemicals, pyrotechnics, and similar stores (e.g., bombs, guns and ammunition, flares, smoke, or napalm).
Passive sonar	A sonar system for detecting or receiving acoustic energy without the system itself emitting acoustic energy.
Pelagic	The open, upper portion of marine waters rather than waters adjacent to land or near the sea floor, and the species which typically occupy this habitat.
Permanent threshold shift (PTS)	A nonrecoverable (permanent) change in the threshold of hearing due to destruction of tissues within the auditory system from exposure to high-intensity sound. PTS therefore qualifies as an injury and is classified as Level A harassment under the wording of the MMPA.
Ping	Pulse of sound created by sonar.
Pinger	A pulse generator using underwater sound transmission to relay data such as subject location. Includes range and tracking pingers.
Pinniped	Any member of the suborder (Pinnipedia) of aquatic carnivorous mammals (i.e., seals and sea lions) with all four limbs modified into flippers.
Platform	A vessel, aircraft, pier, barge, etc. from which training activities can be conducted.
Predation	A biological interaction where a predator organism feeds on another living organism or organisms known as prey. The act of predation results in the ecologically significant death of the prey.
Range complex	A geographically defined area that encompasses military operating areas, ranges, test facilities, and other designated sites on the sea, on land, or in the airspace.
Received level	The level of sound that arrives at the receiver (such as a marine animal or a hydrophone). The received level is the source level minus the transmission losses from the sound traveling through the water.
Record of Decision (ROD)	A summary of the decision made by the action proponent (e.g., Navy) from the alternatives presented in the Final EIS. The ROD is published in the *Federal Register*.
Resonance	A phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration—the particular frequency at which the object vibrates most readily. Several factors determine the frequency at which resonance will occur.
Restricted Area (Airspace)	Airspace where aircraft are subject to restriction due to the existence of unusual, often invisible hazards (e.g., release of ordnance) to aircraft. Some areas are under strict control of the DoD, and some are shared with nonmilitary agencies.
Restricted Area (Surface)	A restricted area is a defined water area for the purpose of prohibiting or limiting public access to the area. Restricted areas generally provide security for Government property and/or protection to the public from the risks of damage or injury arising from the Government's use of that area (33 C.F.R. §334).
Scoping	An early and open process with federal and state agencies and interested parties to identify possible alternatives and the significant issues to be addressed in an environmental planning action.
Ship	Self-propelled Navy-owned or leased surface vessel with in-water hull configuration (i.e., not a hovercraft like the LCAC [landing craft, air cushion]) and surfaced submarines; may include craft operated by uniform personnel or civilians with a bridge crew including a captain and watch personnel; operations are conducted in accordance with Navy standard operating procedures, which maximize personnel and public safety and mission success.
Small boat	Self-propelled Navy-owned or leased surface craft with in-water hull configuration, short range and small capacity (e.g., rigid hull inflatable boats or commercially available boats used to support test operations); may include craft operated by uniform personnel or civilians with a pilot but not a designated bridge crew; operations are conducted in accordance with Navy standard operating procedures, which maximize personnel and public safety and mission success though procedures may be adapted for vessel size.

Term	Definition
Sound	*Sound* is an oscillation in pressure, particle displacement, and particle velocity, as well as the auditory sensation evoked by these oscillations, although not all sound waves evoke an auditory sensation (i.e., they are outside of an animal's hearing range) (American National Standards Institute 1994).[4]
Sound navigation and ranging (sonar)	Any anthropogenic (man-made) or animal (e.g., bats, dolphins) system that uses transmitted acoustic signals or echo returns to navigate, communicate, or determine the position and bearing of a target. There are two broad types of anthropogenic sonar: active and passive.
Sound pressure level (SPL)	The relative loudness of sounds calculated by the ratio of the sound pressures. SPL is described by taking the logarithm of the ratio of the measured sound pressure to a reference pressure.
Sound source	A source of sound. Sound sources proposed for use in this Supplemental EIS/OEIS are grouped into "bins" or "classes," based on certain parameters such as source level, frequency, duty cycle, and beam patterns. Sounds can be generally categorized as impulse and non-impulse (see *impulse sound* and *non-impulse sound* definitions in this glossary).
Source level	The SPL of an underwater sound as measured 1 meter from the source.
Special Use Airspace	Airspace of defined dimensions where activities must be confined because of their nature or where limitations may be imposed upon aircraft operations that are not part of those activities (Federal Aviation Administration Order 7400.8 series).
Standard operating procedures	Standard practices employed by the Navy to provide for the safety of personnel and equipment, including vessels and aircraft, as well as the success of training and testing activities.
Submarine	Self-propelled manned vessel capable of operating when submerged; may include vessel operated by uniform personnel or civilians; when surfaced, the standard operating procedures of ships apply; when submerged, the standard operating procedures for submarines apply.
Substrate	Any object or material upon which an organism grows or to which an organism is attached.
Surface Danger Zone	A danger zone is a defined water area used for target practice, bombing, rocket firing, or other especially hazardous military activities. Danger zones are established pursuant to statutory authority of the Secretary of the Army and are administered by the Army Corps of Engineers. Danger zones may be closed to the public on a full-time or intermittent basis (33 C.F.R. §334).
Tactical Sonar	A category of sonar-emitting equipment mounted on the hulls of surface ships and submarines.
Take	Defined under the MMPA as "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." Defined under the Endangered Species Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect."
Temporary threshold shift (TTS)	A short-term (temporary) change in the threshold of hearing due to stress of tissues within the auditory system from exposure to high-intensity sound. Recovery may occur within minutes, hours, or days. TTS is less than an injury and is classified as Level B harassment under the wording of the MMPA.
Threatened species	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Threshold shift	A diminution in ability of an animal to detect sounds within the normal hearing range. The effect may be temporary or permanent. A threshold shift may be caused by stress or damage to tissue of the auditory system, or by masking sounds normally received by the animal.

[4] American National Standards Institute. (1994). ANSI S1.1-1994 (R 2004) American National Standard Acoustical Terminology (Vol. S1.1-1994 [R 2004]). New York, NY: Acoustical Society of America.

Term	Definition
Transmission loss	Energy losses that occur as the pressure wave, or sound, travels through a medium. The associated wave front diminishes due to the spreading of the sound over an increasingly larger volume and the absorption of some of the energy by the medium.
Unmanned device	Self-propelled devices which are remotely operated in, on, or over the water; devices may be small enough for a human to lift or as large as a rigid-hull inflatable boat, may be tethered or untethered.
Very high-frequency	As defined by the Navy, frequencies greater than 100 kHz.
Vessel	All manned self-propelled ships, submarines, and small boats, but not unmanned devices or craft without propulsion (e.g., barges).
Warning Area	Areas of defined dimensions, extending from 3 nm outward from the coast of the United States, which serve to warn nonparticipating aircraft of potential danger.

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1 Purpose and Need

TABLE OF CONTENTS

1 PURPOSE AND NEED 1-1

1.1 INTRODUCTION 1-1
1.2 THE NAVY'S ENVIRONMENTAL COMPLIANCE 1-2
1.3 PROPOSED ACTION 1-4
1.4 PURPOSE OF AND NEED FOR PROPOSED MILITARY READINESS TRAINING ACTIVITIES 1-4
1.4.1 WHY THE NAVY TRAINS 1-4
1.5 OVERVIEW AND STRATEGIC IMPORTANCE OF THE JOINT PACIFIC ALASKA RANGE COMPLEX 1-5
1.6 THE ENVIRONMENTAL PLANNING PROCESS 1-6
1.6.1 NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS 1-6
1.6.2 EXECUTIVE ORDER 12114 1-7
1.6.3 OTHER ENVIRONMENTAL REQUIREMENTS CONSIDERED 1-7
1.7 SCOPE AND CONTENT 1-7
1.8 ORGANIZATION OF THIS SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT 1-8
1.9 RELATED ENVIRONMENTAL DOCUMENTS 1-8

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

FIGURE 1.2-1: GULF OF ALASKA NAVY TRAINING ACTIVITIES STUDY AREA 1-3
FIGURE 1.6-1: NATIONAL ENVIRONMENTAL POLICY ACT PROCESS 1-6

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1 PURPOSE AND NEED

1.1 INTRODUCTION

Major conflicts, terrorism, lawlessness, and natural disasters all have the potential to threaten the national security of the United States. National security, prosperity, and vital interests of the United States are increasingly tied to other nations because of the close relationships between the United States and other national economies. The United States (U.S.) Department of Defense (DoD) carries out training activities to be able to protect the United States against its enemies, as well as to protect and defend the rights of the United States and its allies to move freely on the oceans, and provide humanitarian assistance and disaster relief to nations requiring such assistance. The U.S. Department of the Navy (Navy) operates on the world's oceans, seas, and within coastal areas—the international maritime domain—on which 90 percent of the world's trade and two-thirds of its oil are transported. The majority of the world's population also lives within a few hundred miles of an ocean.

The U.S. Congress, after World War II, established the National Command Authorities (DoD Directive 5100.30 dated 2 December 1971) to identify defense needs based on the existing and emergent situations in the United States and overseas. The National Command Authorities, which are comprised of the President, the Secretary of Defense, and their deputized alternates or successors, divide defense responsibilities among services. The heads (secretaries) of each service ensure military personnel are trained, prepared, and equipped to meet those operational requirements.

Training activities that prepare the military to fulfill its mission to protect and defend the United States and its allies have the potential to impact the environment. These activities may trigger legal requirements identified in a number of U.S. federal environmental laws, regulations, and executive orders (EOs).

Training. Navy personnel first undergo entry-level (or schoolhouse) training, which varies according to their assigned warfare community (aviation, surface warfare, submarine warfare, and special warfare) and the community's unique requirements. Personnel then train within their warfare community at sea in preparation for deployment; each warfare community has primary mission areas (areas of specialized expertise that involve multiple warfare communities) that overlap with one another, described in detail in Chapter 2 (Description of Proposed Action and Alternatives).

The Navy prepared this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) pursuant to the National Environmental Policy Act (NEPA) and EO 12114. The purpose of this Supplemental EIS/OEIS is to update the *Final Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy 2011a), hereinafter referred to as the 2011 GOA Final EIS/OEIS, with new information and analytical methods emerging since 2011. The supplemental EIS/OEIS is being prepared pursuant to 40 Code of Federal Regulations (C.F.R.) §1502.9(c)(2). The Record of Decision (ROD) for the 2011 GOA Final EIS/OEIS was signed in 2011 (U.S. Department of the Navy 2011b). This Supplemental EIS/OEIS compares the environmental impacts predicted in the 2011 GOA Final EIS/OEIS to the environmental impacts predicted utilizing current circumstances and information. The 2011 GOA Final EIS/OEIS used an acoustic modeling methodology and marine mammal density information developed by the Navy in cooperation with the National Marine Fisheries Service (NMFS)—which is a part of the National Oceanic and Atmospheric Administration—that was the best available information at the time. A subsequent review on behalf of NMFS by the Center for Independent Experts analyzed the various approaches the Navy used for acoustic effects analyses, leading to the refinement of the previous

methodologies for determining acoustic effects. The result was the development of a standard Navy model for acoustic effects, the Navy Acoustics Effects Model (NAEMO). By using this more comprehensive modeling software, the inclusion of sources not previously analyzed, updated marine mammal densities, and revised acoustic criteria, the predicted effects are expected to change from those quantified in the 2011 GOA Final EIS/OEIS. This document presents the environmental consequences based on new marine mammal density data, a new acoustic modeling method, and new scientific information.

Although the new information and analytical methods which have emerged since the 2011 GOA Final EIS/OEIS do not present a substantially different picture of the environmental consequences or the significance of impacts resulting from the Navy's proposed action, the Navy has determined that preparing this Supplemental EIS/OEIS furthers the purpose of NEPA, pursuant to the Council on Environmental Quality (CEQ) regulations (40 C.F.R. § 1500.1(b) and 40 C.F.R. § 1502.9(c)(2)). This Supplemental EIS/OEIS identifies, presents, and evaluates new information that could be seen as applicable to the proposed action and its environmental impacts.

The 2011 GOA Final EIS/OEIS Study Area consisted of three components: (1) GOA Temporary Maritime Activities Area (TMAA), (2) U.S. Air Force (Air Force) overland Special Use Airspace (SUA) and air routes over the Gulf of Alaska and State of Alaska, and (3) U.S. Army (Army) training lands. Collectively, for the purposes of this Supplemental EIS/OEIS, these areas are referred to as the Joint Pacific Alaska Range Complex (JPARC).[1] The Study Area for this Supplemental EIS/OEIS is the TMAA only (Figure 1.2-1). The geographic boundaries of the TMAA have not changed since the completion of the 2011 GOA Final EIS/OEIS. The Air Force SUA and Army training lands were previously analyzed for NEPA purposes under separate environmental documents and are not included in the analysis in this Supplemental EIS/OEIS, but environmental analysis from those NEPA documents is incorporated by reference pursuant to 40 C.F.R. §1502.21, and are listed in Section 1.9 (Related Environmental Documents), as applicable.

1.2 THE NAVY'S ENVIRONMENTAL COMPLIANCE

The 2011 GOA Final EIS/OEIS document identified major training activities; analyzed potential environmental impacts; and supported the Marine Mammal Protection Act (MMPA) incidental take authorization (also known as a "Letter of Authorization"), issued by NMFS, pursuant to Section 101(a)(5) of the MMPA, which was obtained for Navy training activities in the Gulf of Alaska for May 2011 through May 2016.

[1] In the 2011 Final EIS/OEIS, the Navy defined these three training areas as the Alaska Training Areas (ATAs). After the publication of the ROD for the 2011 Final EIS/OEIS, the U.S. Departments of the Army and Air Force published a Final EIS, titled *Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex (JPARC)* (June 2013), for which a ROD was approved and signed on 6 August 2013. The JPARC EIS included the ATAs, and other training areas, and labeled them the JPARC. As such, the Navy has adopted the term "JPARC" when referring to the ATAs.

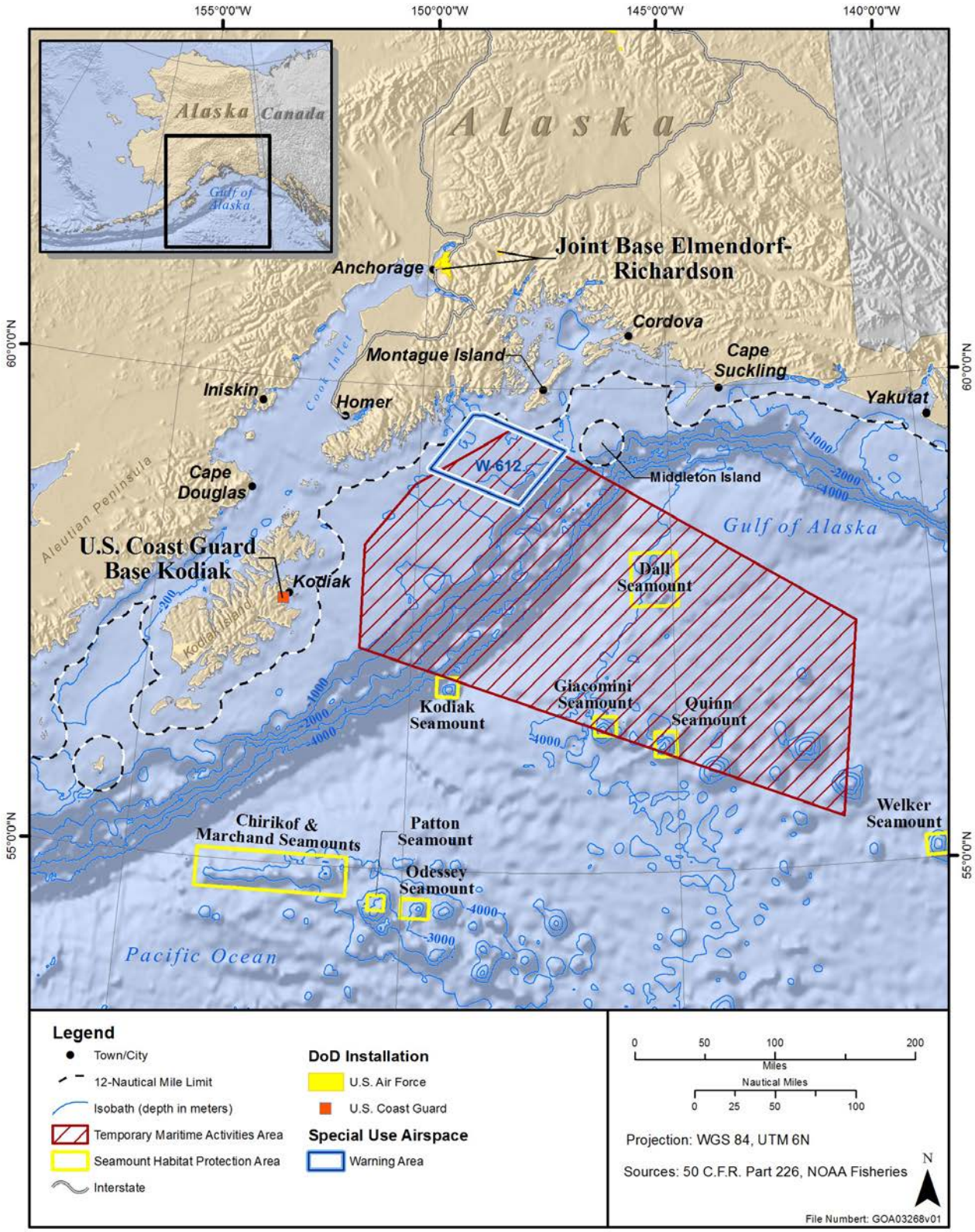

Figure 1.2-1: Gulf of Alaska Navy Training Activities Study Area

This Supplemental EIS/OEIS will also support the Navy's request to obtain an incidental take authorization under the MMPA from NMFS, beginning in May 2016 when the current authorization expires. To support the reissuance of the MMPA authorization, the Navy's re-analysis includes consideration of changes since the 2011 GOA Final EIS/OEIS, including new information related to the resources being analyzed, use of a new acoustic effects model, and consideration of evolving and emergent best available science. Specifically, for the Marine Mammals analysis, these changes include the following:

- Integration of results from a new GOA survey and predictive habitat-based density modeling to derive improved marine mammal density data for the GOA Study Area
- Changes in the Endangered Species Act (ESA) status of certain species
- Integration of revised acoustic impact criteria and revised acoustic impact thresholds
- Use of a newly developed standard Navy model for acoustic effects analysis
- Consideration of research published since the 2011 GOA Final EIS/OEIS
- Integration of results from scientific monitoring and research relating to understanding impacts to marine mammals from Navy training activities

For resources other than marine mammals, similar consideration of changes since the 2011 GOA Final EIS/OEIS is being made through this analysis for those resources to determine if there is a need to re-analyze the potential for impacts accordingly.

1.3 Proposed Action

The Navy's Proposed Action is the same as the Proposed Action presented in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011a) and *Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities* (U.S. Department of the Navy 2011b). The Proposed Action, described in detail in Chapter 2 (Description of Proposed Action and Alternatives), entails the military continuing training activities previously conducted and as described in the 2011 GOA Final EIS/OEIS, for which a ROD was issued.

1.4 Purpose of and Need for Proposed Military Readiness Training Activities

This is a supplemental document to the 2011 GOA Final EIS/OEIS and ROD (U.S. Department of the Navy 2011a, b) pursuant to 40 C.F.R. §1502.9(c)(1)(ii), and EO 12114. As identified in the 2011 GOA Final EIS/OEIS, the purpose of the Navy's Proposed Action is to achieve and maintain fleet readiness using the Alaska Training Areas to support and conduct current, emerging, and future training activities.

The following sections are an overview of the need for military readiness training activities.

> Title 10 Section 5062 of the U.S. Code provides: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

1.4.1 Why the Navy Trains

Naval forces must be ready for a variety of military operations—from large-scale conflict to maritime security and humanitarian assistance/disaster relief—to deal with the dynamic, social, political, economic, and environmental issues that occur in today's world. The Navy supports these military operations through its continuous presence on the world's oceans; the Navy can respond to a wide

range of issues because, on any given day, over one-third of its ships, submarines, and aircraft are deployed overseas. Naval forces must be prepared for a broad range of capabilities—from full-scale armed conflict in a variety of different geographic areas[2] to disaster relief efforts[3]—prior to deployment on the world's oceans. To learn these capabilities, personnel must train with the equipment and systems to achieve military objectives. The training process provides personnel with an in-depth understanding of their individual limits and capabilities. Refer to Chapter 1, Section 1.2.1 (Why the Navy Trains) in the 2011 GOA Final EIS/OEIS for additional information on Navy training.

1.5 Overview and Strategic Importance of the Joint Pacific Alaska Range Complex

Since the 1990s, the DoD has conducted a major joint training exercise in Alaska and off the Alaskan coast that involves the Departments of the Navy, Army, Air Force, and Coast Guard participants reporting to a unified or joint commander who coordinates the activities planned to demonstrate and evaluate the ability of the services to engage in a conflict and carry out plans in response to a threat to national security. Due to the severe environmental conditions during the winter months, the exercise normally occurs between April and October.

The JPARC has a unique combination of attributes that make it a strategically important training venue to include:

- **Location.** The large contingent of Air Force aircraft and Army assets based within a few hundred miles of the TMAA creates the possibility of rare joint training opportunities with Navy forces. The TMAA provides a maritime training venue located within flight range of Joint Base Elmendorf-Richardson, Eielson Air Force Base, Fort Wainwright, Fort Greely, and their associated air and land training ranges (see Figure 1.2-1). The abundance of commercial vessels in shipping lanes within the Gulf of Alaska provides additional valuable realistic training during exercise scenarios, specifically on avoiding conflicts between military and civilian air and marine traffic.
- **Oceanographic conditions.** The complex bathymetric and oceanographic conditions, including a continental shelf, submarine canyons, numerous seamounts, and fresh water infusions from multiple sources provide a challenging environment for training in the search, detection, and localization of submarines. The TMAA provides a safe, cold-water training environment in the summer.
- **Area of Training Space.** The JPARC is one of the largest air, surface, subsurface, and land training areas in the Northern Pacific. This vast area provides ample space to support a full range of joint training scenarios.

The 2011 GOA Final EIS/OEIS analyzed Navy activities within the entire JPARC which included the TMAA, the Air Force SUA, and the Army training lands and associated airspace. For this Supplemental EIS/OEIS, only actions involving underwater acoustic impacts within the TMAA are being considered.

TMAA. The TMAA is composed of the 42,146 square nautical miles (nm^2) of surface and subsurface OPAREA and overlying airspace that includes the majority of Warning Area (W)-612 located over Blying

[2] Operation Iraqi Freedom in Iraq and Operation Enduring Freedom in Afghanistan; maritime security operations, including anti-piracy efforts like those in Southeast Asia and the Horn of Africa.
[3] Evacuation of non-combatants from American embassies under hostile conditions, as well as humanitarian assistance/disaster relief like the tsunami responses in 2005 and 2011 and Haiti's earthquake in 2009.

Sound. W-612 is 2,256 nm^2 of SUA. The TMAA is roughly rectangular shaped and oriented from northwest to southeast, approximately 300 nautical miles (nm) long by 156 nm wide, situated south of Prince William Sound and east of Kodiak Island. The TMAA is bounded by the following coordinates: 57° 30'N, 141° 30'W to 29° 36'N, 148° 10'W to 58° 57'N, 150° 04'W to 58° 20'N, 151° 00'W to 57° 16'N, 151° 00'W to 55° 30'N, 142° 00'W. The majority of Navy training activities occur in the TMAA (Figure 1.2-1).

1.6 THE ENVIRONMENTAL PLANNING PROCESS

The NEPA of 1969 requires federal agencies to examine the environmental impacts of their proposed actions within the United States and its territories. An EIS is a detailed public document that provides an assessment of the potential effects a major federal action might have on the human environment. The Navy undertakes environmental planning for major Navy actions occurring throughout the world in accordance with applicable laws, regulations, and EOs.

Figure 1.6-1: National Environmental Policy Act Process

Pursuant to 40 C.F.R. §1502.9(c), a supplemental EIS is prepared when the agency makes substantial changes in the proposed action that are relevant to environmental concerns; or there are significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts. An agency may also supplement a final EIS when the agency determines that the purpose of NEPA will be furthered by doing so. The Navy's original purpose and need and Proposed Action, as identified in the 2011 GOA Final EIS/OEIS, have not changed and are applicable to this Supplemental EIS/OEIS. Although new information and analytical methods have emerged since the 2011 GOA Final EIS/OEIS, this new information is not significant and does not present a substantially different picture of the environmental consequences or the significance of impacts resulting from the Navy's proposed action. Nonetheless, pursuant to the CEQ regulations (40 C.F.R. § 1500.1(b) and 40 C.F.R. § 1502.9(c)(2)), the Navy has determined that preparing this Supplemental EIS/OEIS furthers the purpose of NEPA by updating the GOA 2011 Final EIS with new information relevant to the public's concerns. This Supplemental EIS/OEIS will update the marine mammal resource analysis in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011a) and ROD (U.S. Department of the Navy 2011b). There is no significant new information relevant to the other resource areas evaluated in the 2011 GOA Final EIS/OEIS. Additionally, there is no additional information that changes the best available science for those resource areas. For these reasons, re-analysis of the alternatives in relation to the other resource areas is not warranted. The alternatives analysis for these resource areas in the 2011 GOA Final EIS/OEIS is still valid and is not being re-analyzed in this Supplemental EIS/OEIS. (Refer to Chapter 3 and the individual resource sections of this Supplemental EIS/OEIS for detailed discussions.)

1.6.1 NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS

The NEPA process for an EIS is displayed in Figure 1.6-1. As was done for the 2011 GOA Final EIS/OEIS, the Navy will comply with all the NEPA process requirements for this Supplemental EIS/OEIS. It should

be noted that in accordance with the CEQ regulations for implementing the requirements of NEPA, scoping is not required for a Supplemental EIS; however, in an effort to maximize public participation and ensure the public's concerns are addressed, the Navy chose to conduct a scoping period for this Supplemental EIS/OEIS. The scoping process for this Supplemental EIS/OEIS was initiated by publication of the Notice of Intent in the *Federal Register* (January 16, 2013) and local newspapers (*Anchorage Daily News, Cordova Times*, *Juneau Empire*, *Kodiak Daily Mirror*, *and Peninsula Clarion*) (See Appendix C for more information on the Navy's scoping process for this Supplemental EIS/OEIS).

1.6.2 EXECUTIVE ORDER 12114

Executive Order 12114, *Environmental Impacts Abroad of Major Federal Actions*, directs federal agencies to provide for informed environmental decision-making for major federal actions outside the United States and its territories. Presidential Proclamation 5928, issued on 27 December 1988, extended the exercise of U.S. sovereignty and jurisdiction under international law to 12 nm; however, the proclamation expressly provides that it does not extend or otherwise alter existing federal law or any associated jurisdiction, rights, legal interests, or obligations. Thus, as a matter of policy, the Navy analyzes environmental effects and actions within 12 nm under NEPA (an EIS) and those effects occurring beyond 12 nm under the provisions of EO 12114 (an OEIS).

1.6.3 OTHER ENVIRONMENTAL REQUIREMENTS CONSIDERED

The Navy must comply with all applicable federal environmental laws, regulations, and EOs as discussed in the 2011 GOA Final EIS/OEIS (Table 6-1). With the exception of effects analysis conducted for compliance with the MMPA and the ESA-listed marine mammal species under NMFS jurisdiction), there are no changes from 2011 GOA Final EIS/OEIS analyses. Analysis of impacts under the MMPA and the ESA can be found in Chapter 3 (General Approach to Analysis) of this Supplemental EIS/OEIS. Additionally, Chapter 6, Table 6.1-1 (Summary of Environmental Compliance for the Proposed Action) provides an updated listing of the Navy's compliance status.

1.7 SCOPE AND CONTENT

In this Supplemental EIS/OEIS, the Navy reevaluated potential impacts from the ongoing military training activities in the GOA TMAA. Unlike other Navy training areas, testing activities are not currently conducted in the GOA TMAA. Therefore, testing activities are not part of the Proposed Action of this Supplemental EIS/OEIS. Additionally, the alternative analysis presented in the 2011 GOA Final EIS/OEIS and ROD does not change under any resource area except marine mammals, taking into account the new information and analytical methods. As such, those resource areas are not carried forward for reanalysis in this Supplemental EIS/OEIS. Through the application of new scientific information and the NAEMO acoustic effects model, the Navy reanalyzed direct, indirect, cumulative, short-term, long-term, irreversible, and irretrievable impacts that result from the Navy's training activities upon marine mammals in this Supplemental EIS/OEIS. Although the 2011 GOA Final EIS/OEIS Preferred Alternative (Alternative 2) was selected by the Navy in the ROD, this Supplemental EIS/OEIS analyzes the impacts to marine mammals under all three alternatives—the No Action Alternative, Alternative 1, and Alternative 2.

The Navy is the lead agency for the Proposed Action and is responsible for the scope and content of this Supplemental EIS/OEIS. The NMFS is a cooperating agency pursuant to 40 C.F.R. §1501.6, because of its expertise and regulatory authority over marine resources. Additionally, this document will serve as the NMFS's NEPA documentation for the rulemaking process under the MMPA.

At the end of this process, the Navy will issue a ROD that will be based on factors analyzed in this Supplemental EIS/OEIS, including military training objectives, best available science and modeling data, potential environmental impacts, and public input.

1.8 Organization of this Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

To meet the need for decision-making, this Supplemental EIS/OEIS is organized as follows:

- Chapter 1 describes the purpose of and need for the Proposed Action.
- Chapter 2 describes the Alternatives analyzed and presented in the ROD for the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011b).
- Chapter 3 describes the existing conditions of the affected environment and environmental consequences on those resources requiring additional discussion or analysis beyond what was analyzed in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011a).
- Chapter 4 describes the analysis of cumulative impacts, which are the impacts of the Proposed Action, as described in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011a) when added to past, present, and reasonably foreseeable future actions.
- Chapter 5 describes and focuses on the measures the Navy evaluated that could mitigate impacts to marine mammal resources as well as mitigations beyond those discussed in the 2011 GOA Final EIS/OEIS (U.S. Department of the Navy 2011a) for other resource areas.
- Chapter 6 describes other considerations required by the NEPA and describes how the Navy complies with other federal, state, and local plans, policies, and regulations.
- Chapter 7 includes a list of the Supplemental EIS/OEIS preparers.
- Appendices provide technical information that supports the Supplemental EIS/OEIS analyses and its conclusions.

1.9 Related Environmental Documents

The progression of NEPA/EO 12114 documentation for Navy activities has developed from planning individual range complex exercises and testing events to theater assessment planning that spans multiple years and covers multiple range complexes. The following documents are referenced in this Supplemental EIS/OEIS where appropriate:

- *Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement* (U.S. Department of the Navy 2011a) – This EIS/OEIS is the initial document that analyzes environmental compliance coverage for Navy training activities in the Gulf of Alaska. This document provides the basis for this Supplemental EIS/OEIS.
- *Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities* (U.S. Department of the Navy 2011b) – This document, signed on May 11, 2011, is the formal decision document that identifies and explains the reasoning and decision on the selected alternative in the 2011 GOA Final EIS/OEIS.
- *Final Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex* (U.S. Departments of Army and Air Force 2013a) – This EIS analyzes the need to modernize and enhance the range and airspace infrastructure of the training ranges in Alaska to meet DoD Service component training requirements. Current and future Navy training activities are included in this document and it provides environmental coverage for Navy overland activities.

- *Record of Decision for Final Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex* (U.S. Departments of Army and Air Force 2013b) – This document, which was approved and signed on 6 August 2013, provides the reasoning and decision on the selected alternative in the JPARC EIS.

REFERENCES CITED AND CONSIDERED

U.S. Department of the Navy. (2000). Compliance with Environmental Requirements in the Conduct of Naval Exercises or Training At Sea. (pp. 11). Prepared by The Under Secretary of the Navy.

U.S. Department of the Navy. (2011a). Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement (Volumes 1 and 2). (pp. 804 and 906).

U.S. Department of the Navy. (2011b). Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities. (pp. 24).

U.S. Departments of Army and Air Force. (2013a). Final Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex.

U.S. Departments of Army and Air Force. (2013b). Record of Decision for Final Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex.

2 Description of Proposed Action and Alternatives

TABLE OF CONTENTS

2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES 2-1

2.1 DESCRIPTION OF THE JOINT PACIFIC ALASKA RANGE COMPLEX 2-1
2.1.1 GULF OF ALASKA TEMPORARY MARITIME ACTIVITIES AREA 2-2
2.2 DESCRIPTIONS OF ACOUSTIC AND EXPLOSIVE SOURCES EMPLOYED IN THE TEMPORARY MARITIME ACTIVITIES AREA 2-2
2.2.1 CLASSIFICATION OF NON-IMPULSE AND IMPULSE SOURCES 2-2
2.2.1.1 Sources Qualitatively Analyzed 2-5
2.2.1.2 Source Classes Qualitatively Analyzed 2-6
2.3 PROPOSED ACTION AND ALTERNATIVES 2-8

LIST OF TABLES

TABLE 2.2-1: NON-IMPULSIVE ACOUSTIC SOURCE CLASSES ANALYZED 2-4
TABLE 2.2-2: EXPLOSIVE SOURCE CLASSES ANALYZED 2-5
TABLE 2.2-3: SOURCE CLASSES EXCLUDED FROM QUANTITATIVE ANALYSIS 2-7
TABLE 2.3-1: CURRENT AND PROPOSED TRAINING ACTIVITIES 2-11

LIST OF FIGURES

FIGURE 2.2-1: GULF OF ALASKA TEMPORARY MARITIME ACTIVITIES AREA 2-3

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2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The United States (U.S.) Department of the Navy's (Navy's) Proposed Action is the same as the Proposed Action presented in the 2011 *Gulf of Alaska Navy Training Activities Final Environmental Impact Statement/Overseas Environmental Impact Statement*[1] (U.S. Department of the Navy 2011a) and *Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities* (U.S. Department of the Navy 2011b) pursuant to the guidance of 40 Code of Federal Regulations (C.F.R.) §1502.9(c).

At-sea joint exercises in the Gulf of Alaska, as described in the 2011 GOA Final Environmental Impact Statement (EIS)/Overseas EIS (OEIS), must continue to be conducted to support the training of combat-capable naval forces. This Supplemental EIS/OEIS is a supplemental document to the 2011 GOA Final EIS/OEIS and Record of Decision (ROD). The purpose of this Supplemental EIS/OEIS is to update the 2011 GOA Final EIS/OEIS with new information and analytical methods that emerged since 2011. There has been no change to the Proposed Action.

The 2011 GOA Final EIS/OEIS used an acoustic modeling methodology, marine mammal density information, and the best science available at the time. Following the completion of the 2011 GOA Final EIS/OEIS, a new modeling system known as the Navy Acoustics Effects Model (NAEMO) was developed by the Navy in cooperation with the National Marine Fisheries Service (NMFS) (as a cooperating agency) to conduct a more comprehensive acoustic impact analysis for in-water training and testing activities. The analysis also incorporates updated marine mammal density information and other relevant new science. By using this comprehensive modeling software and updated marine mammal density data (Gulf of Alaska Line-Transect Survey II [Rone et al. 2014]), the predicted impacts to marine mammals have changed from those in the 2011 GOA Final EIS/OEIS. Although there has been new information and analytical methods since the 2011 GOA Final EIS/OEIS, this new information does not present a substantially different picture of the environmental consequences or the significance of impacts resulting from the Navy's proposed action. However, in the interest of furthering the purposes of the National Environmental Policy Act (NEPA), this document will analyze those changes and associated potential environmental impacts to marine mammals. This Supplemental EIS/OEIS presents a re-analysis of training activities involving the use of sonar and other active acoustic sources and underwater explosives using the best available science and analytical methodologies. Since training activities involving sonar and other active acoustic sources and underwater explosives only occur in the Temporary Maritime Activities Area (TMAA), this Supplemental EIS/OEIS analyzes impacts associated with these acoustic stressors to marine mammals within the TMAA portion of the 2011 GOA Final EIS/OEIS Study Area. Other potential activities beyond those that cause underwater acoustic impacts are not being reevaluated as those impacts are expected to remain the same as described in the 2011 GOA Final EIS/OEIS.

2.1 DESCRIPTION OF THE JOINT PACIFIC ALASKA RANGE COMPLEX

The Joint Pacific Alaska Range Complex is described in the 2011 GOA Final EIS/OEIS in Section 2.1 (Description of the Alaska Training Areas). As noted in Section 1.1 of this Supplemental EIS/OEIS, the term "Alaska Training Areas" has been changed to the "Joint Pacific Alaska Range Complex." There are no additional changes to the training areas.

[1] Hereafter referred to as the "2011 GOA Final EIS/OEIS."

2.1.1 Gulf of Alaska Temporary Maritime Activities Area

The TMAA is depicted in Figure 2.2-1 and is described in Section 2.1.1 (Gulf of Alaska Temporary Maritime Activities Area) of the 2011 GOA Final EIS/OEIS. There are no changes to the TMAA in this Supplemental EIS/OEIS.

2.2 Descriptions of Acoustic and Explosive Sources Employed in the Temporary Maritime Activities Area

The Navy uses a variety of sensors, platforms, weapons, and other devices, including ones used to ensure the safety of Sailors and Marines, to meet its mission. Training with these systems may introduce acoustic (sound) energy into the environment. The potential environmental impacts of these activities are analyzed in Chapter 3 (Affected Environment and Environmental Consequences) of this Supplemental EIS/OEIS. The training activities, event levels, and descriptions, to include their associated sensors, platforms, weapons, and other devices, covered under this Supplemental EIS/OEIS are the same activities that were covered under the 2011 GOA Final EIS/OEIS (see Chapter 2, Section 2.4, and Table 2-5). As such, they will not be re-described here. However, because the Navy is using the new acoustic modeling system (NAEMO), the model-predicted exposures to marine mammals have changed from those in the 2011 GOA Final EIS/OEIS and are discussed in Section 3.8 (Marine Mammals). This section organizes, presents, and discusses the updated approach and analysis of the NAEMO model in order to analyze the effects from sources of underwater acoustic sound or explosive energy.

2.2.1 Classification of Non-Impulse and Impulse Sources

In order to better organize and analyze approximately 300 individual sources of underwater non-impulsive sound or impulsive energy in use or in development by the Navy, those sound sources that are similar (e.g., similar power, frequency, or impulse) have been analyzed together in groups. These groups will be referred to as “source bins,” or simply “bins” for ease of readership. The use of source bins provides the following benefits:

- The ability for new sensors or munitions to be covered under existing regulatory authorizations, as long as those sources fall within the parameters of a bin.
- It simplifies the source utilization data collection and reporting requirements anticipated under the Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and other regulations.
- It ensures a more thorough and inclusive approach to all impacts estimates, as all sources within a given class are modeled as the loudest source (lowest frequency, highest source level, longest duty cycle, or largest Net Explosive Weight [NEW]) within that bin.
- It allows analysis to be conducted in a more efficient manner, without any compromise of analytical results.
- Finally, the bins provide a framework to support the reallocation of source usage (hours/explosives) between different source bins, as long as the total numbers of takes remain within the overall analyzed and authorized limits. This flexibility is required to support evolving Navy training requirements, which are linked to real world events.

There are two primary types of acoustic sources: impulsive and non-impulsive. A description of each source classification is provided in Table 2.2-1 and Table 2.2-2. Non-impulsive acoustic sources are

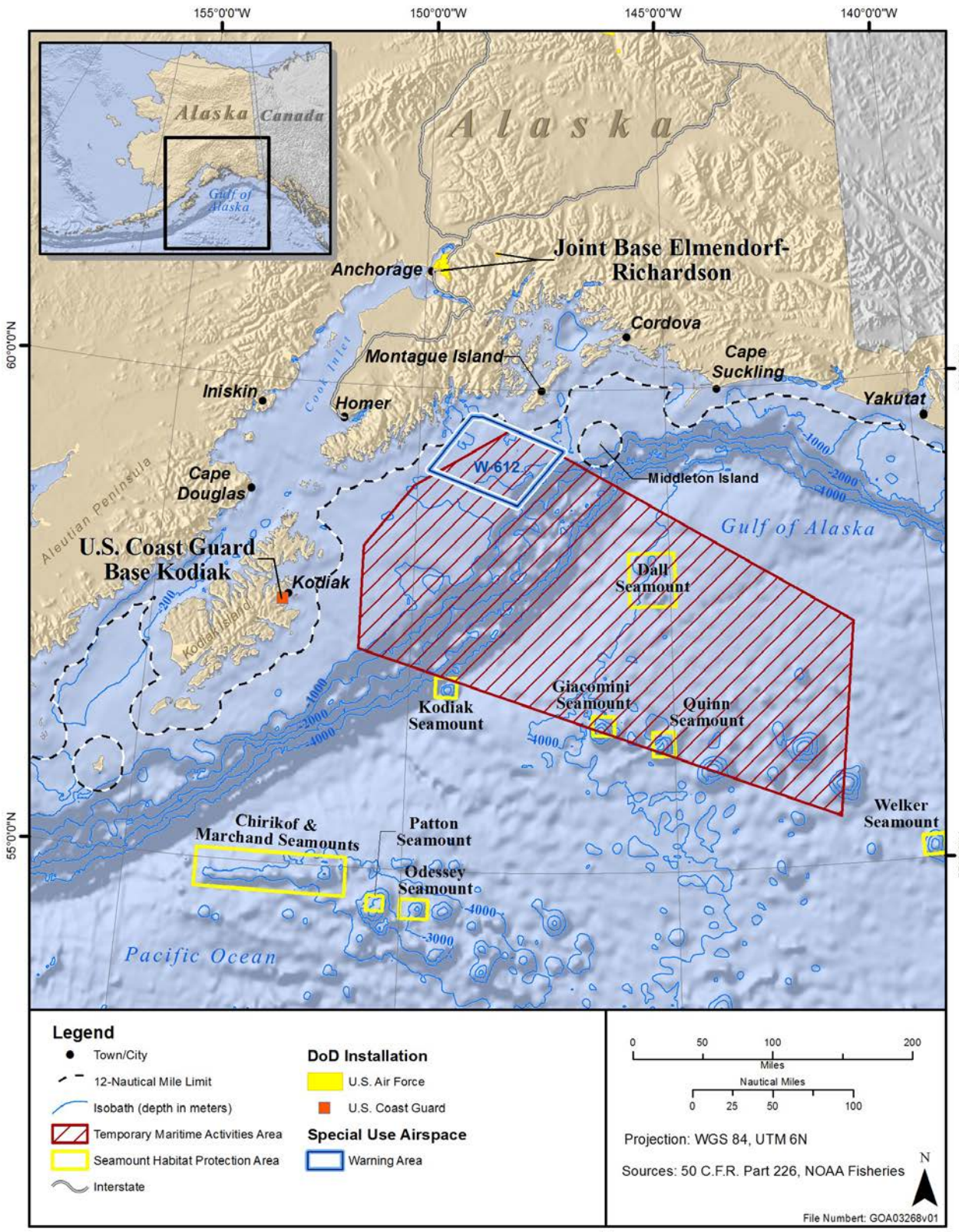

Figure 2.2-1: Gulf of Alaska Temporary Maritime Activities Area

grouped into bins based on the frequency, source level,[2] and, when warranted, the application in which the source would be used during training. Impulsive bins are based on the NEW of the munitions or explosive devices or the source level for air and water guns. The following factors further describe the considerations associated with the development of non-impulsive source bins:

- Frequency of the non-impulsive source:
  - Low-frequency sources operate below 1 kilohertz (kHz)
  - Mid-frequency sources operate at and above 1 kHz, up to and including 10 kHz
  - High-frequency sources operate above 10 kHz, up to and including 100 kHz
  - Very high-frequency sources operate above 100 kHz but below 200 kHz
- Source level of the non-impulsive source:
  - Greater than 160 decibels (dB), but less than 180 dB
  - Equal to 180 dB and up to 200 dB
  - Greater than 200 dB
- Application in which the source would be used:
  - How a sensor is employed supports how the sensor's acoustic emissions are analyzed
  - Factors considered include pulse length (time source is on); beam pattern (whether sound is emitted as a narrow, focused beam or, as with most explosives, in all directions); and duty cycle (how often or how many times a transmission occurs in a given time period during an event)

Table 2.2-1: Non-Impulsive Acoustic Source Classes Analyzed

Source Class Category	Source Class	Description of Representative Source
Mid-Frequency (MF): Tactical and non-tactical sources that produce mid-frequency (1–10 kHz) signals	MF1	Hull-mounted surface ship sonar (e.g., AN/SQS-53C and AN/SQS-61)
	MF3	Hull-mounted submarine sonar (e.g., AN/BQQ-10)
	MF4	Helicopter-deployed dipping sonar (e.g., AN/AQS-22 and AN/AQS-13)
	MF5	Active acoustic sonobuoys (e.g., DICASS)
	MF6	Active underwater sound signal devices (e.g., MK-84)
	MF11	Hull-mounted surface ship sonars with an active duty cycle greater than 80%
High-Frequency (HF): Tactical and non-tactical sources that produce high-frequency (greater than 10 kHz but less than 180 kHz) signals	HF1	Hull-mounted submarine sonar (e.g., AN/BQQ-10)
	HF6	Active sources (equal to 180 dB and up to 200 dB) not otherwise binned
Anti-Submarine Warfare (ASW): Tactical sources such as active sonobuoys and acoustic countermeasures systems used during the conduct of ASW training activities	ASW2	Mid-frequency Multistatic Active Coherent sonobuoy (e.g., AN/SSQ-125)
	ASW3	Mid-frequency towed active acoustic countermeasure systems (e.g., AN/SLQ-25)
	ASW4	Mid-frequency expendable active acoustic device countermeasures (e.g., MK-3)
Torpedoes (TORP): Source classes associated with the active acoustic signals produced by torpedoes	TORP2	Heavyweight torpedo (e.g., MK-48, electric vehicles)

Notes: dB = decibels, DICASS = Directional Command Activated Sonobuoy System, kHz = kilohertz

[2] Source decibel levels are expressed in terms of sound pressure level and are values given in dB referenced to 1 micropascal at 1 meter.

Table 2.2-2: Explosive Source Classes Analyzed

Source Class	Representative Munitions	Net Explosive Weight[1] (lb.)
E4	Improved Extended Echo Ranging sonobuoy	> 2.5–5.0
E5	5 in. projectiles	> 5–10
E6	AGM-114 Hellfire missile	> 11–20
E7	AGM-88 High-speed Anti-Radiation Missile	> 20–60
E8	250 lb. bomb	> 60–100
E9	500 lb. bomb	> 100–250
E10	1,000 lb. bomb	> 250–500
E11	MK-48 Torpedo	> 500–650
E12	2,000 lb. bomb	> 650–1,000

[1] Net Explosive Weight refers to the amount of explosives; the actual weight of a munition may be larger due to other components such as the casing for a bomb, missile, projectile, or device.
Notes: AGM = Air-to-Ground Missile, in. = inches, lb. = pounds

Within the Preferred Alternative in the 2011 GOA Final EIS/OEIS, there were three non-impulse sources (HF1, ASW3, and ASW4; see Table 2.2-1) that were part of the ongoing training but at the time were not considered sources requiring analysis under NEPA, MMPA, or ESA given that they were used during anti-submarine Warfare (ASW) training events simultaneously with much more powerful sources (e.g., SQS-53 sonar). Since the less complex modeling in the 2011 GOA Final EIS/OEIS could only consider each source separately during a training scenario, there was no summation of total sound energy from multiple sources. In this supplemental analysis, the cumulative summation of total sound energy from multiple sources is considered in the acoustic modeling. Additionally, a high-duty cycle mode has been added to the modeling of the SQS-53 (MF11) system, as this mode was not previously analyzed in the Preferred Alternative in the 2011 GOA Final EIS/OEIS.

2.2.1.1 Sources Qualitatively Analyzed

There are in-water active acoustic sources with narrow beam widths, downward directed transmissions, short pulse lengths, frequencies above known hearing ranges, low source levels, or some combination of these factors, that are not anticipated to result in takes of protected species and, therefore, are not required to be quantitatively analyzed. These sources will be categorized as *de minimis* sources and will be qualitatively analyzed to determine the appropriate determinations under NEPA, MMPA, and ESA. When used during training such as the activities in the TMAA, and in a typical environment, *de minimis* sources generally meet one or more of the following criteria:

- Acoustic source classes listed in Table 2.2-1 (actual source parameters listed in the classified bin list)
- Acoustic sources that transmit primarily above 200 kHz
- Sources operated with source levels of 160 dB referenced to 1 micropascal or less

The types of sources with source levels less than 160 dB are typically hand held sonars, range pingers, transponders, and acoustic communication devices. Assuming spherical spreading for a 160 dB source, the sound will attenuate to less than 140 dB within 3 feet (ft.) (10 meters [m]), and less than 120 dB within 30.5 ft. (100 m) of the source. Using the Behavioral Risk Function (BRF) equation:

$$R = \frac{1 - \left(\frac{L - B}{K}\right)^{-A}}{1 - \left(\frac{L - B}{K}\right)^{-2A}}$$

Where,
R = risk (0–1.0)
L = received level (RL) in dB (140 dB)
B = basement RL in dB (120 dB)
K = RL increment above basement with 50 percent risk (45 dB)
A = risk transition sharpness

For odontocetes, pinnipeds, manatees, sea otters, and polar bears, A = 10; therefore, R = 0.0003, or 0.03 percent risk. For mysticetes, A = 8; therefore, R = 0.0015, or 0.15 percent risk.

Therefore:

- For all marine mammals subject to a BRF, these sources will not significantly increase the number of potential exposures as determined by the effects criteria.
- For beaked whales, the range to 140 dB behavioral threshold from a 160 dB source is 10 m (32.8 ft.). The likelihood of any potential behavioral effect is low because of the small affected area and the relative low density of beaked whales.
- For harbor porpoises, there will be a 100 m (328.1 ft.) zone from the source to 120 dB behavioral threshold. Based on the above discussion and the extremely short propagation ranges to 120 dB, the potential for exposures that would result in changes to behavioral patterns to an extent where those patterns are abandoned or significantly altered is unlikely.
- For sea turtles, the behavioral threshold of 175 dB is above the 160 dB source level, and therefore no behavioral effect would be expected.
- Additionally, for all of the above calculations, absorption of sound in water is not a consideration, but would increase the actual transmission losses and further reduce the low potential for exposures.

2.2.1.2 Source Classes Qualitatively Analyzed

An entire source bin, or some sources from a bin, may be excluded from quantitative analysis (Table 2.2-3) within the scope of this Supplemental EIS/OEIS if one or more of the following criteria are met:

- The source may result in no response, or responses would only be short term and inconsequential based on the systems acoustic characteristics (i.e., short pulse length, frequency range at the limit of marine species hearing, low source level, etc.) and manner of system operation.
- The sources meet the criteria specified in Section 2.2.1.1 (Sources Qualitatively Analyzed) or Table 2.2-3.
- Bins contain sources needed for safe operation and navigation.

Sources that meet these criteria are qualitatively analyzed hereafter to determine the appropriate determinations under NEPA, MMPA, and ESA.

Table 2.2-3: Source Classes Excluded from Quantitative Analysis

Source Category	Source Bin	Description
Fathometers High-frequency sources used to determine water depth	FA1–FA4	Marine species are expected to exhibit no more than short-term and inconsequential responses to the sonar, profiler or pinger given their characteristics (e.g., narrow, downward-directed beam, and short pulse length). Such reactions are not considered to constitute "taking" and, therefore, no additional quantitative modeling is required for marine species that might be exposed to these sound sources. Fathometers use a downward directed, narrowly focused directly below the vessel (typically much less than 30 degrees), using a short pulse length (less than 10 msec). Use of fathometers is also required for safe operation of Navy vessels.
Hand-held Sonars High-frequency sonar devices used by Navy divers for object location	HHS1	Hand-held sonars generate very high frequency sound at low power levels, short pulse lengths, and narrow beam widths. Because output from these sound sources would attenuate to below any current threshold for marine species at a very short range, and because they are under positive control of the diver on which direction the sonar is pointed marine species reactions are not likely. No additional quantitative modeling is required for marine species that might be exposed to these sound sources.
Doppler Sonars/Speed Logs Navigation equipment, downward focused, narrow beamwidth, HF/VHF spectrum utilizing very short pulse length pulses.	DS2, DS3, DS4	Marine species are expected to exhibit no more than short-term and inconsequential responses to the sonar, profiler or pinger given their characteristics (e.g., narrow downward-directed beam), which is focused directly beneath the platform. Such reactions are not considered to constitute "taking" and, therefore, no additional quantitative modeling is required for marine species that might be exposed to these sound sources.
Imaging Sonars (IMS) High-frequency or very high-frequency, very short pulse lengths, narrow bandwidths. IMS1 is a side-scan sonar (high-frequency/very high-frequency, narrow beams, downward directed). IMS2 is a downward looking source, narrow beam, and operates above 180 kHz (basically a fathometer)	IMS1, IMS2	These side scan sonars operate in a very high frequency range (over 120 kHz) relative to marine mammal hearing (Richardson et al. 1995; Southall et al. 2007). The frequency range from these side scan sonars is beyond the hearing range of mysticetes (baleen whales) pinnipeds, manatees, and sea turtles, and, therefore, not expected to affect these species in the Study Area. The frequency range from these side scan sonars falls within the upper end of odontocete (toothed whale) hearing spectrum (Richardson et al. 1995), which means they are not perceived as loud acoustic signals with frequencies below 120 kHz by these animals. Therefore, marine species may be less likely to react to these types of systems in a biologically significant way. Further, in addition to spreading loss for acoustic propagation in the water column, high frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies (Urick 1983). Additionally, these systems are generally operated in the vicinity of the sea floor, thus reducing the sound potential of exposure even more. Marine mammals are expected to exhibit no more than short-term and inconsequential responses to the imaging sonar given their characteristics (e.g., narrow downward-directed beam and short pulse length [generally 20 msec]). Such reactions are not considered to constitute "taking" and, therefore, no additional allowance is included for animals that might be affected by these sound sources.

Table 2.2-3: Source Classes Excluded from Quantitative Analysis (continued)

Source Category	Source Bin	Description
Acoustic Modems (M) and Tracking Pingers (P)	M2, P1, P2, P3, P4	Acoustic modems, and tracking pingers operate at frequencies between 2 and 170 kHz, low duty cycles, (single pings in some cases), short pulse lengths (typically 20 msec), and relatively low source levels. Marine species are expected to exhibit no more than short-term and inconsequential responses to these systems given the characteristics as described above. Such reactions are not considered to constitute “taking" and, therefore, no additional quantitative modeling is required for marine species that might be exposed to affected by these sound sources.
Acoustic Releases (R) Systems that transmit active acoustic signals to release a bottom-mounted object from its housing in order to retrieve the device at the surface	R1, R2, R3	Acoustic releases operate at mid and high-frequencies. Since these types of devices are only used to retrieve bottom mounted devices they typically transmit only a single ping. Marine species are expected to exhibit no more than short-term and inconsequential responses to these sound sources given that any sound emitted is extremely short in duration. Such reactions are not considered to constitute “taking" and, therefore, no additional quantitative modeling is required for marine species that might be exposed to these sound sources.
Side-Scan Sonars (SSS) Sonars that use active acoustic signals to produce high-resolution images of the seafloor	SSS1, SSS2, SSS3	Marine species are expected to exhibit no more than short-term and inconsequential responses to these systems given their characteristics such as a downward-directed beam and using short pulse lengths (less than 20 msec). Such reactions are not considered to constitute “taking” and, therefore, no additional allowance is included for animals that might be affected by these sound sources.
Small Impulsive Sources	Sources with explosive weights < 0.25 lb. NEW (< bin E1)	Quantitative modeling in multiple locations has validated that these low level impulsive sources are expected to cause no more than short-term and inconsequential responses in marine species due to the low explosive weight and corresponding very small zone of influence associated with these types of sources.

Notes: HF = high frequency, kHz = kilohertz, lb. = pound, msec = milliseconds, NEW = Net Explosive Weight, VHF = very high frequency

In summary, exposures from these sources are unlikely, but if an exposure does occur, the response would be considered inconsequential because it would not likely result in any biological significant impact to the animal outside the normal variation of an animal’s daily life.

2.3 PROPOSED ACTION AND ALTERNATIVES

Three alternatives were analyzed in the 2011 GOA Final EIS/OEIS: the No Action Alternative (Section 2.4), Alternative 1 (Section 2.5), and Alternative 2 (Section 2.6).

The No Action Alternative consisted of training activities of the types and levels of training intensity as conducted prior to 2011 and did not include ASW training activities involving the use of active sonar. Alternative 1 included all training activities addressed in the No Action Alternative and an increase in training activities. This increase would encompass conducting one large-scale carrier strike group exercise, as well as the inclusion of ASW activities and the use of active sonar, occurring over a maximum time period of up to 21 consecutive days during the summer months (April–October). Alternative 1 also proposed training required by force structure changes for new weapons systems, instrumentation, and technology as well as new classes of ships, submarines, and aircraft. In addition,

Alternative 1 included the development and use of the portable undersea tracking range. Alternative 2 included all elements of Alternative 1 plus one additional carrier strike group exercise during the summer months (April–October). Additionally, Alternative 2 included conducting one sinking exercise per carrier strike group exercise for a total of two per year.[3] Alternative 2 was the Preferred Alternative and was selected in the ROD issued on 11 May 2011.

These alternatives have not changed and are carried forward in this Supplemental EIS/OEIS. All of the resource areas were examined to determine if they need to be re-analyzed in this Supplemental EIS/OEIS. The Supplemental EIS/OEIS will update the marine mammal resource analysis for each alternative in the 2011 GOA Final EIS/OEIS. Updates to the exposure results for marine mammals under the alternatives were performed utilizing NAEMO, new density data, and new scientific data available since the publication of the 2011 GOA Final EIS/OEIS. For other resource areas, the 2011 GOA Final EIS/OEIS analysis remains valid.

There are also no new training activities proposed in this Supplemental EIS/OEIS. Consistent with the 2011 GOA Final EIS/OEIS, the Navy has broken down each training activity into basic components analyzed for their potential environmental impacts.[4] Table 2.3-1 identifies all the Navy training activities that are conducted in the TMAA, and distinguishes which activities have been updated based upon new information and analytical methods.

[3] *See* U.S. DEPARTMENT OF THE NAVY, CHIEF, NAVAL OPERATIONS INSTR. 1541.5, GENERAL POLICY FOR SINKING EXERCISE APPROVAL (29 Jul. 2001) (hereinafter OPNAVINST 1541.5). "The Chief of Naval Operations shall approve or disapprove all valid SINKEX requests contingent upon availability of funding to complete environmental preparations." OPNAVINST 1541.5 para. 4a. "Further, SINKEX events are limited to those required to satisfy requirements for ship survivability or weapons lethality evaluation, major joint or multi-national exercises, or the evaluation of significant new multi-unit tactics or tactics and weapons combinations." OPNAVINST 1541.5 para. 2. The Navy recognizes that the likelihood of there being two SINKEX events in any one year in the TMAA is presently unlikely. In order to ensure flexibility to meet potential Fleet training requirements, however, this Supplemental EIS/OEIS conservatively analyzes the potential impacts of conducting up to two SINKEX events per year in the TMAA.

[4] NAEMO does not model sonar activities on an individual basis. Subsequently, individual events in the table for ASW are modeled together as one event in the model for each of the two exercises in the Proposed Action. This approach is consistent with the modeling and analysis of major sonar training exercises in other Navy training areas, i.e., Hawaii-Southern California Training and Testing Area, Northwest Training and Testing Area.

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Table 2.3-1: Current and Proposed Training Activities

Range Activity	2011 GOA Final EIS/OEIS Alternatives						Changes to the 2011 GOA Final EIS/OEIS Preferred Alternative (Alternative 2)					
	Platform	System or Ordnance	Location	No Action Alternative	Alternative 1	Alternative 2	Platform	System or Ordnance	Location	No Action Alternative Alternative 1 Alternative 2	Number of events (yearly) or Number of Sonar hours/items (yearly)[5]	Requires re-analysis utilizing NAEMO
ANTI-AIR WARFARE (AAW)												
Aircraft Combat Maneuvers	EA-6B, EA-18G, FA-18, F-16, F-15, F-22, E-2	None	TMAA, Air Force SUA[1]	300 sorties[2]	300 sorties	600 sorties	No Change					No
Air Defense Exercise	FA-18, F-16, F-15, F-22, EA-6B, EA-18G, E-2, P-3C, P-8 MMA, CVN, CG, DDG	None	TMAA	3 events	4 events	8 events	No Change					No
Surface-to-Air Missile Exercise	CVN, CG, DDG	Sea Sparrow Missile, Standard Missile 1, or RAM *Targets:* BQM-74E	TMAA	2 events	3 events	6 events	No Change					No
Surface-to-Air Gunnery Exercise	CG, DDG, AOE	5-inch/54BLP, 20 mm CIWS, 7.62 mm. *Targets:* Towed TDU-34	TMAA	2 events	3 events	6 events	No Change					No
Air-to-Air Missile Exercise	FA-18, F-16, F-15, F-22, E-2, EA-6B, EA-18G	AIM-7, AIM-9, AIM-120 *Targets:* TALD or LUU-2B/B	TMAA, Air Force SUA[1]	2 events	3 events	6 events	No Change					No
ANTI-SURFACE WARFARE (ASUW)												
Visit, Board, Search, and Seizure	MH-60S, RHIB, NSW Personnel	None	TMAA	12 events	12 events	24 events	No Change					No
Air-to-Surface Missile Exercise	MH-60R/S, FA-18, F-16, F-15, F-22, EA-6B, EA-18G	None	TMAA	1 event	2 events	4 events	No Change					No
Air-to-Surface Bombing Exercise	FA-18, F-16, F-15, F-22	MK-82 (live), MK-83 (live), MK-84 (live), BDU-45 (inert), MK-58 marine marker	TMAA	12 events	18 events	36 events	No Change					Yes
Air-to-Surface Gunnery Exercise	MH-60R/S	GAU-16 (0.50 cal) or M-60 (7.62 mm) machine gun *Targets:* HSMST, Trimaran, SPAR, Surface Target Balloon	TMAA	5 events	7 events	14 events	No Change					No
Surface-to-Surface Gunnery Exercise	CVN, CG, DDG, AOE	5 inch/54 BLP, 20 mm CIWS, 25 mm, 7.62 mm, 57 mm, .50 cal *Targets:* HSMST, Trimaran, SPAR, Surface Target Balloon	TMAA	5 events	6 events	12 events	No Change					Yes
Maritime Interdiction	All	None	TMAA	14 events	14 events	28 events	No Change					No
Sea Surface Control	FA-18, EA-6B, EA-18G, E-2, P-3C, P-8 MMA, CG, DDG	None	TMAA	6 events	6 events	12 events	No Change					No
Sinking Exercise[3]	FA-18, F-16, F-15, F-22, EA-6B, EA-18G, P-3C, P-8 MMA, MH-60R/S, CVN, CG, DDG	MK-82 (inert), MK-82 (live), MK-83, AGM-88 HARM, AGM-84, Harpoon, AGM-65 Maverick, AGM-114 Hellfire, AGM-119 Penguin, Standard Missile 1, Standard Missile 2, 5-inch/54 BLP	TMAA	n/a	n/a	2 events	Added SSN[4] (note SSN was included in original 2011 EIS/OEIS activity description but left off of original table)	No Change				Yes
ANTI-SUBMARINE WARFARE (ASW)												
ASW Tracking Exercise – Helicopter	MH-60R	*Targets*: SSN, MK-39 EMATT Sonobuoys: AN/AQS-22, SSQ-36 BT, SSQ-53 DIFAR (passive), SSQ-62 DICASS (active), SSQ-77 VLAD Other: MK-58 marine marker	TMAA	n/a	22 events	44 events	No Change	Same; however, removed SSQ-62 DICASS as all MF5 bin buoys are now accounted for in ASW Tracking – MPA	No Change	210 dips (increase of 18 dips due to modeling changes)		Yes
ASW Tracking Exercise – Maritime Patrol Aircraft (MPA)	P-3C, P-8 MMA	*Targets*: SSN, MK-39 EMATT Sonobuoys: SSQ-36 BT, SSQ-53 DIFAR (passive), SSQ-62 DICASS (active), SSQ-77 VLAD Other: MK-58 marine marker	TMAA	n/a	13 events	26 events	No Change	252 DICASS buoys (decrease of 14 buoys due to modeling changes)	Yes	ASW Tracking Exercise – Maritime Patrol Aircraft (MPA)		P-3C, P-8 MMA

Table 2.3-1: Current and Proposed Training Activities (continued)

Range Activity	2011 GOA Final EIS/OEIS Alternatives						Changes to the 2011 GOA Preferred Alternative (Alternative 2)					
	Platform	System or Ordnance	Location	No Action Alternative	Alternative 1	Alternative 2	Platform	System or Ordnance	Location	No Action Alternative Alternative 1 Alternative 2	Number of events (yearly) or Number of Sonar hours/items (yearly)[5]	Requires re-analysis utilizing NAEMO
ANTI-SUBMARINE WARFARE (ASW) (continued)												
ASW Tracking Exercise – Extended Echo Ranging (EER) (includes IEER & MAC)	P-3C, P-8 MMA	SSQ-110A EER/IEER, SSQ-125 MAC, SSQ-77 VLAD	TMAA	n/a	2 events	4 events	No Change			80 IEER and 80 MAC buoys were modeled (will only use one during the exercise, but results are the same)		Yes
ASW Tracking Exercise – Surface Ship	DDG	SQS-53C, SQS-56 MFA sonar *Targets*: SSN, MK-39 EMATT	TMAA	n/a	2 events	3 events	No Change	Same; however, removed all SQS-56 MFA sonar hours and added them to SQS-53 hours total. Added SQL-25 NIXIE as none were modeled in previous EIS/OEIS	No Change	619 hours MF1 + MF11 bins (decrease of 2 hours, previously 578 hours of MF1 and 52 hours of MF2, ASW3), NIXIE = 546 hours (NIXIE was not modeled in previous EIS/OEIS)		Yes
ASW Tracking Exercise – Submarine	SSBN, SSGN	*Targets*: MK-39 EMATT	TMAA	n/a	2 events	3 events	SSN	No Change		48 hours of MF3 (same as before), 24 hours of HF1 (same as before)		Yes
ELECTRONIC COMBAT (EC)												
EC Exercises	EA-6B, EA-18G, E-2, P-3, EP-3, CVN, CG, DDG	None	TMAA, Air Force SUA[1]	4 events	5 events	10 events	No Change					No
Chaff Exercises	EA-6B, EA-18G, P-3, EP-3, FA-18, CVN, CG, DDG, AOE	Chaff	TMAA, Air Force SUA[1]	2 events	2 events	4 events	No Change					No
Counter Targeting Exercises	EA-6B, EA-18G, P-3, EP-3, FA-18, CVN, CG, DDG, AOE	None	TMAA	4 events	4 events	8 events	No Change					No
NAVAL SPECIAL WARFARE (NSW)												
Special Warfare Operations	C-130, MH-60S, SDV, RHIB, NSW Personnel	None	TMAA, Air Force SUA[1] Army Training Lands[1]	10 events	10 events	20 events	No Change					No
STRIKE WARFARE (STW)												
Air-to-Ground Bombing Exercise	FA-18, F-16, F-15, F-22, EA-6B, EA-18G, E-2	MK-82/83/84 (live/inert), BDU-45 (inert), CATM-88C (not released)	Air Force SUA[1], Army Training Lands[1]	150 sorties	150 sorties	300 sorties	No Change					No
Personnel Recovery	CVN, CG, DDG, AOE, E-2, MH-60S, RHIB, NSW Personnel	None	Air Force SUA[1], Army Training Lands[1]	3 events	4 events	8 events	No Change					No
SUPPORT OPERATIONS												
Deck Landing Qualifications	Helicopters (Air Force, Army, Coast Guard – various)	None	TMAA	4 events	6 events	12 events	No Change					No

[1] Activities within and upon these areas are covered under separate NEPA analysis.
[2] A sortie is defined as a single activity by one aircraft (i.e., one complete flight from takeoff to landing).
[3] Per a 24 January 2014 EPA/Navy agreement, "Navy agrees that SINKEX vessels will not likely, in the future, include aircraft carriers or submarines" (as the target vessel of a SINKEX).
[4] SSN, as a firing platform, was included in original activity description but left off of original table.
[5] ASW is depicted in hours to be consistent with the new modeling technique. Although ASW is modeled as a scenario (multi-day) vice individual events, the hours per event have been provided for clarity.
Notes: AIM = Air Intercept Missile; ASW = Anti-submarine Warfare; BDU = Bomb Dummy Unit; BQM = Aerial Target Drone Designation; cal = caliber; CATM = Combat Arms and Training Maintenance; CG = Cruiser; CVN = Aircraft Carrier, Nuclear; CIWS = Close-in Weapons System; DDG = Destroyer; DICASS = Directional Command Activated Sonobuoy System; DIFAR = Directional Frequency and Ranging; EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement; EMATT = Expendable Mobile ASW Training Target; EPA = Environmental Protection Agency; GOA = Gulf of Alaska; HARM = High Speed Anti-radiation Missile; HSMST = High Speed Maneuverable Surface Target; IEER = Improved Extended Echo Ranging; MAC = Military Operations in Urban Terrain Assault Course; MFA = Mid-frequency Active; mm = millimeters; MMA = Multi-mission Maritime Aircraft; MPA = Maritime Patrol Aircraft; n/a = not applicable; NAEMO = Navy Acoustic Effects Model; Navy = United States Department of the Navy; NEPA = National Environmental Policy Act; RAM = Rolling Airframe Missile; RHIB = Rigid Hull Inflatable Boat; SDV = Sea, Air, Land Delivery Vehicle; SINKEX = Sinking Exercise; SSN = Nuclear-Powered Fast Attack Submarine; SUA = Special Use Airspace; TALD = Tactical Air-Launched Decoy; TDU = Target Drone Unit; TMAA = Temporary Maritime Activities Area

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3 General Approach to Analysis

TABLE OF CONTENTS

3 GENERAL APPROACH TO ANALYSIS 3-1

3.0 INTRODUCTION 3.0-1
3.0.1 APPROACH TO ANALYSIS 3.0-2
3.0.2 REGULATORY FRAMEWORK 3.0-2
3.0.2.1 Applicable Federal Statutes 3.0-2
3.0.2.2 Guidance 3.0-3
3.0.3 DATA SOURCES AND BEST AVAILABLE DATA 3.0-4
3.0.4 RESOURCES AND ISSUES CONSIDERED FOR RE-EVALUATION IN THIS DOCUMENT 3.0-4
3.0.4.1 Resources Carried Forward for Alternatives Re-Analysis 3.0-5
3.0.5 STRESSORS-BASED ANALYSIS 3.0-6
3.0.5.1 Introduction to Acoustics 3.0-6
3.0.5.2 Stressors 3.0-6
3.0.5.3 Marine Mammal Resource-Specific Impacts Analysis for Acoustic Stressors 3.0-11
3.0.5.4 Cumulative Impacts 3.0-11

LIST OF TABLES

TABLE 3.0-1: RESOURCE AREA RE-EVALUATION IN THE SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT 3.0-5
TABLE 3.0-2: ACOUSTIC STRESSORS ASSOCIATED WITH TRAINING ACTIVITIES 3.0-7
TABLE 3.0-3: SONAR AND OTHER ACTIVE ACOUSTIC SOURCES QUANTITATIVELY ANALYZED IN THE GULF OF ALASKA NAVY TRAINING ACTIVITIES STUDY AREA 3.0-8
TABLE 3.0-4: EXPLOSIVE SOURCES USED DURING TRAINING IN THE GULF OF ALASKA STUDY AREA 3.0-10

LIST OF FIGURES

There are no figures in this section.

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3 GENERAL APPROACH TO ANALYSIS

3.0 INTRODUCTION

This chapter outlines the United States (U.S.) Department of the Navy's (Navy's) rational for resource analysis in the Gulf of Alaska (GOA) Navy Training Activities Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS).

In accordance with 40 Code of Federal Regulations (C.F.R.) §1502.9(c), Agencies:

> (1) Shall prepare supplements to either draft or final environmental impact statements if:
>
> > (i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
> > (ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.
>
> (2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.
>
> (3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.
>
> (4) Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council.

In March 2011, the Navy released the GOA Navy Training Activities Final EIS/OEIS (U.S. Department of the Navy 2011), hereafter referred to as the 2011 GOA Final EIS/OEIS, for which a Record of Decision (ROD) was received (*Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities* [U.S. Department of the Navy 2011]) pursuant to the guidance of 40 C.F.R. §1502.9(c). However, subsequent to completion of the 2011 GOA Final EIS/OEIS, the Navy, in coordination with the National Marine Fisheries Service (NMFS), developed a new acoustic impact model (the Navy Acoustics Effects Model [NAEMO]), that reflects a more complex modeling approach along with the integration of new impact criteria and marine mammal density data. Additional details on this new modeling approach (NAEMO) are available in the Marine Mammal Modeling Team Technical Report (*in progress*, 2014).

This chapter describes existing environmental conditions in the Study Area (the Temporary Maritime Activities Area [TMAA]) as well as the analysis of resources potentially impacted by the Proposed Action described in Chapter 2 (Description of Proposed Action and Alternatives). The Study Area is described in Section 2.1.1 (Gulf of Alaska Temporary Maritime Activities Area) and depicted in Figure 2.2-1.

Section 3.0.1 (Approach to Analysis) identifies the methodology used in this Supplemental EIS/OEIS to assess resource impacts associated with the Proposed Action. Section 3.0.2 (Regulatory Framework) presents the regulatory framework on which this Supplemental EIS/OEIS is based. It identifies applicable laws, regulations, executive orders (EOs), and directives used to develop the analyses. Section 3.0.3 (Data Sources and Best Available Data) lists the sources of data used in the analysis. Section 3.0.4 (Resources and Issues Considered for Re-Evaluation in This Document) describes a general approach to the analysis. It identifies the resources that were analyzed in the 2011 GOA Final EIS/OEIS, as well as those resources eliminated from further consideration in this Supplemental EIS/OEIS.

The Navy's approach to environmental analysis has evolved from a resource-based activities analysis to a stressors-based analysis. As such, Section 3.0.5.2 (Stressors) introduces the stressors-based approach,

and Section 3.0.5.2.1 (Identification of Acoustic Sources for Analysis) presents a detailed description of each acoustic stressor category.

3.0.1 APPROACH TO ANALYSIS

The methods used in this Supplemental EIS/OEIS to assess resource impacts associated with the Proposed Action include the procedural steps outlined below:

- Review of the existing GOA ROD
- Review of the existing 2011 GOA Final EIS/OEIS
- Review of existing federal and state regulations and standards relevant to resource-specific management and/or protection.
- Review of new literature, to include new surveys, new information on habitat, new information on how resources could be affected by stressors, as well as new literature, laws, regulations, and publications pertaining to the resources identified in the 2011 GOA Final EIS/OEIS
- Description of any changes to existing resource conditions from the 2011 GOA Final EIS/OEIS and ROD.
    - Determine if an existing activity needs to be re-analyzed based upon a change in the activity
    - Determine if the affected environment has changed
    - Determine if there is a new method of analysis for the existing activity
- Identification of resource sections for re-analysis within this Supplemental EIS/OEIS
    - Resource-specific impacts analysis for individual stressors[1]
    - Examination of potential population-level impacts
- Cumulative impacts analysis
- Consideration of mitigations to reduce identified potential impacts

3.0.2 REGULATORY FRAMEWORK

In accordance with the Council on Environmental Quality (CEQ) regulations for implementing the requirements of the National Environmental Policy Act (NEPA), other planning and environmental review procedures are integrated to the fullest extent possible. This section identifies the primary applicable federal statutes and applicable executive orders (Section 3.0.2.1), and guidance (Section 3.0.2.2) that form the regulatory framework for the resource evaluations. Chapter 6 (Additional Regulatory Considerations) provides a summary listing and status of compliance with the applicable environmental laws, regulations, and executive orders that were considered in preparing this Supplemental EIS/OEIS (including those that may be secondary considerations in the resource evaluations).

3.0.2.1 Applicable Federal Statutes

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972 (16 U.S. Code [U.S.C.] §1451) was discussed in the 2011 GOA Final EIS/OEIS in the Executive Summary (ES 1.3.3); Sections 1.5.5, 3.3, and 6.1.1; and Table 6-1.

[1] The term "stressor" is broadly used in this document to refer to an agent, condition, or other stimulus that causes stress to an organism or alters physical, socioeconomic, or cultural resources.

Since the March 2011 publication of the 2011 GOA Final EIS/OEIS, the Alaska Coastal Management Program (ACMP) ended on 14 May 2011, pursuant to the provisions of Alaska Statute (AS 44.66.030), when the Alaska Legislature adjourned their special legislative session without passing the legislation required to extend the ACMP past the "sunset clause" date contained within the ACMP when it was initially authorized in 1979. Therefore, Alaska currently does not have an approved Coastal Management Program (CMP), and the Navy has no requirements to prepare any sort of CZMA determination until such time another ACMP is implemented by the State of Alaska.

Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. §1531 et seq.) was discussed in the 2011 GOA Final EIS/OEIS in Section 1.5.7, and Table 6-1.

Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 U.S.C. §1361 et seq.) was discussed in the 2011 GOA Final EIS/OEIS in Section 1.5.6, and Table 6-1.

National Environmental Policy Act

The Navy prepared this EIS/OEIS in accordance with the President's CEQ regulations implementing NEPA (40 C.F.R. §§1500–1508 et seq.). NEPA was discussed in the 2011 GOA Final EIS/OEIS in the Executive Summary (ES 1.3.1), Section 1.5.1, and Table 6-1.

Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*

This Supplemental OEIS has been prepared in accordance with EO 12114, *Environmental Effects Abroad of Major Federal Actions* (44 Federal Register [FR] 1957), and Navy implementing regulations in 32 C.F.R. Part 187. EO 12114 was discussed in the 2011 GOA Final EIS/OEIS in the Executive Summary (ES 1.3.2), Section 1.5.2, and Table 6-1.

Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*

EO 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes* (75 FR 43023), was issued in 2010. It is a comprehensive national policy for the stewardship of the ocean, our coasts, and the Great Lakes. This order adopts the recommendations of the Interagency Ocean Policy Task Force and directs executive agencies to implement the recommendations under the guidance of a National Ocean Council. This order establishes a national policy to:

- ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources;
- enhance the sustainability of ocean and coastal economies, preserve our maritime heritage;
- support sustainable uses and access;
- provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification; and
- coordinate with our national security and foreign policy interests.

3.0.2.2 Guidance

Department of Defense and Navy Directives and Instructions

Several military communications are included in this Supplemental EIS/OEIS that establish policy or a plan to govern an action, conduct, or procedure. For example, DoD Directive 4540.1, *Use of Airspace by U.S. Military Aircraft and Firings over the High Seas*, specifies procedures for conducting aircraft

maneuvers and for firing missiles and projectiles. Each range complex has its own manual; however, many of the components are similar.

3.0.3 Data Sources and Best Available Data

The Navy used the best available scientific data and information to compile the environmental baseline and environmental consequences evaluated in Chapter 3. In accordance with NEPA, the Administrative Procedure Act of 1946 (5 U.S.C. §§551–559), and EO 12114, best available data accepted by the appropriate regulatory and scientific communities were used in the analyses of potential impacts on resources.

Literature searches of journals, books, periodicals, bulletins, and other technical reports were conducted in preparation of this Supplemental EIS/OEIS. Searches included general queries in the resource areas evaluated to document the environmental baseline, and specific queries support analysis of environmental consequences. A wide range of primary literature was used in preparing this Supplemental EIS/OEIS from federal agencies such as NMFS, the U.S. Environmental Protection Agency (USEPA), international organizations, state agencies, and nonprofit and nongovernment organizations. Internet searches were conducted, and websites were evaluated for credibility of the source, quality of the information, and relevance of the content to ensure use of the best available information in this document.

3.0.4 Resources and Issues Considered for Re-Evaluation in This Document

In the 2011 GOA Final EIS/OEIS, the resources analyzed were identified and the expected geographic scope of potential impacts for each resource, known as the resource's Region of Influence, was defined. Physical resources and issues that were considered for re-evaluation in this Supplemental EIS/OEIS are those that were analyzed in the 2011 GOA Final EIS/OEIS and include air quality, expended materials, water resources, and acoustic environment (airborne). Biological resources (including threatened and endangered species) considered include marine plants and invertebrates, fish, sea turtles, marine mammals, and birds. Human resources and issues considered in this Supplemental EIS/OEIS include cultural resources, transportation and circulation, socioeconomics, environmental justice and protection of children, public safety, and cumulative impacts. However, this Supplemental EIS/OEIS is being conducted because there is new information and analytical methods to analyze acoustic impacts to marine mammals. In the process of preparing this Supplemental EIS/OEIS, the Navy has also taken into account new research, literature, laws, and regulations that have emerged since the publication of the 2011 GOA Final EIS/OEIS that may affect other resource areas. Subsequently, the Navy used this information to identify and evaluate all the resource areas to determine which ones required alternatives re-analysis in this Supplemental EIS/OEIS (Table 3.0-1). As illustrated in Table 3.0-1, it was determined that the majority of the resource areas do not warrant alternatives re-analysis.

Table 3.0-1: Resource Area Re-Evaluation in the Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement

Resource Area	New or Changes to Laws or Regulations	Changes to Existing Resource Conditions	New Research/ Information	Impacts Can Be Measured by NAEMO	Requires Alternatives Re-analysis
Air Quality	No	No	Yes	No	**No**
Expended Materials	Yes	No	Yes	No	**No**
Water Resources	Yes	No	No	No	**No**
Acoustic Environment (Airborne)	No	No	No	No	**No**
Marine Plants and Invertebrates	No	No	Yes	No	**No**
Fish	No	No	Yes	No	**No**
Sea Turtles	No	No	Yes	No	**No**
Marine Mammals	Yes	Yes	Yes	Yes	**Yes**
Birds	No	No	Yes	No	**No**
Cultural Resources	No	No	No	No	**No**
Transportation and Circulation	No	No	No	No	**No**
Socioeconomics	No	No	Yes	No	**No**
Environmental Justice and Protection of Children	No	No	No	No	**No**
Public Safety	No	No	No	No	**No**

Notes: EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, NAEMO = Navy Acoustic Effects Model, NMFS = National Marine Fisheries Service

3.0.4.1 Resources Carried Forward for Alternatives Re-Analysis

As illustrated in Table 3.0-1, a "yes" entry in a particular column indicates changes to that resource area since the 2011 GOA Final EIS/OEIS. These resource areas were then evaluated as to whether the change affected the analysis contained in the 2011 GOA Final EIS/OEIS. The change was also assessed based upon whether the impacts could be measured by NAEMO. Finally, a determination was made as to whether the resource area required alternatives re-analysis. As shown in Table 3.0-1, marine mammals is the only resource area meeting all the criteria and is being carried forward for alternatives re-analysis in this Supplemental EIS/OEIS. The sections following Section 3.0 briefly discuss and explain why each of the additional resource areas was not carried forward for alternatives re-analysis.

3.0.5 STRESSORS-BASED ANALYSIS

As mentioned above, the Navy's approach to environmental analysis has evolved from a resource/activities-based analysis to a stressors-based analysis since the publication of the 2011 GOA Final EIS/OEIS. As such, the following sections introduce the stressors-based approach and present a detailed description of each acoustic stressor category.

3.0.5.1 Introduction to Acoustics

To fully understand the stressors to marine mammals (underwater acoustic stressors), one must understand the transmission of sound through different media. However, the transmission of sound in air and in water can be a complex topic and may be difficult to understand. Appendix G (Acoustic Primer) provides a technical introduction to acoustics including the various sources of underwater sound, including physical, biological and anthropogenic sounds. The acoustic primer also explains the transmission of sound in the ocean, defines acoustic terms, abbreviations, and units of measurement used in the analysis, as well as frequencies produced during Navy training activities. Please refer to Appendix G (Acoustic Primer) for information regarding sound transmission in the ocean environment and air.

3.0.5.2 Stressors

The term stressor is broadly used in this document to refer to an agent, condition, or other stimulus that causes stress to an organism or alters physical, socioeconomic or cultural resources. For the Supplemental EIS/OEIS, acoustic sound is being analyzed as an acoustic stressor. Other information that was evaluated to identify and analyze stressors included public and agency scoping comments, previous environmental analyses, agency consultations, resource-specific information, and applicable laws, regulations, and executive orders. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this Supplemental EIS/OEIS.

As previously mentioned, this Supplemental EIS/OEIS is analyzing the same warfare areas and activities that produce underwater sound as was analyzed in the 2011 GOA Final EIS/OEIS. However, in the Supplemental EIS/OEIS, the analysis is using NAEMO, new threshold criteria, and updated marine mammal density data as compared to the 2011 GOA Final EIS/OEIS. Table 3.0-2 identifies the acoustic stressors that will be quantified by NAEMO for the analysis of marine mammal impacts.

3.0.5.2.1 Identification of Acoustic Sources for Analysis

In order to make the transition from an activities-based analysis to a stressor-based analysis, the same training activities that were analyzed in the 2011 GOA Final EIS/OEIS were re-evaluated to identify specific components that could act as acoustic stressors (Table 3.0-2) by having direct or indirect impacts on marine mammals and which were applicable and quantifiable by NAEMO. This evaluation included identification of the spatial variation of the identified acoustic stressors. The following subsections describe the acoustic stressors in more detail.

3.0.5.2.1.1 Acoustic Stressors

This section describes the characteristics of sounds produced during naval training activities and the relative magnitude of these sound-producing activities. This provides the basis for analysis of acoustic and explosive impacts to marine mammals in the remainder of Chapter 3. For additional details on the properties of sound and explosives, see Appendix G (Acoustic Primer).

Table 3.0-2: Acoustic Stressors Associated with Training Activities

Warfare Area and Activities that Occurred and Were Analyzed in the 2011 GOA Final EIS/OEIS and Will Occur under the Supplemental EIS/OEIS	Acoustic Stressors Analyzed in This Supplemental EIS/OEIS		Requires NAEMO Re-analysis
Warfare Area and Activity	**Sonar/Other Active Acoustic Sources**	**Explosives**	
AAW			
Aircraft Combat Maneuvers			
Air Defense Exercise			
Surface-to-Air Missile Exercise			
Surface-to-Air Gunnery Exercise			
Air-to-Air Missile Exercise			
ASUW			
Visit, Board, Search, and Seizure			
Air-to-Surface Missile Exercise		✓	✓
Air-to-Surface Bombing Exercise		✓	✓
Air-to-Surface Gunnery Exercise		✓	✓
Surface-to-Surface Gunnery Exercise		✓	✓
Maritime Interdiction Exercise			
Sea Surface Control			
Sinking Exercise	✓	✓	✓
ASW*			
ASW Tracking Exercise – Helicopter	✓	✓	✓
ASW Tracking Exercise – Maritime Patrol Aircraft	✓	✓	✓
ASW Tracking Exercise – Extended Echo Ranging (EER) (Includes IEER and MAC)	✓	✓	✓
ASW Tracking Exercise – Surface Ship	✓		✓
ASW Tracking Exercise – Submarine	✓		✓
EC			
Electronic Combat Exercises			
Chaff Exercises			
Counter Targeting Exercises			
NSW			
Special Warfare Operations			
STW			
Air-to-Ground Bombing Exercise			
Personnel Recovery			
Support Operations			
Deck Landing Qualifications			

* ASW Warfare sensors used include MF1, MF3, MF4, MF5, MF6, MF11, HF1, HF6, ASW2, ASW3, ASW4, and E4 (Extended Echo Ranging and Improved Extended Echo Ranging sonobuoys).
Notes: (1) For this Supplemental EIS/OEIS, listing the ASW activity in the same format that was used in the 2011 GOA Final EIS/OEIS does not accurately reflect how modeling was conducted. For this Supplemental EIS/OEIS, ASW activity was not modeled as individual unit level training events (as was done in the 2011 GOA Final EIS/OEIS) but instead was modeled using the NAEMO model, which models all non-impulsive (e.g., sonar) sources together over the course of three 7-day exercises using the amount of sonar sources authorized in the Gulf of Alaska Temporary Maritime Activities Area Federal Register and Letter of Authorization evenly divided between these three periods of exercises. (2) Explosive events are modeled separately from sonar events within NAEMO (different models within NAEMO). (3) AAW = Anti-Air Warfare, ASUW = Anti-Surface Warfare, ASW = Anti-Submarine Warfare, EC = Electronic Combat, EER = Extended Echo Ranging, EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, IEER = Improved Extended Echo Ranging, NAEMO = Navy Acoustics Effects Model, NSW = Naval Special Warfare, STW = Strike Warfare

Sonar and Other Active Acoustic Sources

Sonar and other non-impulsive sound sources emit sound waves into the water to detect objects, safely navigate, and communicate. Most systems operate within specific frequencies (although some harmonic frequencies may be emitted at lower sound pressure levels). Sonar use associated with anti-submarine warfare (ASW) would emit the most underwater non-impulsive sound during training activities. General categories of sonar systems are described in Section 2.2.1 (Classification of Non-Impulse and Impulse Sources). Table 3.0-3 presents the hours of operation proposed for the source classes that are being quantitatively analyzed for impacts.

Underwater sound propagation is highly dependent upon environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation (see Appendix G, Acoustic Primer).

Table 3.0-3: Sonar and Other Active Acoustic Sources Quantitatively Analyzed in the Gulf of Alaska Navy Training Activities Study Area

For Annual Training Activities				
Source Class Category	**Source Bins**	**Units**	**Annual Training from the Proposed Action**	**Requires NAEMO Re-analysis**
Mid-Frequency (MF) Tactical and non-tactical sources that produce signals from 1 to 10 kHz	MF1	Hours	541	Yes
	MF3	Hours	48	Yes
	MF4	Hours	53	Yes
	MF5	Items	25	Yes
	MF6	Items	0.15	Yes
	MF11	Hours	78	Yes
High-Frequency (HF) Tactical and non-tactical sources that produce signals greater than 10 kHz but less than 180 kHz	HF1	Hours	24	Yes
	HF6	Hours	80	Yes
Anti-Submarine Warfare (ASW) Tactical sources used during anti-submarine warfare training activities	ASW2	Hours	31	Yes
	ASW3	Hours	546	Yes
	ASW4	Items	4	Yes
Torpedoes (TORP) Source classes associated with active acoustic signals produced by torpedoes	TORP2	Items	5	Yes

Notes: kHz = kilohertz, NAEMO = Navy Acoustic Effects Model

Most use of active acoustic sources involves a single unit or several units (ship, submarine, aircraft, or other platform) employing a single active sonar source in addition to sound sources used for communication, navigation, and measuring oceanographic conditions. Anti-submarine warfare activities may also use an acoustic target or an acoustic decoy.

Anti-Submarine Warfare Sonar

Sonar used in ASW is deployed on many platforms and is operated in various ways. Anti-submarine warfare active sonar is usually mid-frequency (1–10 kHz) because mid-frequency sound balances sufficient resolution to identify targets and distance within which threats can be identified.

- Surface ship tactical hull-mounted sonar accounts for 43 percent (619 hours) of the overall non-impulse sound in the Study Area, all of which is conducted in the TMAA. Duty cycle can vary from about a ping per minute (for source bin MF1) to continuously active (for source bin MF11). Sonar can be wide-ranging in a search mode or highly directional in a track mode.
- A submarine's mission revolves around its stealth; therefore, a submarine's mid-frequency sonar is used infrequently because its use would also reveal a submarine's location.
- Aircraft-deployed, mid-frequency, ASW systems include omnidirectional dipping sonar (deployed by helicopters) and Directional Command Activated Sonobuoy System (MF5) sonobuoys (deployed from various aircraft), which have a typical duty cycle of several pings per minute.
- Acoustic countermeasures that continuously emulate broadband vessel sound or other vessel acoustic signatures may be deployed by ships and submarines during training.
- Torpedoes use directional high-frequency sonar when approaching and locking onto a target. Practice targets emulate the sound signatures of submarines or repeat received signals.

Anti-submarine warfare events in the Study Area would occur more than 12 nautical miles (nm) from shore. Additionally, most events usually occur over a limited area and are completed in less than 1 day, often within a few hours. Multi-day ASW events requiring coordination of movement and effort between multiple platforms with active sonar over a larger area occur less often, but constitute a large portion of the overall non-impulsive underwater noise that would be impacted by Navy activities. Such would be the case for Navy training activities in the Study Area, which would have periods of concentrated, near-continuous ASW sonar use by several platforms throughout the duration of the exercise.

Other Active Acoustic Sources

Active sound sources used for navigation and obtaining oceanographic information (e.g., depth, bathymetry, and speed) are typically directional, have high duty cycles, and cover a wide range of frequencies, from mid-frequency to very high-frequency. These sources are similar to the navigation systems on standard large commercial and oceanographic vessels. These sound sources could be used by vessels during most activities and while transiting throughout the Study Area.

3.0.5.2.1.2 Explosives

Explosive detonations during training activities are associated with high-explosive ordnance, including bombs, missiles, and naval gun shells; torpedoes; and explosive buoys. Most explosive detonations during training involving the use of high-explosive ordnance, including bombs, missiles, and naval gun shells, would occur in the air or near the water's surface. Explosives associated with torpedoes and explosive sonobuoys would occur in the water column. Detonations would occur in waters greater than 200 feet (ft.) (61 meters [m]) in depth, and greater than 12 nm from shore.[2] Detonations associated with ASW would typically occur in waters greater than 600 ft. (183 m) depth, which is over 13 nm from the closest point of land (Cape Cleare, on Montague Island). The numbers of explosions in each explosive source class are shown in Table 3.0-4.

[2] As noted elsewhere, Cape Cleare on Montague Island is located approximately 12 nm from the northern point of the TMAA, and the nearest shoreline (Kenai Peninsula) is located approximately 24 nm north of the TMAA's northern boundary.

Explosive detonations occurring during a Sinking Exercise (SINKEX) would occur in accordance with a permit from the USEPA. The target,[3] typically a decommissioned combatant or merchant ship that has been made environmentally safe for sinking according to standards set by the USEPA, is placed in a specific location that is greater than 50 nm out to sea in water depths greater than 6,000 ft. (1,830 m) (40 C.F.R. §229.2).

Explosives in the water introduce loud, impulse, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: (1) the weight of the explosive warhead, (2) the type of explosive material, and (3) the detonation depth. The net explosive weight, the explosive power of a charge expressed as the equivalent weight of trinitrotoluene (TNT), accounts for the first two parameters. The properties of explosive detonations are discussed in Appendix G (Acoustic Primer). Table 3.0-4 shows the depths at which representative explosive source classes are assumed to detonate underwater for purposes of analysis.

Table 3.0-4: Explosive Sources Used during Training in the Gulf of Alaska Study Area

Explosives (Source Class and Net Explosive Weight) (lb.)	Number of Explosives with the Proposed Action	Requires NAEMO Re-analysis	Representative Underwater Detonation Depth[1]
E4 (> 2.6–6 lb. NEW)	80	Yes	10 m (33 ft.), 20 m (66 ft.)
E5 (> 6–10 lb. NEW)	112	Yes	1 m (3 ft.)
E6 (> 11–20 lb. NEW)	2	Yes	15 m (50 ft.)
E7 (> 20–60 lb. NEW) AGM-88 HARM	4	Yes	15 m (50 ft.)
E8 (> 61–100 lb. NEW)	6	Yes	1 m (3 ft.)
E9 (> 101–250 lb. NEW)	142	Yes	1 m (3 ft.)
E10 (> 251–500 lb. NEW)	32	Yes	6 m (20 ft.), 10 m (33 ft.)
E11 (> 501–650 lb. NEW) MK-48 Torpedo	2	Yes	6 m (20 ft.), 10 m (33 ft.)
E12 (> 651–1,000 lb. NEW) 2,000 lb. bomb	4	Yes	1 m (3 ft.)

[1] Underwater detonation depths listed are those assumed for purposes of acoustic impacts modeling. Detonations assumed to occur at a depth of 3.3 ft. (1 m) include detonations that would actually occur at or just above the water surface.
Notes: HARM = High Speed Anti-Radiation Missile, m = meters, NEW = Net Explosive Weight, ft. = feet, lb. = pounds, n/a = not applicable, NAEMO = Navy Acoustics Effects Model

In general, explosive events would consist of a single explosion or multiple explosions over a short period. During training, all high-explosive bombs would be detonated near the surface over deep water. Bombs with high-explosive ordnance would be fused to detonate on contact with the water. Other detonations would occur near but above the surface upon impact with a target; these detonations are conservatively assumed to occur at a depth of 3.3 ft. (1 m) for purposes of analysis. Detonations of projectiles during anti-air warfare would occur far above the water surface.

Since most explosive sources used in military activities are munitions that detonate essentially upon impact, the effective source depths are quite shallow and, therefore, the surface-image interference effect can be pronounced (see Appendix G, Acoustic Primer). This effect would reduce peak pressures and potential impacts near the water surface.

[3] Per a 24 January 2014 EPA/Navy agreement, "Navy agrees that SINKEX vessels will not likely, in the future, include aircraft carriers or submarines" (as the target vessel of a SINKEX).

3.0.5.3 Marine Mammal Resource-Specific Impacts Analysis for Acoustic Stressors

The direct and indirect impacts of each acoustic stressor carried forward for further analysis were analyzed for marine mammals in Section 3.8 (Marine Mammals). Quantitative and semi-quantitative methods were used to the extent possible, but inherent scientific limitations required the use of qualitative methods for acoustic stressor/marine mammal resource interactions. Resource-specific methods are described in Section 3.8 (Marine Mammals), where applicable. While specific methods used to analyze the impacts of individual stressors varied, the following generalized approach was used for all acoustic stressor/marine mammal resource interactions:

- The frequency, duration, and spatial extent of exposure to each acoustic stressor was analyzed for marine mammals. The frequency of exposure to each acoustic stressor or frequency of a proposed activity was characterized as intermittent or continuous, and was quantified in terms of number per unit of time when possible. Duration of exposure was expressed as short- or long-term and was quantified in units of time (e.g., seconds, minutes, and hours) when possible. The spatial extent of exposure was generally characterized as widespread or localized, and the acoustic stressor footprint or area (e.g., square feet, square nautical miles) was quantified when possible.
- An analysis was conducted to determine whether and how marine mammals are likely to respond to acoustic stressor exposure or be altered by acoustic stressor exposure based upon available scientific knowledge. This step included reviewing available scientific literature and empirical data. For many acoustic stressor/marine mammal interactions, a range of likely responses or endpoints was identified. For example, exposure of an organism to sound produced by an underwater explosion could result in no response, a physiological response such as increased heart rate, a behavioral response such as being startled, injury, or mortality.
- The information obtained was used to analyze the likely impacts of individual acoustic stressors on a marine mammal species and to characterize the type, duration, and intensity (severity) of impacts. The type of impact was generally defined as beneficial or adverse and was further defined as a specific endpoint (e.g., change in behavior, mortality, change in concentration, loss of habitat). When possible, the endpoint was quantified. The duration of an impact was generally characterized as short-term (e.g., minutes, days, weeks, months, depending on the resource), long-term (e.g., months, years, decades, depending on the resource), or permanent. The intensity of an impact was then determined. For marine mammals, the analysis started with individual organisms and their habitats, and then addressed populations, species, communities, and representative ecosystem characteristics, as appropriate.

3.0.5.4 Cumulative Impacts

A cumulative impact is the impact on the environment that results when the incremental impact of an action is added to other past, present, and reasonably foreseeable future actions. The cumulative impacts analysis (see Chapter 4, Cumulative Impacts) considers other actions regardless of what agency (federal or nonfederal) or person undertakes the actions. Cumulative impacts result when individual actions combine with similar actions taking place over a period of time to produce conditions that frequently alter the historical baseline (40 C.F.R. §1508.7). The goal of the analysis is to provide the decision makers with information relevant to reasonably foresee potentially significant impacts. See Chapter 4 (Cumulative Impacts) for the specific approach used for determining cumulative impacts.

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3.1 Air Quality

TABLE OF CONTENTS

3.1 AIR QUALITY 3.1-1
3.1.1 AFFECTED ENVIRONMENT 3.1-1
3.1.1.1 Existing Conditions 3.1-1
3.1.1.2 Current Requirements and Practices 3.1-2
3.1.2 ALTERNATIVES ANALYSIS 3.1-2
3.1.3 CONCLUSIONS 3.1-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.1 AIR QUALITY

3.1.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for air quality remains the same as that identified in the March 2011 Gulf of Alaska (GOA) Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area). Areas inland from the coastline, including United States (U.S.) Air Force air ranges and U.S. Army training lands, are addressed in separate environmental documents completed by those services.

3.1.1.1 Existing Conditions

3.1.1.1.1 Climate, Regional Emissions, Existing Air Quality

Climate, regional emissions, and existing air quality in the TMAA were discussed in the 2011 GOA Final EIS/OEIS. The climate and regional emissions within the ROI have not appreciably changed since the publication of the 2011 GOA Final EIS/OEIS (State of Alaska, Division of Air Quality 2011; U.S. Environmental Protection Agency 2013a, b). However, regarding existing air quality:

- Anchorage remains a maintenance area for carbon monoxide (CO)
- Juneau remains a non-attainment area for particulate matter under 10 micrometers (µm) in size (expressed as PM_{10} for particulate matter ranging in size above 2.5 and up to 10 µm)
- Fairbanks remains a maintenance area for CO and has been listed as a non-attainment area for particulate matter under 2.5 µm (expressed as $PM_{2.5}$ for particulate matter up to 2.5 µm in size)
- Eagle River was a non-attainment area for PM_{10}, but is now listed as a maintenance area for PM_{10}

As stated in the 2011 GOA Final EIS/OEIS, with the exception of Cape Cleare on Montague Island (an island with no permanent population), which is located over 12 nautical miles (nm) from the northern edge of the TMAA, the nearest shoreline (Kenai Peninsula) is located approximately 24 nm north of the TMAA's northern boundary. Air quality regions, as defined, only extend to state waters (3 nm). Additionally, the actions taken in maintenance and non-attainment areas will not interfere with the state's plans to meet national standards for air quality; general conformity will not be impacted either. Therefore, climate, regional emissions, and existing air quality will not be re-analyzed in this Supplemental EIS/OEIS. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.1.1.1.2 Sensitive Receptors

Sensitive receptors within the ROI are mainly crews of vessels and recreational users of the GOA. Following a review of recent literature, it was noted that the number of registered boats (civilian vessel traffic) in Alaska has dropped since the release of the Final EIS/OEIS by approximately 2,100 fewer registered boats in 2012 (Section 3.12.1.1.3, Tourism and Recreation, of this Supplemental EIS/OEIS provides a discussion on the decline of registered boats within the ROI). Despite the fact that sensitive receptors within the Study Area have decreased since the publication of the 2011 GOA Final EIS/OEIS, the general discussion regarding sensitive receptors in the Final EIS/OEIS remains valid.

3.1.1.1.3 Climate Change

Climate change in the TMAA was discussed in the 2011 GOA Final EIS/OEIS. Additional information on climate change, to include global warming and greenhouse gases (GHGs), can be found in Chapter 4

(Cumulative Impacts). In general, though, GHG emissions for a proposed action can be inventoried, based on methods prescribed by state and federal agencies. However, the specific contributions of a particular project to global or regional climate change generally cannot be identified based on existing scientific knowledge, because individual projects typically have a negligible effect. Also, climate processes are understood at only a general level. Furthermore, the U.S. Department of the Navy (Navy) is not proposing any new activities in this Supplemental EIS/OEIS. As such, the information regarding climate change presented in the 2011 GOA Final EIS/OEIS remains valid.

3.1.1.2 Current Requirements and Practices

Current requirements and practices were discussed in the 2011 GOA Final EIS/OEIS. Also, equipment used by military organizations within the Gulf of Alaska, including ships, other marine vessels, aircraft, and other equipment, are properly maintained in accordance with applicable Navy and Marine Corps requirements (e.g., Chief of Naval Operations Instruction [OPNAVINST] 4790.2J, *Naval Aviation Maintenance Program*, and OPNAVINST 4790.8B, *Ship's Maintenance and Material Management Manual*), and meet federal and state emission standards, where applicable. Additionally, the Navy is not proposing any new activities or equipment utilization in this Supplemental EIS/OEIS. However, should new aircraft or vessels eventually be introduced to the fleet, they too will undergo rigorous emissions testing and comply with all applicable maintenance requirements and federal and state emissions standards, where applicable. Additional information regarding current requirements and practices is discussed in detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.1.2 Alternatives Analysis

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to air quality management or protection, as well as a review of new literature, to include laws, regulations, and publications pertaining to air quality. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to air quality is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.1.3 Conclusions

As described above, there is new information on existing environmental conditions with regard to air quality, to include updates on particulate matter and non-attainment area designations and maintenance area designations. However, this new information does not change the affected environment, which forms the environmental baseline of the air quality analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect air quality in the TMAA. Therefore, conclusions for air quality impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on air quality under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.1-6 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

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3.2 Expended Materials

TABLE OF CONTENTS

3.2 EXPENDED MATERIALS 3.2-1
3.2.1 AFFECTED ENVIRONMENT 3.2-1
3.2.1.1 Existing Conditions 3.2-1
3.2.1.2 Current Requirements and Practices 3.2-1
3.2.2 ALTERNATIVES ANALYSIS 3.2-2
3.2.3 CONCLUSION 3.2-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.2 EXPENDED MATERIALS

3.2.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for expended materials remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.2.1.1 Existing Conditions

Expended materials, both hazardous and nonhazardous, can result from United States (U.S.) Department of the Navy (Navy) training activities in the TMAA. Both hazardous expended materials, to include heavy metals, propellants, explosives, and pyrotechnics, and nonhazardous expended materials are described in the 2011 GOA Final EIS/OEIS. Following a review of recent literature (peer reviewed literature, internet search, personal communications), the definitions, properties, and fates of expended materials in salt water, as presented in the 2011 GOA Final EIS/OEIS, have not appreciably changed since the publication of the 2011 GOA Final EIS/OEIS. However, additional information regarding military expended materials such as chaff and plastics is provided below. This information does not change or alter the conclusions made in the 2011 GOA Final EIS/OEIS and is provided here for reference.

3.2.1.1.1 Contaminants from Expended Materials

Military expended material, including targets and vessel hulks involved in sinking exercises (SINKEXs), contains materials other than metals, explosives, or chemicals. Principal components of these military expended materials include aluminized fiberglass (chaff), carbon or Kevlar fiber (missiles), and plastics (canisters, targets, sonobuoy components, parachutes). Chaff has been extensively studied, and no indirect toxic effects are known at realistic concentrations in the marine environment (Arfsten et al. 2002). Glass, carbon, and Kevlar fibers are not known to have potential toxic effects on marine invertebrates. Plastics contain chemicals that have potential effects on fish and invertebrates (Derraik 2002, Mato et al. 2001, Teuten et al. 2007).

Potentially harmful chemicals in plastics are not readily adsorbed to marine sediments; instead, fish and invertebrates are most at risk via ingestion or bioaccumulation. Because plastics retain many of their chemical properties as they physically degrade into plastic particles (Singh and Sharma 2008), the exposure risks to marine invertebrates are dispersed over time. It is conceivable that marine invertebrates could be indirectly impacted by chemicals associated with plastics; however, absent bioaccumulation, these effects would be limited to direct contact with the material.

3.2.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, releases or discharges of hazardous wastes or materials are heavily regulated through comprehensive federal and state processes. In addition, the International Convention for the Prevention of Pollution from Ships (MARPOL) prohibits certain discharges of oil, garbage, and other substances from vessels. The MARPOL convention is implemented by national legislation, including the Act to Prevent Pollution from Ships (33 United States Code [U.S.C.] 1901, et seq.) and the Federal Water Pollution Control Act (Clean Water Act [CWA]; 33 U.S.C. 1321, et seq.). These and other requirements are implemented by Navy guidance documents and manuals (e.g., Chief of Naval Operations Manual [OPNAV M-5090.1D, *Environmental Readiness Program Manual*) that require hazardous materials to be stored and handled appropriately, both ashore and afloat. Environmental compliance policies and procedures applicable to shipboard activities afloat are defined in OPNAV M-5090.1D, Chapter 35, “Environmental Compliance Afloat”; and Department of Defense

Instruction 5000.2-R (§C5.2.3.5.10.8, "Pollution Prevention"). In addition, provisions in Executive Order (EO) 12856, *Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements*, and EO 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, reinforce the CWA prohibition against the discharge of harmful quantities of hazardous substances into U.S. waters out to 200 nautical miles (nm), and mandate stringent hazardous waste discharge and storage, dumping, and pollution prevention requirements.

Explosive detonations occurring during a SINKEX (described in the Final EIS/OEIS in Section 2.6.1.1 and Figure 2-7) would occur in accordance with a permit from the U.S. Environmental Protection Agency (USEPA). The target,[1] typically a decommissioned combatant or merchant ship that has been made environmentally safe for sinking according to standards set by the USEPA, is placed in a specific location that is greater than 50 nm out to sea in water depths greater than 6,000 feet (1,830 meters). Of note, the original SINKEX permit was from an agreement dated in 1999. The latest agreement between the USEPA and the Navy was signed on 24 January 2014. The updated agreement includes additional information and clarification of the permit's requirements on Verification of Navy SINKEX Process, SINKEX Vessel Preparation Requirements Relating to PCB (polychlorinated biphenyls) Removal under Permit, Pre-sink SINKEX Vessel Preparation Verification, and Post-sink SINKEX Vessel Information to submit to Environmental Protection Agency (EPA). The final resolution is that the Navy may continue SINKEX operations as long as they are in compliance with the permit, to include SINKEX vessel preparation and documentation-related requirements referred to above.

3.2.2 Alternatives Analysis

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to expended materials, as well as a review of new literature, to include laws, regulations, and publications pertaining to expended materials. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to expended materials is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.2.3 Conclusion

As described above, there is new information on existing environmental conditions, including updated Navy regulations, and new information on a USEPA/Navy SINKEX agreement. However, this new information does not change the affected environment, which forms the environmental baseline of the expended materials analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect expended materials in the TMAA. Therefore, conclusions for expended materials impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on expended materials under both the National Environmental Policy Act and EO 12114, please refer to Table 3.2-24 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

[1] Per a 24 January 2014 EPA/Navy agreement, "Navy agrees that SINKEX vessels will not likely, in the future, include aircraft carriers or submarines" (as the target vessel of a SINKEX).

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3.3 Water Resources

TABLE OF CONTENTS

3.3 WATER RESOURCES.....3.3-1
3.3.1 AFFECTED ENVIRONMENT.....3.3-1
3.3.1.1 Existing Conditions.....3.3-1
3.3.1.2 Current Requirements and Practices.....3.3-1
3.3.2 ALTERNATIVES ANALYSIS.....3.3-3
3.3.3 CONCLUSION.....3.3-3

LIST OF TABLES

TABLE 3.3-1: WASTE DISCHARGE RESTRICTIONS FOR NAVY VESSELS..... 3.3-2

LIST OF FIGURES

There are no figures in this section.

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3.3 WATER RESOURCES

3.3.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for water resources remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.3.1.1 Existing Conditions

3.3.1.1.1 Ocean Water Resources, Climate, and Existing Water Quality

Ocean water resources, climate, and the existing water quality in the TMAA were discussed in the 2011 GOA Final EIS/OEIS. As stated in the 2011 GOA Final EIS/OEIS, there is little information on open ocean water quality; however, some studies suggest that deep water is, in general, of higher quality than surface waters. Additionally, water quality in marine environments is determined by complex interactions between physical, chemical, and biological processes. However, in regards to existing water quality:

- The TMAA includes a broad and deep continental shelf that contains troughs, seamounts, and ridges.
- The Gulf of Alaska region experiences high amounts of freshwater input from winter runoff. Timing and magnitude of winter runoff influences the temperature distribution of water around the continental shelf (Janout et al. 2010).
- Ocean circulation in the Gulf of Alaska is dominated by the counter-clockwise Alaska Gyre, which is made up of the Alaska Current, the Alaskan Stream, and the North Pacific Current.
- The Alaska Coastal Current is the primary element of continental shelf circulation in the Gulf of Alaska.

Following a review of recent literature, including the GAK1 station oceanographic data time series, the *Journal of Geophysical Research: Oceans*, the Alaska Ocean Observing System, and other peer-reviewed and scientific literature, no additional changes to water resources have been identified within the Study Area. Additionally, no new or additional United States (U.S.) Department of the Navy (Navy) training activities are being proposed in this Supplemental EIS/OEIS that would affect water resources in the Study Area. As such, the information and analysis on water resources presented in the 2011 GOA Final EIS/OEIS is still valid.

3.3.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS and in Section 3.2 (Expended Materials) of this Supplemental EIS/OEIS, while at sea, Navy vessels are required to operate in a manner that minimizes or eliminates any adverse impacts on the marine environment. Environmental compliance policies and procedures applicable to shipboard operations afloat are defined in Chief of Naval Operations Manual (OPNAV M) 5090.1, Chapter 35, “Environmental Compliance Afloat” (U.S. Department of the Navy 2014); and Department of Defense Instruction 5000.2-R (§C5.2.3.5.10.8, “Pollution Prevention”). In addition, provisions in Executive Order (EO) 12856, *Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements*, and EO 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, reinforce the Clean Water Act prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nautical miles, and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Shipboard waste-handling procedures governing the discharge of nonhazardous waste

streams have been established for commercial and Navy vessels. These categories of wastes include solids (garbage) and liquids such as "black water" (sewage), "gray water" (water from deck drains, showers, dishwashers, laundries, etc.), and oily wastes (oil-water mixtures). An updated Table 3.3-1, from OPNAV M-5090.1, (Chapter 35) summarizes the waste stream discharge restrictions for Navy vessels at sea and provides information on Navy Standard Operating Procedures (SOPs) and Best Management Practices (BMPs) for shipboard management, storage, and discharge of hazardous materials and wastes, and on other pollution protection measures intended to protect water quality. Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS discusses additional SOPs and BMPs used by the Navy to protect water resources.

Table 3.3-1: Waste Discharge Restrictions for Navy Vessels

Zone (nm from shore)	Type of Waste		
	Sewage ("Black Water")	Gray Water	Oily Waste
0–3 nm (U.S. Waters)	No discharge from Type III MSD; direct discharge from Type II MSD while underway, outside NDZs. In port, discharge to pierside collection facilities.	If no pierside collection capability exists, direct discharge permitted.	No sheen. If equipped with OCM, discharge = < 15 ppm oil.[1]
3–12 nm (U.S. Contiguous Zone)	Direct discharge permitted	Direct discharge permitted	No sheen. If equipped with OCM, discharge = < 15 ppm oil.[1]
12–25 nm	Direct discharge permitted	Direct discharge permitted	If equipped with OCM, discharge = < 15 ppm oil. Ships with OWSs or BWPTs but inoperable OCM must process all machinery space bilge water through OWS or BWPT.[2,3]
> 25 nm	Direct discharge permitted	Direct discharge permitted	Same as 12–25 nm[2,3]
> 50 nm and High Seas	Direct discharge permitted	Direct discharge permitted	Same as 12–25 nm[2,3]
Zone (nm from shore)	**Garbage (Non-plastic)**	**Garbage (Plastic)**	
0–3 nm (U.S. Waters)	No discharge	No discharge	
3–12 nm (U.S. Contiguous Zone)	Pulped or comminuted food and pulped paper and cardboard waste may be discharged > 3 nm	No discharge	
12–25 nm	Bagged shredded glass and metal waste may be discharged > 12 nm[4]	No discharge	
> 25 nm	Direct discharge permitted[5]	No discharge	
> 50 nm and High Seas	Direct discharge permitted[5]	No discharge	

[1] If operating properly, OWS or BWPT discharge will routinely be less than 15 ppm.
[2] Surface ships without an operable OWS must retain oily waste for shore disposal. If operating conditions require at sea disposal, minimal discharge is permitted beyond 50 nm from nearest land.
[3] Indicates a change from what was stated in the Final EIS/OEIS.
[4] Submarines may discharge compacted, non-plastic, sinkable garbage between 12 and 25 nm, provided the depth of water is greater than 1,000 fathoms.
[5] Surface ships equipped with pulpers and shredders shall use them for all discharges of food products, paper, cardboard, glass, and metal wastes. Shredded metal and glass must be bagged prior to disposal. Submarines shall discharge compacted, non-plastic, sinkable garbage.
Notes: BWPT = Bilge Water Processing Tank, MSD = Marine Sanitation Device, NDZ = No Discharge Zone, nm = nautical mile(s), OCM = Oil Content Monitor, ppm = parts per million, OWS = oil/water separator, U.S. = United States
Source: Chief of Naval Operations Manual 5090.1

3.3.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to water resources, as well as a review of new literature, to include laws, regulations, and publications pertaining to water resources. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to water resources is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.3.3 CONCLUSION

As described above, there is new information on existing environmental conditions, including updated Navy regulations. However, this new information does not change the affected environment, which forms the environmental baseline of the water resources analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect water resources in the TMAA. Therefore, conclusions for water resources impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on water resources under both the National Environmental Policy Act and EO 12114, please refer to Table 3.3-16 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

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3.4 Acoustic Environment (Airborne)

TABLE OF CONTENTS

3.4 ACOUSTIC ENVIRONMENT (AIRBORNE) 3.4-1
3.4.1 AFFECTED ENVIRONMENT 3.4-1
3.4.1.1 Existing Conditions 3.4-1
3.4.1.2 Current Requirements and Practices 3.4-1
3.4.2 ALTERNATIVES ANALYSIS 3.4-1
3.4.3 CONCLUSION 3.4-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.4 ACOUSTIC ENVIRONMENT (AIRBORNE)

3.4.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence for the acoustic environment (airborne) remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area). For underwater acoustics, please see Section 3.8 (Marine Mammals) and Appendix D (Acoustic Primer).

3.4.1.1 Existing Conditions

The general introduction to sound and sound characteristics is described in the 2011 GOA Final EIS/OEIS.

3.4.1.1.1 Ambient Sound

As described in the 2011 GOA Final EIS/OEIS, airborne noise sources at sea include those from manmade sources, such as sounds produced from commercial, fishing, research, and recreational vessels, and general and commercial aviation. United States Department of the Navy (Navy) training events may also add to these sounds intermittently and at various locations in the TMAA during an exercise period. These noise sources, or the amount of activities associated with noise sources, have not appreciably changed since the publication of the 2011 GOA Final EIS/OEIS. As such, the information and analysis regarding ambient sound conditions presented in the 2011 GOA Final EIS/OEIS remains valid.

3.4.1.1.2 Sound from Military Sources

Sound generated from military sources was described in the 2011 GOA Final EIS/OEIS. In summary, airborne noise attributable to military activities in the TMAA results from multiple sources, including naval ship power plants, military aircraft, target engine noise, bombs, missiles, and gunfire. Although it is possible that some new military aircraft and ships will be part of the Navy's future inventory, and would be used in the Proposed Action, these newer platforms generate sounds similar to those described in the 2011 GOA Final EIS/OEIS. However, no new or additional ordnance, missiles and targets, or other non-explosive impact airborne noise generating devices are being proposed in this Supplemental EIS/OEIS. As the sounds from military sources are similar to those analyzed in the 2011 GOA Final EIS/OEIS, the information and analysis regarding sources of military sound presented in the 2011 GOA Final EIS/OEIS remain valid.

3.4.1.2 Current Requirements and Practices

The requirements and practices associated with aircraft operations have not changed appreciably from those presented in the 2011 GOA Final EIS/OEIS. As such, the information regarding current requirements and practices presented in the 2011 GOA Final EIS/OEIS remains valid. However, Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS discusses the latest standard operating procedures and best management practices used by the Navy.

3.4.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to the acoustic environment (airborne), as well as a review of new literature, to include laws, regulations, and publications pertaining to airborne acoustics. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions

have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to the acoustic environment (airborne) is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.4.3 CONCLUSION

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the acoustic environment (airborne) analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect the acoustic environment in the TMAA. Therefore, conclusions for acoustic environment (airborne) impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on acoustic environment (airborne) under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.4-4 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

3.5 Marine Plants and Invertebrates

TABLE OF CONTENTS

3.5 MARINE PLANTS AND INVERTEBRATES 3.5-1
3.5.1 AFFECTED ENVIRONMENT 3.5-1
3.5.1.1 Existing Conditions 3.5-1
3.5.1.2 Current Requirements and Practices 3.5-2
3.5.2 ALTERNATIVES ANALYSIS 3.5-2
3.5.3 CONCLUSION 3.5-3

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.5 MARINE PLANTS AND INVERTEBRATES

3.5.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for marine plants and invertebrates remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (the Study Area).

3.5.1.1 Existing Conditions

Following a review of recent literature, the existing conditions of marine plants and invertebrates in the Study Area, as listed in the 2011 GOA Final EIS/OEIS, has not appreciably changed. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.5.1.1.1 Open Ocean (Pelagic) Habitats

All areas, except those near the coast and the sea floor, are called the pelagic or oceanic zone. The descriptions of pelagic habitats in the Study Area, as listed in the 2011 GOA Final EIS/OEIS, have not changed. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.5.1.1.1.1 Microscopic Communities

Plankton are organisms that float or drift in the water column and are unable to maintain their position against the movement of water masses (Parsons et al. 1984); they move with the currents through the aquatic environment. Planktonic assemblages include phytoplankton (plant-like) and zooplankton (animal). In general, plankton are very small or microscopic, although there are exceptions. For example, jellies (some grow to 10 feet [3 meters] in diameter) and pelagic *Sargassum* (macroalgal seaweed) are both considered part of the plankton group due to their inability to move against surrounding currents.

Phytoplankton and Zooplankton

Following a review of recent literature, including government technical documents and reports and online scientific journal databases, the information presented on phytoplankton and zooplankton in the Study Area, as listed in the 2011 GOA Final EIS/OEIS, has not changed. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

Pelagic Invertebrates

Following a review of recent literature, including government technical documents and reports and online scientific journal databases, the information presented on pelagic invertebrates in the Study Area, as listed in the 2011 GOA Final EIS/OEIS, has not changed. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.5.1.1.2 Open Ocean Deepwater Benthic Habitats

Open ocean deepwater benthic habitats in the Study Area include the continental shelf, continental slope, submarine canyon communities, abyssal plain, seamounts, chemosynthetic ecosystem, cold seeps, whale falls, artificial habitats, and buoy moorings. Descriptions of these habitats found in the study area are described in the 2011 GOA Final EIS/OEIS and have not changed since the publication of the 2011 GOA Final EIS/OEIS.

After the publication of the 2011 GOA Final EIS/OEIS, a petition was filed with the National Marine Fisheries Service (NMFS) requesting the listing of 44 taxa of coral (42 species, 1 subspecies, and 1 variant) in the Alaska region as threatened or endangered. Ten of the 42 species are present in the

GOA, with 7 inhabiting the continental shelf and 3 found exclusively in very deep waters associated with seamounts. On February 14, 2013, NMFS issued a negative ruling because none of the species on the petition met the criteria for listing (Endangered and Threatened Wildlife, 2013). Noting the negative ruling on the coral petition, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.5.1.1.3 Federally Protected Areas

3.5.1.1.3.1 Marine Protected Areas, National Marine Sanctuaries, and Protected Habitats

Many areas of the marine environment in the United States have some level of federal, state, or local management or protection. Marine protected areas (MPAs) have conservation or management purposes, defined boundaries, and some legal authority to protect resources. These areas vary widely in purpose, managing agency, management approaches, level of protection, and restrictions on human uses. They have been designated to achieve objectives ranging from conservation of biodiversity, to preservation of sunken historic vessels, to protection of spawning habitats important to commercial and recreational fisheries. Executive Order (EO) 13158, *Marine Protected Areas*, was created to "strengthen the management, protection, and conservation of existing MPAs and establish new or expanded MPAs; develop a scientifically based, comprehensive national system of MPAs representing diverse United States (U.S.) marine ecosystems, and the nation's natural and cultural resources; and avoid causing harm to MPAs through federally conducted, approved, or funded activities."

EO 13158 requires each Federal agency whose actions affect the natural or cultural resources that are protected by a national system of MPAs to identify such actions, and in taking such actions, avoid harm to those natural and cultural resources. Pursuant to Section 5 of EO 13158, agency requirements apply only to the natural or cultural resources specifically afforded protection by the site as described by the List of National System MPAs. For sites that have both a terrestrial and marine area, only the marine portion and its associated protected resources are included on the List of National System Marine Protected Areas and are subject to Section 5 of EO 13158. A full list and map of areas accepted in the National System of MPAs are available from the National Marine Protected Areas Center.

The National Marine Sanctuary (NMS) system is administered by the National Oceanic and Atmospheric Administration and protects special natural and cultural resources. Protected areas (Conservation Areas) throughout the Gulf of Alaska restrict groundfish harvest to minimize harmful impacts of fishing methodology and equipment to ocean bottom habitat. A recent review revealed no changes have been made to the current listings of the National System of MPAs, NMS, and protected areas within the Study Area as listed in the 2011 GOA Final EIS/OEIS. As such, the information and analysis presented in the2011 GOA Final EIS/OEIS remains valid.

3.5.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, the U.S. Department of the Navy (Navy) has no existing protective measures in place specifically for marine plants and invertebrates. However, marine plants and invertebrates benefit from measures in place to protect marine mammals, sea turtles, and Essential Fish Habitat. For a complete description of these measures, see Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.5.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of

existing federal and state regulations and standards relevant to marine plants and invertebrates, as well as a review of new literature, to include laws, regulations, and publications pertaining to marine plants and invertebrates. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OIES. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the Temporary Maritime Activities Area (TMAA) in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to marine plants and invertebrates is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.5.3 CONCLUSION

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the marine plants and invertebrates analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect plants and invertebrates in the TMAA. Therefore, conclusions for plants and invertebrates impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No action Alternative, Alternative 1, and Alternative 2 on marine plants and invertebrates under both the National Environmental Policy Act and EO 12114, please refer to Table 3.5-3 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

REFERENCES CITED AND CONSIDERED

Endangered and Threatened Wildlife; 90-Day Finding on a Petition to List 44 Species of Corals as Threatened or Endangered Under the Endangered Species Act; Notice of 90-day petition finding, 78, *Federal Register,* (31) (14 February 2013) pp 10661–10606.

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3.6 Fish

TABLE OF CONTENTS

3.6 FISH 3.6-1
3.6.1 AFFECTED ENVIRONMENT 3.6-1
3.6.1.1 Existing Conditions 3.6-1
3.6.1.2 Essential Fish Habitat 3.6-2
3.6.1.3 Threatened and Endangered Species 3.6-3
3.6.1.4 Hearing in Fish 3.6-5
3.6.1.5 Current Requirements and Practices 3.6-5
3.6.2 ALTERNATIVES ANALYSIS 3.6-5
3.6.3 CONCLUSION 3.6-6

LIST OF TABLES

TABLE 3.6-1: PACIFIC SALMONID EVOLUTIONARILY SIGNIFICANT UNITS AND DISTINCT POPULATION SEGMENTS IN THE TEMPORARY MARITIME ACTIVITIES AREA AND VICINITY 3.6-3

LIST OF FIGURES

There are no figures in this section.

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3.6 FISH

3.6.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for fish remains the same as that identified in the March 2011 Gulf of Alaska (GOA) Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.6.1.1 Existing Conditions

The following discussion provides an overview of the predominant fish species and habitat types known to occur in the TMAA. Two fish categories are described: salmonids and groundfish. The TMAA is over 12 nautical miles offshore, includes primarily offshore open ocean habitats such as pelagic, continental shelf, slope, and abyssal plain, which are influenced by both the Alaska Coastal Current and the Alaska Gyre.

3.6.1.1.1 Salmonid and Groundfish Species

The life histories of the dominant species of salmonids and groundfish that occur in the Gulf of Alaska are described in the 2011 GOA Final EIS/OEIS. The species of salmonids present in the GOA include: Chinook (*O. tshawytscha)*, coho (*O. kisutch)*, chum (*O. keta)*, pink (*O. gorbuscha)*, sockeye (*O. nerka)*, and steelhead (*O. mykiss*). Groundfish species in the GOA include flatfish, rockfish, roundfish, skates, sharks, and chimeras. Neither the species nor the species status of salmonids and groundfish have changed from that described in the 2011 GOA Final EIS/OEIS. Therefore, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.6.1.1.1.1 Summary of Fisheries Management

The historical accounts for Pacific halibut (*Hippoglossus stenolepis*) management occurring prior to the 2011 GOA Final EIS/OEIS, are fully described in the 2011 GOA Final EIS/OEIS. Following a review of recent stock assessment reports, the Pacific halibut fishery commercial catch decreased 6 percent between 2009 and 2010 with only a 1 percent decrease in effort in the Gulf of Alaska (International Pacific Halibut Commission 2013). However, the overall trend does not indicate declines in abundance throughout the Gulf of Alaska. Additionally, no new or additional United States (U.S.) Department of the Navy (Navy) training activities are being proposed in this Supplemental EIS/OEIS that would affect fish resources in the Study Area. Since the changes presented in the Pacific halibut stock assessment reports relate to landings, catch-per-unit-effort, and variable abundance across the GOA, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.6.1.1.2 Fish Habitat in the Gulf of Alaska Temporary Maritime Activities Area and Offshore Habitats

The habitat characteristics, which include geomorphic, physical, biological, and chemical parameters, as well as islands, biogenic habitats, benthic habitats, and the water column, are described in the 2011 GOA Final EIS/OEIS. Additionally, offshore areas, such as corals, sponge habitats, benthic habitats, artificial habitats, and the water column, are also described in the 2011 GOA Final EIS/OEIS. These habitat descriptions and locations within the TMAA, as listed in the 2011 GOA Final EIS/OEIS, have not changed due to their intrinsic static nature. Since the habitats types have remained the same, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.6.1.2 Essential Fish Habitat

Descriptions of essential fish habitat (EFH) in the Gulf of Alaska were presented in the 2011 GOA Final EIS/OEIS. This Supplemental EIS/OEIS addresses the same activities within the TMAA as did the 2011 GOA Final EIS/OEIS. The North Pacific Fishery Management Council has three Fishery Management Plans (FMP) in effect for the Gulf of Alaska, including the scallop, groundfish, and the high seas salmon fisheries, which are described below. Although a few updates have occurred to the FMPs since the 2011 GOA Final EIS/OEIS, none have changed or affected the previous information or analyses. As such, the general description of the EFH within the TMAA in the 2011 GOA Final EIS/OEIS has not changed; thus, the information presented remains valid. However, the updates to each FMP are presented below, by species group.

3.6.1.2.1 Scallop Fishery Management Plan

As presented in the 2011 GOA Final EIS/OEIS, there is a scallop FMP for the Gulf of Alaska. A recent review of the FMP and associated documents indicated that the National Marine Fisheries Service (NMFS) approved an amendment to the scallop fishery management plan in October 2011. This amendment implemented an annual catch limit and accountability measures to prevent overfishing. Since the new amendment was included to facilitate support for a sustainable scallop fishery and did not include changes to fishable habitat area or impose new environmental baseline restrictions, the information presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.2.2 Ground Fishery Management Plan

As presented in the 2011 GOA Final EIS/OEIS, there is a groundfish FMP for the Gulf of Alaska. A recent review of the FMP and associated documents indicated that NMFS issued several amendments to the management plan. Amendments 76 through 93 have been implemented following the completion of the 2011 GOA Final EIS/OEIS. The additional amendments focused on stricter regulations on quotas, licenses, gear, and annual catch rates, as well as the implementation of an observer program for the commercial halibut sector and the removal of the dusky rockfish *(Sebastes ciliates)* from federal management. Since the 17 new amendments were included to help facilitate a sustainable groundfish fishery by reducing overall catch and did not impose new environmental baseline restrictions, the information in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.2.3 High Seas Salmon Fishery Management Plan

As presented in the 2011 GOA Final EIS/OEIS, there is a high seas salmon FMP for the Gulf of Alaska. A recent review of the FMP and associated documents showed that NMFS had issued Amendments 10 through 12 to the management plan. Amendment 10 allows NMFS to recover administration costs associated with processing permit applications. Amendment 11 extended the time period to solicit proposals for habitat areas of particular concern from every 3 years to every 5 years. Amendment 12 revises the plan in order to better facilitate the State of Alaska salmon management. Since the three new amendments were administrative (e.g., permit cost recovery and proposal review period) and resource management related and did not propose any new restrictions on the habitat or the species, the information and analyses presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.3 Threatened and Endangered Species

3.6.1.3.1 Salmonids

Following a review of literature published since the 2011 GOA EIS/OEIS, including the National Marine Fisheries Office of Protected Resources website, Federal Registrar publications, and online scientific journal databases (such as BIOSIS), the most recent information pertaining to threatened and endangered salmonids is presented in Table 3.6-1. Chinook, coho, chum, pink, and sockeye salmon and steelhead trout do not have any listing designations in the Gulf of Alaska, and thus are absent from the table. Table 3.6-1 describes listed salmonid species in California, Oregon, and Washington for comparison purposes.

Table 3.6-1: Pacific Salmonid Evolutionarily Significant Units and Distinct Population Segments in the Temporary Maritime Activities Area and Vicinity

Species	ESU[1]/DPS[2]	ESA Listing Status	Critical Habitat in the TMAA
Chinook Salmon	Sacramento River Winter-run ESU	Endangered	No
	Upper Columbia River Spring-run ESU	Endangered	No
	Snake River Spring/Summer-run ESU	Threatened	No
	Snake River Fall-run ESU	Threatened	No
	Central Valley Spring-run ESU	Threatened	No
	California Coastal ESU	Threatened	No
	Puget Sound ESU	Threatened	No
	Lower Columbia River ESU	Threatened	No
	Upper Willamette River ESU	Threatened	No
	Upper Klamath and Trinity Rivers Basin ESU[3]	Candidate Species[3]	No[3]
	Central Valley Fall, Late Fall ESU	Species of Concern	No
Coho Salmon	Central California Coast ESU	Endangered	No
	Southern Oregon/Northern California Coasts ESU	Threatened	No
	Lower Columbia River ESU	Threatened	No
	Oregon Coast ESU	Threatened	No
	Puget Sound/Strait of Georgia ESU[3]	Species of Concern[3]	No[3]
Chum Salmon	Hood Canal Summer-run ESU	Threatened	No
	Columbia River ESU	Threatened	No
Sockeye Salmon	Snake River ESU	Endangered	No
	Ozette Lake ESU	Threatened	No
	Southern California DPS	Endangered	No
	Upper Columbia River DPS	Threatened	No
	Snake River Basin DPS	Threatened	No
	Middle Columbia River DPS	Threatened	No
	Lower Columbia River DPS	Threatened	No
	Upper Willamette River DPS	Threatened	No
	South-Central California Coast DPS	Threatened	No
	Central California Coast DPS	Threatened	No
	Northern California DPS	Threatened	No
	California Central Valley DPS	Threatened	No
	Puget Sound DPS	Threatened	No
	Oregon Coast DPS	Species of Concern	No

[1] ESU is a population of organisms that is considered distinct for purposes of conservation.
[2] A species with more than one DPS can have more than one ESA listing status, as individual DPSs can be either not listed under the ESA or can be listed as endangered, threatened, or a candidate species.
[3] New/updated information differing from the Final Environmental Impact Statement/Overseas Environmental Impact Statement
Notes: DPS = Distinct Population Segment, ESA = Endangered Species Act, ESU = Evolutionarily Significant Unit, TMAA = Temporary Maritime Activities Area

3.6.1.3.1.1 Chinook Salmon

Of the 17 Chinook salmon distinct population segments (DPSs), 11 have current listing status with 2 listed as endangered, 7 as threatened, and 1 each as a candidate species and a species of concern (National Marine Fisheries Service 2012a). Critical habitat for nine Chinook salmon DPSs has been designated (National Marine Fisheries Service 2012a). Most of the DPSs have a low abundance relative to historical levels (National Marine Fisheries Service 2012a). NMFS has reported population sizes from individual DPSs, but because all of these fish school while at sea, it is difficult to accurately estimate the marine life stage population. Specific population estimates based on freshwater adult returns within each of the DPSs can be found in Good et al. (2005). With the exception of this additional information about the new critical habitat and the variability of the adult population, the information regarding Chinook salmon presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.3.1.2 Coho Salmon

Of the seven coho DPSs, five are recorded as listed, three listed as threatened, and one each is listed as endangered and a species of concern (National Marine Fisheries Service 2012b). Most of the DPSs have a low abundance relative to historical levels and have seen decreases in recent years (National Marine Fisheries Service 2012b). NMFS has reported population sizes from individual DPSs, but because all of these fish likely school while at sea, it is difficult to accurately estimate the marine population. Specific population numbers, based on freshwater adult returns, within each of the DPSs can be found in Good et al. (2005). With the exception of this additional information citing population decreases, the information regarding coho salmon presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.3.1.3 Chum Salmon

The two evolutionarily significant units (ESUs) of chum salmon were listed as threatened in 1999, with the status reaffirmed in 2005 (70 Federal Register 37160). Some of the populations have shown increases in numbers, but the status review report indicates that the overall population trend has decreased by 6 percent per year (Good et al. 2005). With the exception of this additional information regarding the overall population decline, the information regarding chum salmon presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.3.1.4 Sockeye Salmon

Sockeye salmon is the third-most abundant of the seven species of Pacific salmon after pink salmon and chum salmon (Burgner 1991). However, the Snake River ESU has remained at very low levels of only a few hundred fish, though recent hatchery-reared fish have returned to spawn (National Marine Fisheries Service 2012c). Data collection practices for the Ozette Lake ESU makes differentiating between the number of hatchery and natural spawners difficult; however, the size of the population is small, though possibly growing (National Marine Fisheries Service 2012c). NMFS has reported population sizes from individual DPSs, but because all of these fish school while at sea, it is difficult to estimate the marine population. Specific population numbers, based on freshwater adult returns, within each of the DPSs can be found in Good et al. (2005). With the exception of this additional information regarding the fluctuating population and apparent need to implement new ways to distinguish hatchery stock from wild fish, the information presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.3.1.5 Steelhead Trout

Of the 15 steelhead DPSs, 12 have listing status with two listed as endangered, nine as threatened, and one as a species of concern (National Marine Fisheries Service 2010). Critical habitat for 10 west coast steelhead DPSs was designated in 2005, although none occur in the Study Area (National Marine Fisheries Service 2012d). Most of the DPSs have a low abundance relative to historical levels, and there is widespread occurrence of hatchery stock spawning with natural populations (Good et al. 2005; National Marine Fisheries Service 2010). NMFS has reported population sizes from individual DPSs, but because all of these fish likely school while at sea, it is difficult to accurately estimate the marine population. Specific population numbers based on freshwater adult returns within each of the DPSs is found in Good et al. (2005). No new or additional information or analyses on steelhead trout has been developed, hence the information regarding steelhead presented in the 2011 GOA Final EIS/OEIS remains valid. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.4 Hearing in Fish

Following a recent review of government technical documents and scientific literature, additional relevant information pertaining to fish hearing is presented below. A fish's gas-filled swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear. Fish with swim bladders generally have better sensitivity and better high-frequency hearing than fish without swim bladders. In reality, many fish species possess a continuum of anatomical specializations that may enhance their sensitivity to pressure (versus particle motion), and thus higher frequencies and lower intensities (Popper and Fay 2011). However, additional studies have shown that there are more fish species than originally investigated by researchers, such as deep sea fish, that may have evolved morphological adaptations to enhance hearing capabilities (Buran et al. 2005; Deng et al. 2011). There is also evidence, based on the structure of the ear and the relationship between the ear and the swim bladder, that some deep sea species, including myctophids (lanternfishes), may have hearing specializations and thus are able to hear higher frequencies (Popper 1977; Popper 1980; Deng et al. 2011). However, it has not been possible to conduct actual measures of hearing on these fish species from great depths. Marine fishes species investigated lack mid-frequency hearing (i.e., greater than 1,000 Hertz [Hz]). Lake sturgeon (*Acipenser fulvescens*) have been recorded to detect sound up to 400 or 500 Hz (Meyer et al. 2010; Lovell et al. 2005).Atlantic salmon (*Salmo salar*) (Hawkins and Johnstone 1978) and steelhead trout (Kane et al. 2010) can detect sound up to about 500 Hz. This additional information does not contribute to nor conflict with the information regarding fish hearing presented in the 2011 GOA Final EIS/OEIS. Additionally, no new relevant studies have produced data to initiate the re-analysis of the environmental impacts presented in the 2011 GOA Final EIS/OEIS. Therefore, no additional update to the 2011 GOA Final EIS/OEIS is required.

3.6.1.5 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, the comprehensive suite of protective measures and standard operating procedures implemented by the Navy to reduce impacts to marine mammals and sea turtles, also offer protections to habitats associated with the fish assemblage and communities. Mitigation is discussed in more detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.6.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to fish, as well as a review of new

literature, to include laws, regulations, and publications pertaining to fish. Although additional information relating to existing conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to fish is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.6.3 CONCLUSION

As described above, there is new information on existing environmental conditions as well as updated fish stock assessment reports and information on fish hearing. However, this new information does not change the affected environment, which forms the environmental baseline of the fish analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect fish in the TMAA. Therefore, conclusions for fish impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on fish under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.6-11 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

According to 50 Code of Federal Regulations (C.F.R.) Section 600.920(a), a supplemental consultation for EFH is required for renewals, reviews, or substantial revisions of actions if these actions may adversely affect EFH. There are no changes to Navy activities or designated EFH in the TMAA that are substantial in nature and that may adversely affect EFH previously analyzed. The analysis previously captured in Appendix C of the 2011 GOA Final EIS/OEIS (U.S. Navy, August 2010, Gulf of Alaska (GOA) Navy Training Activities Essential Fish Habitat Assessment) remains unchanged.

As part of the SEIS, the Navy is consulting under Section 7 of the ESA with NMFS for the ESA-listed fish, but will continue to rely on the prior analysis from the 2011 GOA Final EIS/OEIS and Biological Evaluation, as it remains valid. Specifically, there has not been an exceedance of incidental take for listed fish under the current Biological Opinion; there is no new information that reveals new effects to listed fish species or critical habitat for listed fish that were not previously considered; Navy training activities in the TMAA are not being substantially modified in a manner that would cause effect to listed fish species or their critical habitat that was not previously considered; and there has not been a new species of fish listed or critical habitat for other fish species created within the TMAA.

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3.7 Sea Turtles

TABLE OF CONTENTS

3.7 SEA TURTLES 3.7-1
3.7.1 AFFECTED ENVIRONMENT 3.7-1
3.7.1.1 Existing Conditions 3.7-1
3.7.1.2 Current Requirements and Practices 3.7-3
3.7.2 ALTERNATIVES ANALYSIS 3.7-3
3.7.3 CONCLUSION 3.7-3

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.7 SEA TURTLES

3.7.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for sea turtles remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.7.1.1 Existing Conditions

The nearest shoreline (Kenai Peninsula) is located approximately 24 nautical miles (nm) north of the TMAA's northern boundary. The approximate middle of the TMAA is located 140 nm offshore. Given that the TMAA is more than 12 nm from the closest point of land, it is therefore outside of United States (U.S.) territorial seas.

As described in the 2011 GOA Final EIS/OEIS, the cold waters off Alaska are above the typical northern limits for sea turtles from the Cheloniidae family (green, olive ridley, and loggerhead sea turtles) and are considered as rare in the ROI. Although sightings of sea turtles from the Cheloniidae family have been documented in the Study Area, most of these involve individuals that were either cold stressed, likely to become cold stressed, or already deceased (Hodge and Wing 2000). Thus, the ROI is considered to be outside the normal range for sea turtle species of the Cheloniidae family, and these species are not considered further for analysis in this Supplemental EIS/OEIS.

3.7.1.1.1 Species Accounts and Life History

As presented in the 2011 GOA Final EIS/OEIS, the leatherback sea turtle is listed as a single population and is classified as endangered under the Endangered Species Act (ESA). In January 2012, the National Marine Fisheries Service designated critical habitat in the Pacific Ocean along California (from Point Arena to Point Arguello, east of the 3,000-meter [m] [9,842.5-foot {ft.}] depth contour) and Washington and Oregon (from Cape Flattery, Washington, to Cape Blanco, Oregon, east of the 2,000 m [6,561.7 ft.] depth contour) (77 Federal Register 4170). However, there is no critical habitat designated for the leatherback sea turtle in the Study Area.

Leatherback sea turtles are highly migratory and can be present in the open ocean waters of the Study Area. As described in the 2011 GOA Final EIS/OEIS, the habitat and geographic range of the leatherback turtle remains the most widely distributed of all sea turtles. Following a review of recent literature (JSTOR, Web of Science, Google Scholar, EBSCO Academic, and U.S. Fish and Wildlife Service websites), including Eckert et al. (2012), the habitat and geographic range of leatherback sea turtles, as listed in the 2011 GOA Final EIS/OEIS, has not changed. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS is still valid, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS.

As presented in the 2011 GOA Final EIS/OEIS, the leatherback is the deepest diving sea turtle, with a recorded maximum depth of 4,200 ft. (1,280 m), although most dives are much shallower (usually less than 820 ft. [250 m]) (Hays et al. 2004a, b; Sale et al. 2006). Following a review of recent literature, the diving ability of the leatherback sea turtle as listed in the 2011 GOA Final EIS/OEIS has not appreciably changed (Eckert et al. 2012). As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS.

At the time the 2011 GOA Final EIS/OEIS was completed, the world's female leatherback turtle population was estimated at 35,860. Worldwide estimates of leatherback sea turtle populations have varied dramatically over the years as a result of both significant declines in the population and the discovery of new nesting colonies, particularly a colony in Gabon, Africa. Recent reviews of literature indicate that the largest nesting populations are located off Gabon in equatorial West Africa (5,865–20,499 females nesting per year [Witt et al. 2009]), in the western Atlantic in French Guiana (4,500–7,500 females nesting per year [Dutton et al. 2007]), Trinidad (estimated 6,000 turtles nesting annually [Eckert 2002]), and in the western Pacific in West Papua (formerly Irian Jaya), Indonesia (about 600–650 females nesting per year [Dutton et al. 2007]).

The western Pacific (west of the International Date Line) leatherback population was estimated in the Final EIS/OEIS to contain 2,700–4,500 nesting females (Dutton et al. 2007). There are 28 known nesting sites for the western Pacific Ocean stock, from Australia and Melanesia (Papua New Guinea, Solomon Islands, Fiji, and Vanuatu) to Indonesia, Thailand, and China (Chaloupka et al. 2004; Chua 1988; Dutton 2006; Hirth et al. 1993; Suarez et al. 2000). Recent studies by Tapilatu et al. (2013) reported leatherback nesting trends at the largest nesting site in the western Pacific (Papua Barat, Indonesia) and have reported a continual and significant long-term nesting decline of 5.9 percent a year, which parallels the population declines of other nesting populations throughout the Pacific. The major nesting populations of the Eastern Pacific Ocean stock occur in Mexico, Costa Rica, Panama, Colombia, Ecuador, and Nicaragua (Chaloupka et al. 2004; Dutton et al. 1999; Eckert and Sarti-Martinez 1997; Márquez M. 1990; Sarti-Martinez et al. 1996; Spotila et al. 1996), with the largest ones in Mexico and Costa Rica.

As stated in the 2011 GOA Final EIS/OEIS, a subset of these females, and an unknown number of males, forage off the U.S. west coast each year from about May to November, when dense aggregations of jellyfish (leatherback prey) are present (Benson et al. 2007). It is possible that the leatherback sea turtle could travel farther north into Alaskan waters during these foraging expeditions. However, only 19 sightings of leatherback sea turtles in Alaska waters have been recorded between 1960 and 1998 (Hodge and Wing 2000), all within the Gulf of Alaska. Thus, the leatherback turtle is treated as rare in the ROI. There are no known nesting habitats for the leatherback sea turtle in the Study Area.

3.7.1.1.2 Natural and Induced Mortality

The general threats to sea turtles are described in the 2011 GOA Final EIS/OEIS. Following a review of recent literature, general threats to sea turtles have not changed since the publication of the Final EIS/OEIS. As such, the information and analysis presented in the2011 GOA Final EIS/OEIS remains valid, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS.

3.7.1.1.3 Sea Turtle Hearing

As presented in the 2011 GOA Final EIS/OEIS, sea turtle auditory sensitivity is not well studied, though a few studies suggest that it is limited to low-frequency bandwidths (< 1,600 Hertz [Hz]), such as the sounds of waves breaking on a beach. Following a review of recent literature, work using auditory evoked potentials has shown that leatherback sea turtle hatchlings are able to detect sounds underwater and in air, responding to stimuli between 50 and 1,200 Hz in water and 50 and 1,600 Hz in air, with maximum sensitivity between 100 and 400 Hz in water and 50 and 400 Hz in air, with sharp decreases in sensitivity above 400 Hz in both media (Dow Piniak et al. 2013). With the exception of this additional information, the information regarding sea turtle hearing presented in the 2011 GOA Final EIS/OEIS, as well as the analysis based on this information, remains valid.

3.7.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, the comprehensive suite of protective measures and standard operating procedures implemented by the U.S. Department of the Navy (Navy) to reduce impacts to marine mammals also serves to mitigate potential impacts on sea turtles. In particular, personnel and watchstander training, establishment of marine mammal exclusion zones for at-sea explosions, and pre- and post-exercise surveys all serve to reduce or eliminate potential impacts of Navy activities on sea turtles that may be present in the vicinity. Mitigation is discussed in more detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.7.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to sea turtles, as well as a review of new literature, to include laws, regulations, and publications pertaining to sea turtles. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed for use in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to sea turtles is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.7.3 CONCLUSION

As described above, there is new information on existing environmental conditions, including updated information on sea turtle hearing. However, this new information does not change the affected environment, which forms the environmental baseline of the sea turtle analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect sea turtles in the TMAA. Therefore, conclusions for sea turtle impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on sea turtles under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.7-2 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

As part of this Supplemental EIS/OEIS, the Navy is consulting under Section 7 of the ESA with NMFS for the ESA-listed leatherback sea turtle, but will continue to rely on the prior analysis from the 2011 GOA Final EIS/OEIS and Biological Evaluation, as it remains valid. Specifically, there has not been an exceedance of incidental take for the leatherback sea turtle under the current Biological Opinion; there is no new information that reveals new effects to leatherback sea turtles or critical habitat associated with leatherback sea turtles that were not previously considered; Navy training activities in the TMAA are not being substantially modified in a manner that would cause effects to listed leatherback sea turtles or their critical habitat that was not previously considered; and there has not been a new species of sea turtle listed or critical habitat for other sea turtles created within the TMAA.

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3.8 Marine Mammals

TABLE OF CONTENTS

3.8 MARINE MAMMALS 3.8-1
3.8.1 INTRODUCTION 3.8-1
3.8.1.1 Species Unlikely to Be Present in the Study Area 3.8-7
3.8.2 AFFECTED ENVIRONMENT 3.8-8
3.8.2.1 Group Size 3.8-9
3.8.2.2 Diving 3.8-9
3.8.2.3 Vocalization and Hearing of Marine Mammals 3.8-10
3.8.2.4 General Threats 3.8-14
3.8.2.5 Marine Mammal Density Estimates 3.8-17
3.8.2.6 North Pacific Right Whale (*Eubalaena japonica*) 3.8-18
3.8.2.7 Humpback Whale (*Megaptera novaeangliae*) 3.8-21
3.8.2.8 Blue Whale (*Balaenoptera musculus*) 3.8-24
3.8.2.9 Fin Whale (*Balaenoptera physalus*) 3.8-25
3.8.2.10 Sei Whale (*Balaenoptera borealis*) 3.8-27
3.8.2.11 Minke Whale (*Balaenoptera acutorostrata*) 3.8-28
3.8.2.12 Gray Whale (*Eschrichtius robustus*) 3.8-29
3.8.2.13 Sperm Whale (*Physeter macrocephalus*) 3.8-31
3.8.2.14 Killer Whale (*Orcinus orca*) 3.8-32
3.8.2.15 Harbor Porpoise (*Phocoena phocoena*) 3.8-35
3.8.2.16 Dall's Porpoise (*Phocoenoides dalli*) 3.8-36
3.8.2.17 Cuvier's Beaked Whale (*Ziphius cavirostris*) 3.8-37
3.8.2.18 Baird's Beaked Whale (*Berardius bairdii*) 3.8-38
3.8.2.19 Stejneger's Beaked Whale (*Mesoplodon stejnegeri*) 3.8-39
3.8.2.20 Steller Sea Lion (*Eumetopias jubatus*) 3.8-40
3.8.2.21 California Sea Lion (*Zalophus californianus*) 3.8-42
3.8.2.22 Northern Fur Seal (*Callorhinus ursinus*) 3.8-43
3.8.2.23 Northern Elephant Seal (*Mirounga angustirostris*) 3.8-44
3.8.2.24 Harbor Seal (*Phoca vitulina*) 3.8-44
3.8.2.25 Ribbon Seal (*Histriophoca fasciata*) 3.8-45
3.8.2.26 Northern Sea Otter (*Enhydra lutris kenyoni*) 3.8-46
3.8.3 ENVIRONMENTAL CONSEQUENCES 3.8-48
3.8.3.1 Acoustic Stressors 3.8-51
3.8.3.2 Application of the Marine Mammal Protection Act to Potential Acoustic Effects 3.8-108
3.8.3.3 Analysis of Effects on Marine Mammals 3.8-111
3.8.4 SUMMARY OF IMPACTS (COMBINED IMPACTS OF ALL STRESSORS) ON MARINE MAMMALS 3.8-180
3.8.5 SUMMARY OF OBSERVATIONS DURING PREVIOUS NAVY ACTIVITIES 3.8-181
3.8.5.1 Alaska Specific Monitoring and Research 3.8-181
3.8.5.2 U.S. West Coast Baleen Whale Tagging 3.8-182
3.8.5.3 Monitoring and Research at Other Pacific Navy Range Complexes 3.8-183
3.8.6 MARINE MAMMAL PROTECTION ACT DETERMINATIONS 3.8-188
3.8.7 ENDANGERED SPECIES ACT DETERMINATIONS 3.8-188

LIST OF TABLES

TABLE 3.8-1: MARINE MAMMALS WITH POSSIBLE OR CONFIRMED PRESENCE WITHIN THE GULF OF ALASKA STUDY AREA..... 3.8-3
TABLE 3.8-2: HEARING AND VOCALIZATION RANGES FOR ALL MARINE MAMMAL FUNCTIONAL HEARING GROUPS AND SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA 3.8-11
TABLE 3.8-3: HEARING AND VOCALIZATION RANGES FOR ALL MARINE MAMMAL FUNCTIONAL HEARING GROUPS AND SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA 3.8-11
TABLE 3.8-4: ACOUSTIC CRITERIA AND THRESHOLDS FOR PREDICTING PHYSIOLOGICAL EFFECTS TO MARINE MAMMALS UNDERWATER FROM SONAR AND OTHER ACTIVE ACOUSTIC SOURCES 3.8-84
TABLE 3.8-5: CRITERIA AND THRESHOLDS FOR PHYSIOLOGICAL EFFECTS TO MARINE MAMMALS UNDERWATER FOR EXPLOSIVES ... 3.8-88
TABLE 3.8-6: SUMMARY OF BEHAVIORAL THRESHOLDS FOR MARINE MAMMALS 3.8-92
TABLE 3.8-7: RATIOS USED TO PRORATE MODELING RESULTS ON SPECIES TO INDIVIDUAL STOCKS OF MARINE MAMMALS IN THE STUDY AREA 3.8-97
TABLE 3.8-8: LOWER AND UPPER CUTOFF FREQUENCIES FOR MARINE MAMMAL FUNCTIONAL HEARING GROUPS USED IN THIS ACOUSTIC ANALYSIS 3.8-98
TABLE 3.8-9: SIGHTABILITY BASED ON G(0) VALUES FOR MARINE MAMMAL SPECIES IN TEMPORARY MARITIME ACTIVITIES AREA 3.8-107
TABLE 3.8-10: POST-MODEL ACOUSTIC EFFECTS QUANTIFICATION PROCESS 3.8-109
TABLE 3.8-11: APPROXIMATE RANGES TO PERMANENT THRESHOLD SHIFT CRITERIA FOR EACH FUNCTIONAL HEARING GROUP FOR A SINGLE PING FROM THREE OF THE MOST POWERFUL SONAR SYSTEMS WITHIN REPRESENTATIVE OCEAN ACOUSTIC ENVIRONMENTS 3.8-114
TABLE 3.8-12: APPROXIMATE MAXIMUM RANGES TO THE ONSET OF TEMPORARY THRESHOLD SHIFT FOR THREE REPRESENTATIVE SONAR OVER A REPRESENTATIVE RANGE OF OCEAN ENVIRONMENTS 3.8-115
TABLE 3.8-13: RANGE TO RECEIVED SOUND PRESSURE LEVEL IN 6-DECIBEL INCREMENTS AND PERCENTAGE OF BEHAVIORAL HARASSMENTS FOR LOW-FREQUENCY CETACEANS UNDER THE MYSTICETE BEHAVIORAL RESPONSE FUNCTION FOR THREE REPRESENTATIVE SOURCE BINS FOR THE STUDY AREA 3.8-116
TABLE 3.8-14: RANGE TO RECEIVED SOUND PRESSURE LEVEL IN 6-DECIBEL INCREMENTS AND PERCENTAGE OF BEHAVIORAL HARASSMENTS UNDER THE ODONTOCETE* RESPONSE FUNCTION FOR THREE REPRESENTATIVE SOURCE BINS..... 3.8-117
TABLE 3.8-15: MARINE MAMMALS SIGHTINGS FROM THE GULF OF ALASKA LINE-TRANSECT SURVEY (GOALS) II (RONE ET AL. 2013) 3.8-119
TABLE 3.8-16: ANNUAL PREDICTED EFFECTS TO MARINE MAMMALS FROM USE OF SONAR AND OTHER ACTIVE ACOUSTIC SOURCES UNDER ALTERNATIVE 1 ..... 3.8-122
TABLE 3.8-17: ANNUAL PREDICTED EFFECTS TO MARINE MAMMALS FROM USE OF SONAR AND OTHER ACTIVE ACOUSTIC SOURCES UNDER ALTERNATIVE 2 ..... 3.8-139
TABLE 3.8-18: AVERAGE APPROXIMATE RANGE TO EFFECTS FROM EXPLOSIONS FOR MARINE MAMMALS WITHIN THE STUDY AREA 3.8-159
TABLE 3.8-19: IMPULSE ACTIVITIES ADJUSTMENT FACTORS INTEGRATING IMPLEMENTATION OF MITIGATION INTO MODELING ANALYSES FOR THE STUDY AREA 3.8-161
TABLE 3.8-20: ACTIVITIES DURING THE CARRIER STRIKE GROUP EXERCISE WITH MULTIPLE NON-CONCURRENT IMPULSE OR EXPLOSIONS 3.8-161
TABLE 3.8-21: ANNUAL PREDICTED EFFECTS TO MARINE MAMMALS FROM USE OF EXPLOSIVES UNDER THE NO ACTION ALTERNATIVE 3.8-163
TABLE 3.8-22: ANNUAL PREDICTED EFFECTS TO MARINE MAMMALS FROM USE OF EXPLOSIVES UNDER ALTERNATIVE 1 ..... 3.8-169
TABLE 3.8-23: ANNUAL PREDICTED EFFECTS TO MARINE MAMMALS FROM USE OF EXPLOSIVES UNDER ALTERNATIVE 2 ..... 3.8-175
TABLE 3.8-24: NAVY EXERCISE AND MONITORING REPORT SUBMISSIONS FOR THE PACIFIC FROM 2011 THROUGH 1 DECEMBER 2013 ..... 3.8-184
TABLE 3.8-25: ENDANGERED SPECIES ACT EFFECTS DETERMINATIONS FOR ACOUSTIC STRESSORS 3.8-189

LIST OF FIGURES

FIGURE 3.8-1: NORTH PACIFIC RIGHT WHALE CRITICAL HABITAT IN THE VICINITY OF THE TEMPORARY MARITIME ACTIVITIES AREA 3.8-19
FIGURE 3.8-2: STELLER SEA LION WESTERN DISTINCT POPULATION SEGMENT CRITICAL HABITAT IN THE VICINITY OF THE TEMPORARY MARITIME ACTIVITIES AREA 3.8-41
FIGURE 3.8-3: SOUTHWEST ALASKA STOCK SEA OTTER DESIGNATED CRITICAL HABITAT IN THE VICINITY OF THE TEMPORARY MARITIME ACTIVITIES AREA 3.8-47
FIGURE 3.8-4: TWO HYPOTHETICAL THRESHOLD SHIFTS, TEMPORARY AND PERMANENT 3.8-56
FIGURE 3.8-5: COMMERCIAL VESSEL DENSITY INVOLVING THE STUDY AREA IN 2011 ..... 3.8-69
FIGURE 3.8-6: TYPE I AUDITORY WEIGHTING FUNCTIONS MODIFIED FROM THE SOUTHALL ET AL. (2007) M-WEIGHTING FUNCTIONS 3.8-82
FIGURE 3.8-7: TYPE II WEIGHTING FUNCTIONS FOR LOW-, MID-, AND HIGH-FREQUENCY CETACEANS 3.8-83
FIGURE 3.8-8: BEHAVIORAL RESPONSE FUNCTION APPLIED TO MYSTICETES 3.8-91
FIGURE 3.8-9: BEHAVIORAL RESPONSE FUNCTION APPLIED TO ODONTOCETES, PINNIPEDS, AND SEA OTTERS 3.8-91
FIGURE 3.8-10: HYPOTHETICAL RANGE TO SPECIFIED EFFECTS FOR A SONAR SOURCE 3.8-113
FIGURE 3.8-11: THRESHOLD PROFILES FOR SLIGHT LUNG INJURY (LEFT) AND MORTALITY (RIGHT) BASED ON FIVE REPRESENTATIVE ANIMAL MASSES FOR A 0.5-POUND NET EXPLOSIVE WEIGHT CHARGE (BIN E2) DETONATED AT 1-METER DEPTH 3.8-156
FIGURE 3.8-12: THRESHOLD PROFILES FOR SLIGHT LUNG INJURY (LEFT) AND MORTALITY (RIGHT) BASED ON FIVE REPRESENTATIVE ANIMAL MASSES FOR A 10-POUND NET EXPLOSIVE WEIGHT CHARGE (BIN E5) DETONATED AT 1-METER DEPTH 3.8-157
FIGURE 3.8-13: THRESHOLD PROFILES FOR SLIGHT LUNG INJURY (LEFT) AND MORTALITY (RIGHT) BASED ON FIVE REPRESENTATIVE ANIMAL MASSES FOR A 250-POUND NET EXPLOSIVE WEIGHT CHARGE (BIN E9) DETONATED AT 1-METER DEPTH 3.8-157
FIGURE 3.8-14: THRESHOLD PROFILES FOR SLIGHT LUNG INJURY (LEFT) AND MORTALITY (RIGHT) BASED ON FIVE REPRESENTATIVE ANIMAL MASSES FOR A 1,000-POUND NET EXPLOSIVE WEIGHT CHARGE (BIN E12) DETONATED AT 1-METER DEPTH 3.8-158

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3.8 MARINE MAMMALS

MARINE MAMMALS SYNOPSIS

The United States Department of the Navy previously considered training in the Alaska Training Areas and the Gulf of Alaska for all potential stressors and their potential impacts to marine mammals in the analysis as presented in the 2011 Environmental Impact Statement (EIS)/Overseas EIS (OEIS). Since that document was completed, there have been improvements made in the modeling of potential impacts from acoustic stressors as well as the collection of new marine mammal data, new acoustic impact modeling methods, and new impact thresholds and criteria, which have been introduced as the science has evolved. This Supplemental EIS/OEIS, therefore, focuses on a re-analysis of potential impacts on marine mammals from acoustic stressors during training in the Temporary Military Activities Area portion of the 2011 EIS/OEIS Study Area. Acoustic stressors analyzed in this Supplemental EIS/OEIS are identical in impact to those analyzed in the 2011 EIS/OEIS and include the following:

- Sonar and other active acoustic sources
- Explosives

Proposed Action Summary of Impacts

- In general, long-term consequences for individuals or populations of marine mammals would not be expected;
- Pursuant to the Marine Mammal Protection Act (MMPA), use of sonar and other active acoustic sources and explosives may result in Level B harassment of certain marine mammals and may result in Level A harassments of Dall's porpoises;
- Pursuant to the Endangered Species Act (ESA), sonar and other active sources may affect and are likely to adversely affect certain ESA-listed marine mammals;
- Pursuant to the ESA, use of explosives may affect and is not likely to adversely affect ESA-listed marine mammals;
- Acoustic stressors will have no effect on marine mammal critical habitats.

The use of sonar and active acoustic sources and explosives are not expected to result in mortality to marine mammals.

3.8.1 INTRODUCTION

This section (3.8, Marine Mammals) of the Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) provides the analysis of potential impacts to marine mammals that are found in the Gulf of Alaska (GOA) Temporary Maritime Activities Area (TMAA) Study Area (Study Area). The text box above provides a synopsis of the United States (U.S.) Department of Navy's (Navy's) determination of impacts from the Proposed Action on marine mammals. Section 3.8.2 provides an introduction to the species that occur in the Study Area. The complete analysis and summary of potential impacts of the Proposed Action on marine mammals are found in Sections 3.8.3 (Environmental Consequences), 3.8.4 (Summary of Impacts [Combined Impacts of All Stressors] on Marine Mammals), and 3.8.5 (Summary of Observations During Previous Navy Activities), respectively.

Marine mammals are a diverse group of approximately 130 species. Most live predominantly in the marine habitat, although some species (e.g., seals) spend time in terrestrial habitats or, in some cases, in freshwater environments, such as certain freshwater dolphins (Jefferson 2009, Rice 1998). The exact number of formally recognized marine mammal species changes periodically with new scientific understanding or findings (Rice 1998). Even the higher-level classification of marine mammals is controversial because the understanding of their origins and relationships continues to evolve (for a list of current species, see the formal list, *Marine Mammal Species and Subspecies*, maintained by the Society for Marine Mammalogy [Perrin et al. 2009]). This analysis uses the list of species provided by the National Oceanic and Atmospheric Administration (NOAA)/National Marine Fisheries Service (NMFS) 2013 U.S. Pacific Marine Mammal Stock Assessments (Carretta et al. 2014) and the 2013 Alaska Marine Mammal Stock Assessments (Allen and Angliss 2014).

All marine mammals in the United States are protected under the Marine Mammal Protection Act (MMPA), and some species receive additional protection under the Endangered Species Act (ESA). The MMPA defines a marine mammal "stock" as "a group of marine mammals of the same species or smaller taxon in a common spatial arrangement that interbreed when mature." For management purposes under the MMPA, a stock is considered an isolated population or group of individuals within a whole species that is found in the same area. However, generally due to a lack of sufficient information, management stocks defined by NMFS may include groups of multiple species, such as the six species grouped together as the *Mesoplodon* beaked whales management unit for the Pacific U.S. West Coast region (Carretta et al. 2014). In other cases, a single species may include multiple stocks recognized for management purposes (e.g., harbor porpoise in Alaska; see Allen and Angliss 2014).

For summaries of the general biology and ecology of marine mammals beyond the scope of this Supplemental EIS/OEIS, see Berta et al. (2006), Hoelzel (2003), Jefferson et al. (2008), Perrin et al. (2008), Reynolds and Rommel (1999), Rice (1998), and Twiss and Reeves (1999). Additional species profiles and information on the biology, life history, species distribution, and conservation of marine mammals also can be found through the following organizations:

- NMFS Office of Protected Resources (includes species distribution maps)
- Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (known as OBIS-SEAMAP) species profiles
- NOAA Cetacean Density and Distribution Mapping Working Group
- International Whaling Commission
- International Union for Conservation of Nature, Cetacean Specialist Group
- The Marine Mammal Commission
- Society for Marine Mammalogy

Marine mammal survey data in the offshore waters of the Gulf of Alaska are limited, as most survey efforts have been localized and nearshore. Much of what is known about cetacean occurrence has come from whaling records (e.g., Ivashchenko et al. 2012), stranding records, anecdotal sighting reports, and other additional efforts (Davis et al. 2012; Matsuoka et al. 2013). The Navy conducted the first comprehensive marine mammal survey of waters in the Study Area from 10 to 20 April 2009 (Rone et al. 2009). The survey was conducted using systematic line-transect survey protocol, and both visual and acoustic detection methods were used during the survey (Rone et al. 2009). Eleven marine mammal species were seen and positively identified during the survey, including fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), gray whale (*Eschrichtius robustus*), minke whale (*B. acutorostrata*), killer whale (*Orcinus orca*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*),

Dall's porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), Steller sea lion (*Eumetopias jubatus*), harbor seal (*Phoca vitulina*), and sea otter (*Enhydra lutris kenyoni*). In addition, both sperm whales (*Physeter macrocephalus*) and killer whales were detected acoustically (Rone et al. 2009). Sighting data were sufficient to derive line-transect abundance estimates for fin and humpback whales.

The Navy funded a second systematic survey of the Study Area that occurred from 23 June to 18 July 2013 (Rone et al. 2014). The main goal of the second Gulf of Alaska Line-Transect Survey (GOALS II) was to collect data to assess the abundance and spatial distribution of marine mammals from both visual sighting data and passive acoustics using a towed-hydrophone array and sonobuoys. Sighting and acoustic data were collected from four survey strata designed to sample the diverse habitat present in the Study Area, including a continental shelf or "inshore" stratum (22,749 square kilometers [km^2]), slope stratum (36,776 km^2), pelagic or "offshore" stratum (60,051 km^2), and seamount stratum (45,377 km^2). During the survey, there were 802 marine mammal sightings (1,998 individuals) of 13 confirmed species. Confirmed species were Baird's (*Berardius bairdii*) and Cuvier's (*Ziphius cavirostris*) beaked whales, blue (*Balaenoptera musculus*), sperm, fin, humpback, gray, killer and minke whales, Dall's and harbor porpoise, and elephant (*Mirounga angustirostris*) and northern fur (*Callorhinus ursinus*) seals. There were an additional 162 sightings (261 individuals) of unidentified cetaceans and pinnipeds (Rone et al. 2014). Sighting data were sufficient to derive updated line-transect abundance estimates for fin and humpback whales, and new Study Area abundance estimates for blue, sperm, and killer whales, as well as Dall's porpoise and northern fur seals (Rone et al. 2014).

In order to obtain additional information on the occurrence and seasonality of cetaceans in the Study Area, in July 2011 the Navy deployed two High-frequency Acoustic Recording Packages (HARPs) on the shelf (200 meters [m]) and slope (900 m) regions in the north-central Gulf of Alaska (Baumann-Pickering et al. 2012b). During the first 7 months of passive acoustic monitoring, at least 10 species were detected (blue whale [*Balaenoptera musculus*], fin whale, gray whale, humpback whale, sperm whale, killer whale, Stejneger's beaked whale [*Mesoplodon stejnegeri*], Baird's beaked whale [*Berardius bairdii*], Cuvier's beaked whale [*Ziphius cavirostris*], and an unidentified porpoise which was likely Dall's porpoise). Data obtained from these and an additional HARP deployed in September 2012 should provide more data relevant to characterizing the occurrence and seasonality of cetaceans in the Study Area.

Marine mammal species known to occur in the Study Area and their currently recognized stocks are presented in Table 3.8-1. All these species are managed by NMFS or the U.S. Fish and Wildlife Service (USFWS) in the U.S. Exclusive Economic Zone (EEZ). Relevant information on their status, abundance, and distribution is presented in Section 3.8.2 (Affected Environment).

Table 3.8-1: Marine Mammals with Possible or Confirmed Presence within the Gulf of Alaska Study Area

Common Name	Scientific Name[1]	Stock[2]	Stock Abundance[3] (CV)	Occurrence in Region[4]	ESA/MMPA Status
Order Cetacea					
Suborder Mysticeti (baleen whales)					
Family Balaenidae (right whales)					
North Pacific right whale	*Eubalaena japonica*	Eastern North Pacific	31 (0.23)	Rare	Endangered/ Depleted
Family Balaenopteridae (rorquals)					
Humpback whale	*Megaptera novaeangliae*	Central North Pacific	10,103 (n/a)	Likely	Endangered/ Depleted

Table 3.8-1: Marine Mammals with Possible or Confirmed Presence within the Gulf of Alaska Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	Stock Abundance[3] (CV)	Occurrence in Region[4]	ESA/MMPA Status
Family Balaenopteridae (rorquals)					
Humpback whale	*Megaptera novaeangliae*	Western North Pacific	938 (n/a)	Likely	Endangered/ Depleted
Blue whale	*Balaenoptera musculus*	Eastern North Pacific	1,647 (0.07)	Seasonal; highest likelihood July to December	Endangered/ Depleted
		Central North Pacific	81 (1.14)	Seasonal; highest likelihood July to December	Endangered/ Depleted
Fin whale	*Balaenoptera physalus*	Northeast Pacific	1,214 (minimum estimate) (n/a)	Likely	Endangered/ Depleted
Sei whale	*Balaenoptera borealis*	Eastern North Pacific	126 (0.53)	Rare	Endangered/ Depleted
Minke whale	*Balaenoptera acutorostrata*	Alaska	Not available	Likely	-
Family Eschrichtiidae (gray whale)					
Gray whale	*Eschrichtius robustus*	Eastern North Pacific	19,126 (0.07)	Likely: Highest numbers during seasonal migrations	-
		Western North Pacific	155	Rare: Individuals migrate through GOA	Endangered/ Depleted
Suborder Odontoceti (toothed whales)					
Family Physeteridae (sperm whale)					
Sperm whale	*Physeter macrocephalus*	North Pacific	Not available	Likely; More likely in waters > 1,000 m depth, most often > 2,000 m	Endangered/ Depleted
Family Delphinidae (dolphins)					
Killer whale	*Orcinus orca*	Alaska Resident	2,347 (n/a)	Likely	-
		Eastern North Pacific Offshore	211: includes known offshore killer whales along the U.S. west coast, Canada, and Alaska (n/a)	Infrequent: few sightings	-
		AT1 Transient	7	Rare; more likely inside Prince William Sound and Kenai Fjords	-
		GOA, Aleutian Island, and Bering Sea Transient	587	Likely	

Table 3.8-1: Marine Mammals with Possible or Confirmed Presence within the Gulf of Alaska Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	Stock Abundance[3] (CV)	Occurrence in Region[4]	ESA/MMPA Status
Family Delphinidae (dolphins) (continued)					
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	North Pacific	26,880; specific to the GOA, not the management stock (n/a)	Likely	-
Family Phocoenidae (porpoises)					
Harbor porpoise	*Phocoena phocoena*	GOA	31,046 (0.21)	Likely in nearshore locations	-
		Southeast Alaska	11,146 (0.24)	Likely in nearshore locations	
Dall's porpoise	*Phocoenoides dalli*	Alaska	83,400 (0.097); based on survey data from 1987–1991	Likely	-
Family Ziphiidae (beaked whales)					
Cuvier's beaked whale	*Ziphius cavirostris*	Alaska	Not available	Likely	-
Baird's beaked whale	*Berardius bairdii*	Alaska	Not available	Likely	-
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Alaska	Not available	Likely	-
Order Carnivora					
Suborder Pinnipedia[5]					
Family Otariidae (fur seals and sea lions)					
Steller sea lion	*Eumetopias jubatus*	Eastern U.S.	57,966 (minimum estimate) (n/a)	Likely	-
		Western U.S.	45,659 (minimum estimate) (n/a)	Likely	Endangered/ Depleted
California sea lion	*Zalophus californianus*	U.S.	296,750 (n/a)	Rare	-
Northern fur seal	*Callorhinus ursinus*	Eastern Pacific	639,545 (n/a)	Likely	Depleted
Family Phocidae (true seals)					
Northern elephant seal	*Mirounga angustirostris*	California Breeding	124,000 (n/a)	Likely	-
Harbor seal	*Phoca vitulina*	Aleutian Islands	3,579 (0.092)	Extralimital	-
		Pribilof Islands	232 (n/a)	Extralimital	-

Table 3.8-1: Marine Mammals with Possible or Confirmed Presence within the Gulf of Alaska Study Area (continued)

Common Name	Scientific Name[1]	Stock[2]	Stock Abundance[3] (CV)	Occurrence in Region[4]	ESA/MMPA Status
Family Phocidae (true seals)					
Harbor seal	*Phoca vitulina*	Bristol Bay	18,577 (0.058)	Extralimital	-
		N. Kodiak	4,509 (0.064)	Rare (inshore waters)	-
		S. Kodiak	11,117 (0.052)	Rare (inshore waters)	-
		Prince William Sound	31,503 (0.178)	Rare (inshore waters)	-
		Cook Inlet/Shelikof	22,900 (0.053)	Extralimital	-
		Glacier Bay/Icy Strait	5,042 (0.075)	Rare (inshore waters)	-
		Lynn Canal/ Stephens	8,870 (0.053)	Extralimital	-
		Sitka/Chatham	8,586 (0.052)	Rare (inshore waters)	-
		Dixon/Cape Decision	14,388 (0.060)	Rare (inshore waters)	-
		Clarence Strait	23,289 (0.042)	Extralimital	-
Ribbon seal	*Histriophoca fasciata*	Alaska	Not available	Rare	
Family Mustelidae (otters)[6]					
Northern sea otter	*Enhydra lutris kenyoni*	Southeast Alaska	10,563	Rare	-
		Southcentral Alaska	15,090	Rare	-
		Southwest Alaska	47,676	Rare	Threatened

[1] Taxonomy follows Perrin et al. 2009.

[2] Stock names and abundance estimates from Allen and Angliss 2014 and Carretta et al. 2014 except where noted.

[3] The stated coefficient of variation (CV) is an indicator of uncertainty in the abundance estimate and describes the amount of variation with respect to the population mean. It is expressed as a fraction or sometimes a percentage and can range upward from zero, indicating no uncertainty, to high values. For example, a CV of 0.85 would indicate high uncertainty in the population estimate. When the CV exceeds 1.0, the estimate is very uncertain. The uncertainty associated with movements of animals into or out of an area (due to factors such as availability of prey or changing oceanographic conditions) is much larger than is indicated by the CVs that are given.

[4] EXTRALIMITAL: There may be a small number of sighting or stranding records, but the area is outside the species range of normal occurrence. RARE: The distribution of the species is near enough to the area that the species could occur there, or there are a few confirmed sightings. INFREQUENT: Confirmed, but irregular sightings or acoustic detections. LIKELY: Confirmed and regular sightings or acoustic detections of the species in the area year-round. SEASONAL: Confirmed and regular sightings or acoustic detections of the species in the area on a seasonal basis.

[5] There are no data regarding the CV for some of the pinniped species given that abundance is determined by different methods than those used for cetaceans.

[6] There are no data regarding the CV for sea otter given that abundance is determined by different methods than those used for cetaceans.

Notes: CV = coefficient of variation, ESA = Endangered Species Act, GOA = Gulf of Alaska, m = meter(s), MMPA = Marine Mammal Protection Act, n/a = not available, U.S. = United States

3.8.1.1 Species Unlikely to Be Present in the Study Area

The species carried forward for analysis are those likely to be found in the Study Area based on the most recent data available, and do not include species that may have once inhabited or transited the area but have not been sighted in recent years (e.g., species which were extirpated from factors such as nineteenth and twentieth century commercial exploitation). Several species that may be present in the northeast Pacific Ocean have an extremely low probability of presence in the Study Area. These species are considered extralimital, meaning there may be a small number of sighting or stranding records within the Study Area, but the area of concern is outside the species range of normal occurrence. These species include beluga whale (*Delphinapterus leucas*), false killer whale (*Pseudorca crassidens*), short-finned pilot whale (*Globicephala macrorhynchus*), northern right whale dolphin (*Lissodelphis borealis*), and Risso's dolphin (*Grampus griseus*), and have been excluded from subsequent analysis for the reasons described below.

3.8.1.1.1 Beluga Whale (*Delphinapterus leucas*)

There were 28 reported sightings of beluga whales in the GOA region from 1936 to 2000; however, all of these sightings were in the Cook Inlet or in very nearshore locations outside of the Study Area (Goetz et al. 2012, Laidre et al. 2000). The Cook Inlet stock of beluga whales was listed as endangered under the ESA on 22 October 2008 and was designated as depleted under the MMPA (National Oceanic and Atmospheric Administration 2008a). Rugh et al. (2010) found evidence that the Cook Inlet stock has exhibited range contraction towards the northeast, and that sightings in the southern inlet, closest to the Gulf of Alaska, have decreased. Critical habitat was designated for the Cook Inlet stock effective 11 April 2011 (National Oceanic and Atmospheric Administration 2011a), but the areas designated are far from the Study Area. Based on this information and the regulatory definition of the stock as those beluga whales confined to the waters of Cook Inlet (National Oceanic and Atmospheric Administration 2007, 2008a), this stock of beluga whales is not expected to be present in the Study Area. Due to the paucity of any beluga whale sightings in the Gulf of Alaska (Laidre et al. 2000), the occurrence of this species within the Study Area is considered extralimital (see also Goetz et al. 2012; Rugh et al. 2010).

3.8.1.1.2 False Killer Whale (*Pseudorca crassidens*)

False killer whales are found in tropical and temperate waters, generally between 50 degrees (°) South (S) and 50° North (N) latitude (Baird 1989; Odell and McClune 1999), although they are uncommon north of the U.S.-Mexico border. Based on sighting data collected by Southwest Fisheries Science Center during systematic surveys in the northeast Pacific between 1986 and 2005, there were no sightings of false killer whales north of about 30°N (Hamilton et al. 2009). Norman et al. (2004) observed that most strandings for this species north of California occurred during or within a year of an El Niño event. For the MMPA Stock Assessment Reports, there are five management stocks of false killer whale within the U.S. EEZ around the Pacific islands of Hawaii, Palmyra, and American Samoa (Carretta et al. 2014); there are no management stocks recognized for the U.S. west coast or Alaska waters. The occurrence of false killer whale within the Study Area is therefore considered extralimital.

3.8.1.1.3 Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

The short-finned pilot whale is widely distributed throughout most tropical and warm temperate waters of the world. Along the U.S. west coast, short-finned pilot whales are most abundant south of Point Conception, California (Carretta et al. 2014, Reilly and Shane 1986). There are two records of this species in Alaskan waters. A short-finned pilot whale was taken near Katanak on the Alaska Peninsula in 1937, and a group of five short-finned pilot whales were sighted just southeast of Kodiak Island in May 1977 (U.S. Department of the Navy 2006). Stranding records for this species north of California waters are

considered to be beyond the normal range of this species rather than an extension of its range (Norman et al. 2004). For the MMPA Stock Assessment Reports, there are two management stocks of short-finned pilot whale within the Pacific U.S. EEZ, including stocks within: (1) waters off California, Oregon, and Washington; and (2) Hawaiian waters (Carretta et al. 2014). There is no management stock recognized for Alaska waters. The occurrence of short-finned pilot whale within the Study Area is therefore considered extralimital.

3.8.1.1.4 Northern Right Whale Dolphin (*Lissodelphis borealis*)

The northern right whale dolphin occurs in cool-temperate to subarctic waters of the North Pacific Ocean, from the west coast of North America to Japan and Russia. This oceanic species is distributed from approximately 30°N to 50°N, 145° West (W) to 118° East (E) and generally not as far north as the Bering Sea (Jefferson et al. 2008). There are two sighting records of northern right whale dolphins in the Gulf of Alaska, but these are considered extremely rare (National Oceanic and Atmospheric Administration 2012b, U.S. Department of the Navy 2006). For the MMPA Stock Assessment Reports, there is a single management stock of northern right whale dolphin that includes animals found within the U.S. EEZ of California, Oregon, and Washington (Carretta et al. 2014); there is no management stock recognized for Alaska waters. The occurrence of northern right whale dolphin within the Study Area is therefore considered extralimital.

3.8.1.1.5 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are distributed worldwide in tropical to warm-temperate waters, roughly between 60°N and 60°S, where surface water temperature is usually greater than 50° Fahrenheit (F) (10° Celsius [C]); (Kruse et al. 1999). In the eastern North Pacific, Risso's dolphins extend north into Canadian waters (Baird and Stacey 1991, Reimchen 1980). They are most often found along the continental slope (Green et al. 1992, Kruse et al. 1999), and Baumgartner (1997) hypothesized that this distribution strongly correlates with cephalopod distribution. There are a few records of this species near the Study Area. Risso's dolphins have been sighted near Chirikof Island (southwest of Kodiak Island) and offshore in the Gulf of Alaska, just south of the Study Area boundary (Braham 1983, Consiglieri et al. 1980). For the MMPA SARs, there are two management stocks of Risso's dolphin within the Pacific U.S. EEZ, including stocks within: (1) waters off California, Oregon, and Washington; and (2) Hawaiian waters (Carretta et al. 2014). There is no management stock recognized for Alaska waters. Further, NOAA's Cetacean Density and Distribution Mapping Working Group considers the occurrence of Risso's dolphin in the Gulf of Alaska as "unknown" (National Oceanic and Atmospheric Administration 2012c). The occurrence of Risso's dolphin within the Study Area is therefore considered extralimital.

3.8.2 Affected Environment

Four main types of marine mammals are generally recognized: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses [walruses do not occur in the Study Area]), sirenians (manatees, dugongs, and sea cows [none of which occur in the Study Area]), and marine carnivores (sea otters and polar bears [polar bears do not occur in the Study Area]) (Rice 1998).

Detailed reviews of the different groups of cetaceans can be found in Perrin et al. (2008). The order Cetacea is divided into two suborders. The toothed whales, (suborder Odontoceti; e.g., sperm whale, killer whale, dolphins, porpoises, beaked whales) range in size from slightly longer than 3 feet (ft.) (1 m) to more than 60 ft. (18 m) and have teeth, which they use to capture and consume individual prey. The baleen whales (suborder Mysticeti; e.g., minke [*Balaenoptera acutorostrata*], humpback, gray, fin, and blue whales) are universally large (more than 15 ft. [4.6 m] as adults). They are called baleen whales

because, instead of teeth, they have a fibrous structure made of keratin that is suspended from their upper jaws and is called baleen. Keratin is a type of protein similar to that found in human fingernails. The baleen enables the whales to filter and trap food from the water for feeding. They are batch feeders that use baleen instead of teeth to engulf, suck, or skim large numbers of small prey from the water or ocean floor sediments (Heithaus and Dill 2008). The different feeding strategies of mysticetes and odontocetes affect their distribution and occurrence patterns.

Cetaceans inhabit virtually every marine environment in the Study Area, from coastal waters to open ocean environments. Their distribution is influenced by a number of factors, but primary among these are patterns of major ocean currents, bottom relief, and sea surface temperature, which, in turn, affect prey productivity. The continuous movement of water from the ocean bottom to the surface creates a nutrient-rich, highly productive environment for marine mammal prey (Bakun 1996). For most cetaceans, prey distribution, abundance, and quality largely determine where they occur at any specific time (Heithaus and Dill 2008). Most of the large cetaceans are migratory (e.g., Barlow et al. 2011), but many small cetaceans do not migrate in the strictest sense. Instead, they undergo seasonal shifts in distribution induced by changes in their environment (Forney and Barlow 1998).

Pinnipeds in the Study Area are also divided into two groups: phocids (true seals) and otariids (fur seals and sea lions). Phocids lack ear flaps, their fore flippers are short and have hair, and their hind flippers are oriented toward the back of their bodies and cannot be rotated forward. Otariids have external ear flaps, long hairless or partially haired fore flippers, and hind flippers that can be rotated beneath their bodies. Pinnipeds spend a large portion of their time on land at haulout sites used for resting and molting, and at rookeries used for breeding and nursing young, and return to the water to forage. Many pinniped species have well-known seasonal cycles, distributions, and established haulout sites and rookeries that support large colonies of individuals.

The northern sea otter (*Enhydra lutris kenyoni*) is a carnivorous coastal marine mammal species in the family Mustelidae. Sea otters require shallow waters as habitat for reproducing, resting, and foraging. Sea otters rarely come ashore and spend most of their lives in the ocean near shore where they regularly feed and rest.

3.8.2.1 Group Size

Many species of marine mammals, particularly odontocetes, are highly social animals that spend much of their lives living in groups or schools ranging from several to several thousand individuals. Similarly, aggregations of baleen whales may form during particular breeding or foraging seasons. The behavior of aggregating into groups is important for the purposes of mitigation and monitoring in that it can increase the probability of marine mammals being detected. In addition, group size is an important consideration when conducting acoustic exposure analyses. A comprehensive and systematic review of available published and unpublished literature, including journals, books, technical reports, cruise reports, raw cruise data, theses, and dissertations was conducted to summarize relevant information on marine mammal group sizes. The results of this review were compiled into a Technical Report that includes tables of group size information by species along with relevant citations (Watwood and Buonantony 2012).

3.8.2.2 Diving

Some species of marine mammals have developed specialized adaptations to allow them to make deep dives lasting over an hour, primarily for the purpose of foraging on deep-water prey such as squid. Other species spend the majority of their lives close to the surface, and make relatively shallow dives for

shorter durations. The diving behavior of a particular species or individual has implications for the ability to detect them for mitigation and monitoring. In addition, their relative distribution through the water column is an important consideration when conducting acoustic exposure analyses. Information and data on marine mammal diving behavior were compiled and summarized in a Technical Report that provides detailed summaries of time at depth for each species (Watwood and Buonantony 2012).

3.8.2.3 Vocalization and Hearing of Marine Mammals

All marine mammals that have been studied can produce sounds and use sounds to forage, orient and navigate, monitor their environment, detect and respond to predators, and socially interact with others. Measurements of marine mammal sound production and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may affect a marine mammal behaviorally or physiologically. Marine mammal hearing abilities are quantified using live animals and the techniques of behavioral audiometry or electrophysiology (see Au 1993, Nachtigall et al. 2007, Schusterman 1981, Wartzok and Ketten 1999). Behavioral audiograms, which are plots of animals' exhibited hearing threshold versus frequency, are obtained from captive, trained live animals using standard testing procedures with appropriate controls, and are considered to be a more accurate representation of a subject's hearing abilities. Behavioral audiograms of marine mammals are difficult to obtain because many species are too large, too rare, and too difficult to acquire and maintain for experiments in captivity.

Consequently, our understanding of a species' hearing ability may be based on the behavioral audiogram of a single individual or a small group of animals. In addition, captive animals may be exposed to local ambient sounds and other environmental factors that may impact their hearing abilities, whether positively or negatively, and may not accurately reflect the hearing abilities of free-swimming animals (Houser et al. 2010b). For animals not available in captive or stranded settings (including large whales and rare species), estimates of hearing capabilities are made based on morphology and neuroanatomy structures, vocal characteristics, and extrapolations from related species.

In comparison, electrophysiological audiometry measures small electrical voltages produced by neural activity when the auditory system is stimulated by sound. The technique is relatively fast, does not require a conscious response, and is routinely used to assess the hearing of newborn humans. For both methods of evaluating hearing ability, hearing response in relation to frequency is a generalized U-shaped curve or audiogram showing the frequency range of best sensitivity (lowest hearing threshold) and frequencies above and below with higher threshold values.

Direct measurement of hearing sensitivity exists for approximately 25 of the nearly 130 species of marine mammals (Table 3.8-2 and Table 3.8-3). This section provides a summary of sound production and hearing capabilities for marine mammal species in the Study Area. For purposes of the analyses in this document, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities (note that these categories are not the same as the sonar source categories described in Chapter 2, Description of Proposed Action and Alternatives): high-frequency cetaceans, mid-frequency cetaceans, low-frequency cetaceans (mysticetes), phocid pinnipeds (true seals), otariid pinnipeds (sea lions and fur seals), and Mustelidae (sea otters). For a discussion of all marine mammal functional hearing groups and their derivation see Finneran and Jenkins (2012).

Table 3.8-2: Hearing and Vocalization Ranges for All Marine Mammal Functional Hearing Groups and Species Potentially Occurring within the Study Area

Functional Hearing Group	Species Which May be Present in the Study Area	Sound Production[1]		Functional Hearing Ability Frequency Range[1]
		Frequency Range	Source Level (dB re 1 µPa at 1 m)	
High-Frequency Cetaceans	Harbor Porpoise, Dall's Porpoise	100 Hz–200 kHz	120–205	200 Hz–180 kHz
Mid-Frequency Cetaceans	Sperm Whale, Beaked Whales (*Berardius*, *Mesoplodon*, and *Ziphius* species), Killer Whale, Pacific White-sided Dolphin	100 Hz–> 100 kHz	118–236	150 Hz–160 kHz
Low-Frequency Cetaceans	Blue Whale, Gray Whale, Fin Whale, Humpback Whale, Minke Whale, Sei Whale, North Pacific Right Whale	10 Hz–20 kHz	129–195	7 Hz–22 kHz
Phocidae	Northern Elephant Seals, Harbor Seals, Ribbon Seals	100 Hz–12 kHz	103–180	In-water: 75 Hz–75 kHz In-air: 75 Hz–30 kHz

Notes: dB re 1 µPa at 1 m = decibels referenced to 1 micropascal at 1 meter, Hz = Hertz, kHz = kilohertz

Table 3.8-3: Hearing and Vocalization Ranges for All Marine Mammal Functional Hearing Groups and Species Potentially Occurring within the Study Area

Functional Hearing Group	Species Which May be Present in the Study Area	Sound Production[1]		Functional Hearing Ability Frequency Range[1]
		Frequency Range	Source Level (dB re 1 µPa at 1 m)	
Otariidae	Steller Sea Lion, California Sea Lion, Northern Fur Seal	30 Hz–10 kHz	120–196	In-water: 50 Hz–50 kHz In-air: 50 Hz–75 kHz
Mustelidae	Northern Sea Otter	Primarily (in-air) from 4 to 8 kHz; (energy and harmonics present above 10–60 kHz although behavioral functionality unknown)	In-air: up to 113	In-water: unknown In-air: 125 Hz–35 kHz; peak sensitivity at 16 kHz

[1] Sound production levels and ranges and functional hearing ranges are generalized composites for all members of the functional hearing groups, regardless of their presence in this Study Area.
Sound production data adapted and derived from: Aburto et al. 1997; Ghoul and Reichmuth 2012; Hanggi and Schusterman 1994; Kastelein et al. 2002a, b; Marten 2000; McShane, et al. 1995; Møhl et al. 2003; Philips et al. 2003; Richardson et al. 1995; Schusterman et al. 1972; Villadsgaard et al. 2007; Dunlop et al. 2013
Hearing data adapted and derived from: Ghoul and Reichmuth 2012, 2013; Southall et al. 2007
These frequency ranges and source levels include social sounds for all groups and echolocation sounds for mid- and high-frequency groups. In-air vocalizations were not included for pinniped groups. Vocalization parameters for Mustelidae were measured from in-air vocalizations; no underwater data are available for this group.
Notes: dB re 1 µPa at 1 m = decibels referenced to 1 micropascal at 1 meter, Hz = Hertz, kHz = kilohertz

3.8.2.3.1 High-Frequency Cetaceans

Marine mammals within the high-frequency cetacean functional hearing group are all odontocetes (toothed whales; suborder: Odontoceti) and include eight species and subspecies of porpoises (family:

Phocoenidae); dwarf and pygmy sperm whales (family: Kogiidae); six species and subspecies of river dolphins; and four species of Cephalorhynchus. Only two members of the high-frequency cetacean group are known to occur or may rarely occur in the Study Area: harbor porpoise and Dall's porpoise. Functional hearing in high-frequency cetaceans occurs between approximately 200 Hertz (Hz) and 180 kilohertz (kHz) (Southall et al. 2007).

Sounds produced by high-frequency cetaceans range from approximately 100 Hz to 200 kHz with source levels of 120–205 decibels (dB) referenced to (re) 1 micropascal (µPa) at 1 m (Madsen et al. 2005, Richardson et al. 1995, Verboom and Kastelein 2003, Villadsgaard et al. 2007). Porpoises, unlike most other odontocetes, either do not produce whistles or do not whistle often (Awbrey et al. 1979, Bassett et al. 2009, Houck and Jefferson 1999, Thomson and Richardson et al. 1995, Verboom and Kastelein 2003). High-frequency cetaceans also generate specialized clicks used in biosonar (echolocation) at frequencies above 100 kHz that are used to detect, localize, and characterize underwater objects such as prey (Richardson et al. 1995).

From a harbor porpoise audiogram derived using behavioral audiometry methods, detection thresholds were estimated from 250 Hz to 180 kHz, with the range of best hearing from 16 to 140 kHz and maximum sensitivity between 100 and 140 kHz (Kastelein et al. 2002a). While no empirical data on hearing ability for Dall's porpoise are available, data on the morphology of the cochlea allow for estimation of the upper hearing threshold at about 170–200 kHz (Awbrey et al. 1979).

3.8.2.3.2 Mid-Frequency Cetaceans

Marine mammals within the mid-frequency cetacean functional hearing group are all odontocetes, and include the sperm whale (family: Physteredidae), 32 species and subspecies of dolphins (family: Delphinidae), the beluga and narwhal (*Monodon monoceros*) (family: Monodontidae), and 19 species of beaked and bottlenose whales (family: Ziphiidae). The following members of the mid-frequency cetacean group are known to occur or may occur in the Study Area: sperm whale, killer whale, Pacific white-sided dolphin, and beaked whales (Cuvier's beaked whale, Baird's beaked whale, and Stejneger's beaked whale). Functional hearing in mid-frequency cetaceans is conservatively estimated to be between approximately 150 Hz and 160 kHz (Southall et al. 2007).

Hearing studies on cetaceans have focused primarily on odontocete species (Houser and Finneran 2006, Kastelein et al. 2002a, Nachtigall et al. 2005, Szymanski et al. 1999, Yuen et al. 2005). Hearing sensitivity has been directly measured for a number of mid-frequency cetaceans, including Atlantic white-sided dolphins (*Lagenorhynchus acutus*) (Houser et al. 2010a), common dolphins (*Delphinus* spp.) (Houser et al. 2010a), Atlantic bottlenose dolphins (*Tursiops truncatus truncatus*) (Johnson 1967), Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) (Houser et al. 2010a), Black Sea bottlenose dolphins (*Tursiops truncatus ponticus*) (Popov et al. 2007), striped dolphins (*Stenella coeruleoalba*) (Kastelein et al. 2003), white-beaked dolphins (*Lagenorhynchus albirostris*) (Nachtigall et al. 2008), Risso's dolphins (Nachtigall et al. 2005), belugas (Finneran et al. 2005; White et al. 1977), false killer whales (Yuen et al. 2005), killer whales (Szymanski et al. 1999), Gervais' beaked whales (*Mesoplodon europaeus*) (Finneran and Schlundt 2009), and Blainville's beaked whales (*M. densirostris*) (Pacini et al. 2011). All audiograms exhibit the same general U-shaped curve when plotting sound source level against frequency, with a wide nominal hearing range between approximately 150 Hz and 160 kHz.

In general, odontocetes produce sounds across the widest band of frequencies. Their social vocalizations range from a few hundreds of Hz to tens of kHz (Southall et al. 2007) with source levels in the range of 118–236 dB re 1 micropascal-meter (µPa-m) (see Richardson et al. 1995). As mentioned earlier, they

also generate specialized clicks used in echolocation at frequencies above 100 kHz that are used to detect, localize, and characterize underwater objects such as prey (Au 1993). Echolocation clicks have source levels that can be as high as 229 dB re 1 µPa peak-to-peak (Au et al. 1974).

3.8.2.3.3 Low-Frequency Cetaceans

Marine mammals within the low-frequency functional hearing group are all mysticetes. This group is comprised of 13 species and subspecies of mysticete whales in six genera: *Eubalaena*, *Balaena*, *Caperea*, *Eschrichtius*, *Megaptera*, and *Balaenoptera*. The following members of the low-frequency cetacean group (mysticetes) are present or have a reasonable likelihood of being present in the Study Area: North Pacific right (*Eubalaena japonica*), humpback, blue, fin, sei (*Balaenoptera borealis*), minke, and gray whales. Functional hearing in low-frequency cetaceans is conservatively estimated to be between approximately 7 Hz and 22 kHz (Southall et al. 2007).

Because of large animal size and general unavailability of live specimens, direct measurements of mysticete whale hearing are not available, although there was one effort to measure hearing thresholds in a stranded gray whale (Ridgway and Carder 2001). Because hearing ability has not been directly measured in these species, it is inferred from vocalizations, ear structure, and field observations. Vocalizations are audible somewhere in the frequency range of production, but the exact range cannot be inferred (Southall et al. 2007).

Mysticete cetaceans produce low-frequency sounds that range in the tens of Hz to several kHz that most likely serve social functions such as reproduction, but may serve an orientation function as well (Green et al. 1994). Humpback whales are the notable exception within the mysticetes, with some calls exceeding 10 kHz. These sounds can generally be categorized as low-frequency moans, bursts or pulses, or more complex songs (Edds-Walton 1997). Source levels of most mysticete cetacean sounds range from 129 to 190 dB re 1 µPa-m (see Richardson et al. 1995).

3.8.2.3.4 Pinnipeds

Pinnipeds are divided into three functional hearing groups, otariids (sea lions and fur seals), phocid seals (true seals), and odobenids (walrus), with different in-air and in-water hearing ranges. The Study Area contains phocids (true seals) and otariids (fur seals). Species known to occur or that may possibly occur in the Study Area are described in the sections below and include harbor seal (*Phoca vitulina*), northern elephant seal (*Mirounga angustirostris*), California sea lion (*Zalophus californianus*), northern fur seal (*Callorhinus ursinus*), ribbon seal (*Histriophoca fasciata*), and Steller sea lion (*Eumetopias jubatus*). Measurements of hearing sensitivity have been conducted on species representing all of the families of pinnipeds (Phocidae, Otariidae, Odobenidae) (see Kastelein et al. 2002b, 2005a, 2012c; Moore and Schusterman 1987; Schusterman et al. 1972; Terhune 1988; Thomas et al. 1990; Turnbull and Terhune 1990; Wolski et al. 2003).

Pinnipeds produce sounds both in air and water that range in frequency from approximately 100 Hz to several tens of kHz, and it is believed that these sounds only serve social functions (Miller 1991) such as male-male vocal boundary displays, mother-pup recognition and reproduction. Source levels for pinniped vocalizations range from approximately 95–190 dB re 1 µPa (see Richardson et al. 1995).

3.8.2.3.4.1 Phocids

Phocids (true seals) known to occur with varying level of frequency in the Study Area include the harbor seal, northern elephant seal, and ribbon seal. Hearing in phocids has been tested in the following species: gray seals (Ridgway et al. 1975), harbor seals (Kastak and Schusterman 1998, Kastelein et al.

2012c, Richardson et al. 1995, Southall et al. 2007, Terhune and Turnbull 1995, Wolski et al. 2003), harp seals (Terhune and Ronald 1971, 1972), Hawaiian monk seals (Thomas et al. 1990), northern elephant seal (Kastak and Schusterman 1998, 1999), and ringed seals (Terhune and Ronald 1975, 1976).

Phocid hearing limits are estimated to be 75 Hz–30 kHz in air and 75 Hz–75 kHz in water (Kastak and Schusterman 1999; Kastelein et al. 2009; Reichmuth 2008; Terhune and Ronald 1971, 1972).

3.8.2.3.4.2 Otariids

Otariids (sea lions and fur seals) known to occur with varying level of frequency in the Study Area include California sea lion, northern fur seal, and Steller sea lion. Hearing in otariid seals is adapted to low-frequency sound and less auditory bandwidth than phocid seals. Hearing in otariid seals has been tested in two species present in the Study Area: California sea lion (Kastak and Schusterman 1998, Moore and Schusterman 1987, Schusterman et al. 1972, Southall et al. 2005) and northern fur seal (Babushina et al. 1991, Moore and Schusterman 1987). The otariids' hearing ranges are 50 Hz–75 kHz in air and 50 Hz–50 kHz in water, based on these studies.

3.8.2.3.5 Mustelidae (Sea Otters)

Until recently, there had been no direct studies of hearing in sea otters, although behavioral response to playbacks was undertaken previously (Davis et al. 1988). Maximum hearing sensitivity for sea otters has been inferred based on the anatomy of the inner ear, which indicates they likely have a maximum hearing sensitivity at 16 kHz (Davis et al. 1988). For purposes of the analysis in this document, it is assumed that northern sea otters in the Study Area have hearing ranges of 125 Hz–35 kHz in air and 50 Hz–50 kHz in water, based on their phylogenetic and anatomical similarities to otariids (Finneran and Jenkins 2012). Recently, Ghoul and Reichmuth (2013) confirmed that sea otter's in-air hearing closely resembled that of a sea lion, although underwater hearing sensitivity was found to be significantly reduced in comparison to that of pinnipeds. The finding that sea otters are not especially well adapted for hearing underwater suggests that the function of this sense has been less important in their survival and evolution than it has for pinnipeds (Ghoul and Reichmuth 2013).

3.8.2.4 General Threats

Marine mammal populations can be influenced by various factors and human activities. These factors can affect marine mammal populations directly, by activities such as hunting and whale watching, or indirectly, through reduced prey availability or lowered reproductive success of individuals. Twiss and Reeves (1999) provide a general discussion of marine mammal conservation. As detailed in National Oceanic and Atmospheric Administration (2009), investigations of stranded marine mammals are undertaken out of a concern for animal welfare and ocean stewardship. Marine mammals have also been recognized as sentinels of ecosystem health and may therefore provide valuable links to human health (National Research Council 1991). Investigations into the cause of death for stranded animals can also provide indications of the general threats to marine mammals in a given location.

Marine mammals are influenced by natural phenomena, such as storms and other extreme weather patterns. Generally, not much is known about how large storms and other weather patterns affect marine mammals, other than that mass strandings (when two or more marine mammals become beached or stuck in shallow water) sometimes coincide with hurricanes, typhoons, and other tropical storms (Marsh 1989, Rosel and Watts 2008). The global climate is changing and is having impacts on some populations of marine mammals (Salvadeo et al. 2010, Simmonds and Eliott 2009). Climate change can affect marine mammal species directly through habitat loss (especially for species that depend on ice or terrestrial areas) and indirectly via impacts on prey, changing prey distributions and locations, and

changes in water temperature. Changes in prey can impact marine mammal foraging success, which in turn affects reproduction success and survival. Climate change also may influence marine mammals through effects on human behavior, such as increased shipping and oil and gas extraction, resulting from sea ice loss (Alter et al. 2010).

Mass die-offs of some marine mammal species have been linked to toxic algal blooms; that is, they consume prey that have consumed toxic plankton, such as die-offs of California sea lions and northern fur seals because of poisoning caused by the diatom *Pseudo-nitzschia* spp. (Doucette et al. 2006, Fire et al. 2008, Lefebrve et al. 2010, Thomas et al. 2010, Torres de la Riva et al. 2009). All marine mammals have parasites that, under normal circumstances, probably do little overall harm, but under certain conditions, they can cause serious health problems or even death (Bull et al. 2006, Fauquier et al. 2009, Jepson et al. 2005a). Disease affects some individuals (especially older animals), and occasionally disease epidemics can injure or kill a large percentage of the population (Keck et al. 2010, Paniz-Mondolfi and Sander-Hoffmann 2009). Although the cause remains undetermined, there was an Unusual Mortality Event declared for harbor porpoise in the Pacific Northwest in 2006, which continued through 2008 (Calambokidis and Huggins 2008). Recently, the first case of morbillivirus in the central Pacific was documented for a stranded juvenile male Longman's beaked whale (*Indopacetus pacificus*) at Hamoa Beach, Hana, Maui (West et al. 2012).

Human impacts on marine mammals have received much attention in recent decades, and include hunting (both commercial and native practices), fisheries interactions (such as gear entanglement or shootings by fishers), bycatch (accidental or incidental catch), indirect effects of fisheries through takes of prey species, ship strikes, noise pollution, chemical pollution, marine debris (ingestion and entanglement), increased ocean acidification, and general habitat deterioration or destruction. For example, in Alaska between 2007 and 2011, there were 24 Northern fur seals found with entanglements caused by marine debris and fishing gear reported to the stranding network (Allen et al. 2014). See Carretta et al. (2013b) for a presentation of recent data on human related injury and mortality to Pacific west coast marine mammal stocks (some of which are present in the Study Area) occurring between 2007 and 2011.

Direct hunting, as in whaling and sealing operations, provided the original impetus for marine mammal management efforts and has driven much of the early research on cetaceans and pinnipeds (Twiss and Reeves 1999). Some direct hunting still occurs. For example, in 2 years of hunting (2010 and 2011) on St. Paul Island and St. George Island in the Bering Sea, 878 northern fur seals were harvested for subsistence (Testa 2012); a total of 127 gray whales were "struck" during 2013 Russian Federation subsistence whaling (Ilyashenko & Zharikov 2014). However, fishery bycatch is likely the most impactful problem presently and may account for the deaths of more marine mammals than any other cause (Geijer and Read 2013, Hamer et al. 2010, Northridge 2008, Read 2008). In 1994, the MMPA was amended to formally address bycatch. The amendment requires the development of a take reduction plan when a bycatch exceeds a level considered unsustainable by the marine mammal population. At least in part as a result of the amendment, estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer and Read 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period. Fishery interactions other than bycatch include entanglement from nets, fishing line, and the ropes and lines connected to fishing gear (see, for example, Good et al. 2010; Saez et al. 2013; Williams et al. 2011).

Ship strikes are an issue of increasing concern for most marine mammals, particularly baleen whale species. In Alaska waters from 1978 to 2006, there were 62 reported vessel collisions with whales (Gabriele et al. 2007). These involved motorized, non-motorized, large and small vessels, engaged in a variety of activities with private small vessel (less than 15 m in length) strikes the most common. Any strike by a Navy vessel is reported via the Navy chain of command to NMFS independent of any stranding or stranding data. Given that personnel on Navy vessels up to and including aircraft carriers have known when a whale has been struck because of a reported "shudder" in the vessel, even when there has been no visual detection prior to the event, the Navy is confident that unlike most minimally manned commercial vessels, U.S. Navy vessels are likely to detect all strikes involving large whales. There has never been a Navy vessel strike to a marine mammal in the Study Area during any previous training activities.

Chemical pollution is also of great concern, although for the most part, its effects on marine mammals are just starting to be understood. In a broad scale investigation, the 5.5-year expedition of the *Odyssey* collected 955 biopsy samples from sperm whales around the world to provide a consistent baseline database of ocean contamination and to measure future effects (Ocean Alliance 2010). Chemical pollutants found in pesticides and other substances flow into the marine environment from human use on land and are absorbed into the bodies of marine mammals, accumulating in their blubber or internal organs, or are transferred to the young from mother's milk (Fair et al. 2010). Important factors that determine the levels of pesticides, heavy metals, and industrial pollutants that accumulate in marine mammals are gender (i.e., adult males have no way to transfer pesticides whereas females may pass pollutants to their calves through milk), habitat, and diet. Living closer to the source of pollutants and feeding on higher-level organisms increase the potential to accumulate toxins (Moon et al. 2010). The buildup of human-made persistent compounds in marine mammals not only increases their likelihood of contracting diseases or developing tumors but also compromises the function of their reproductive systems (Fair et al. 2010).

Oil and other chemical spills are a specific type of ocean contamination that can have damaging effects on some marine mammal species (Marine Mammal Commission 2011). Although information on effects of oil spills on marine mammals is limited, new information gained from study of the recent Deep Water Horizon oil spill in the Gulf of Mexico has provided insight on assessment of long-term effects (Marine Mammal Commission 2011) as well as continued study of the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska (Bodkin et al. 2012, Matkin et al. 2008). In short, marine mammals can be affected directly by contact or ingestion of the oil, indirectly by activities during the containment and cleanup phases, and through long-term impacts on prey and habitat.

Habitat deterioration and loss is a major factor for almost all coastal and inshore species of marine mammals, especially those that live in rivers or estuaries, and it may include such factors as depleting a habitat's prey base and the complete loss of habitat (Ayres et al. 2012, Kemp 1996, Smith et al. 2009). In some locations, especially where urban or industrial activities or commercial shipping is intense, chronic anthropogenic noise is also being increasingly considered as a potential habitat level stressor. Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. Chronic noise may cause marine mammals to leave a habitat, impair their ability to communicate, or cause stress (Dunlop et al. 2010; Erbe et al. 2012, Hildebrand 2009, Holt et al. 2008, Rolland et al. 2012, Tyack et al. 2011; Williams et al. 2014a). Noise can cause behavioral disturbances, mask other sounds including their own vocalizations, may result in injury, and, in some cases, result in behaviors that ultimately lead to

death (National Research Council of the National Academies 2003, 2005; Nowacek et al. 2007; Southall et al. 2009a; Tyack 2009; Würsig and Richardson 2008).

Anthropogenic noise is generated from a variety of sources, including commercial shipping, oil and gas exploration and production activities, commercial and recreational fishing (including fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), recreational boating and whale-watching activities, offshore power generation, research (including noise from air guns, sonar, and telemetry), and military training and testing activities. Commercial shipping's contribution to ambient noise in the ocean has increased by as much as 12 dB over the last few decades (Hildebrand 2009, McDonald et al. 2008). Navy training activities in the Study Area are not a chronic noise source and are not on par with sources of noise such as those from oil and gas seismic exploration or commercial shipping.

3.8.2.5 Marine Mammal Density Estimates

A quantitative impact analysis requires an estimate of the number of animals that might be affected by anthropogenic activities. A key element of this estimation is knowledge of the abundance and concentration of the species in specific areas where those activities will occur. The most appropriate unit of metric for this type of analysis is animal density, or the number of animals present per unit area. Marine species density estimation requires a significant amount of effort to both collect and analyze data to produce a reasonable estimate. Unlike surveys for terrestrial wildlife, many marine species spend much of their time submerged, and are not easily observed. In order to collect enough sighting data to make reasonable density estimates, multiple observations are required, often in areas that are not easily accessible (e.g., far offshore). Ideally, marine species sighting data would be collected for the specific area and time period (e.g., season) of interest and density estimates derived accordingly. However, in many places, poor weather conditions and high sea states prohibit the completion of comprehensive visual surveys.

For most cetacean species, abundance is estimated using line-transect surveys or mark-recapture studies (e.g., Barlow 2010, Barlow and Forney 2007, Calambokidis et al. 2008). The result provides one single density estimate value for each species across broad geographic areas, such as waters within the U.S. EEZ off California, Oregon, and Washington. This is the general approach applied in estimating cetacean abundance in the NMFS Stock Assessment Reports. Although the single value provides a good average estimate of abundance (total number of individuals) for a specified area, it does not provide information on the species distribution or concentrations within that area, and it does not estimate density for other timeframes or seasons that were not surveyed. More recently, habitat modeling has been used to estimate cetacean densities (Barlow et al. 2009; Becker et al. 2010, 2012a, b, c; Ferguson et al. 2006a; Forney et al. 2012; Redfern et al. 2006). These models estimate cetacean density as a continuous function of habitat variables (e.g., sea surface temperature, seafloor depth, etc.) and thus allow predictions of cetacean densities on finer spatial scales than traditional line-transect or mark-recapture analyses. Within the geographic area that was modeled, densities can be predicted wherever these habitat variables can be measured or estimated.

Uncertainty in published density estimates is typically large because of the low number of sightings available for their derivation. Uncertainty is typically expressed by the coefficient of variation (CV) of the estimate, which is derived using standard statistical methods and describes the amount of variation with respect to the population mean. It is expressed as a fraction or sometimes a percentage and can range upward from zero, indicating no uncertainty, to high values. For example, a CV of 0.85 would indicate high uncertainty in the population estimate. When the CV exceeds 1.0, the estimate is very uncertain.

The uncertainty associated with movements of animals into or out of an area (due to factors such as availability of prey or changing oceanographic conditions) is much larger than is indicated by the CV.

The methods used to estimate pinniped at-sea densities are typically different than those used for cetaceans. This is discussed in more detail in the Pacific Navy Marine Species Density Database Technical Report (U.S. Department of the Navy 2014a). Pinniped abundance is generally estimated via shore counts of animals at known rookeries and haulout sites. Translating these numbers to in-water densities is difficult given the variability in foraging ranges, migration, and haulout behavior between species and within each species, and is driven by factors such as age class, sex class, seasonal variation, etc. Details of the density derivation for each species of pinniped in the Study Area are provided in the U.S. Department of the Navy (2014a). In summary, the methods used to derive pinniped densities involved a series of species-specific data reviews to compile the most accurate and up-to-date information available. The total abundance divided by the area of the region was the resultant density estimate for each species in a given location.

There is no single source of density data for every area, species, and season because of the fiscal costs, resources, and effort involved to provide enough survey coverage to sufficiently estimate density. Therefore, to characterize marine mammal density for areas of concern such as the Study Area, the Navy compiled data from multiple sources. Each data source may use different methods to estimate density and uncertainty (e.g., variance) associated with the estimates.

The Navy thus developed a protocol to select the best available data sources based on species, area, and time (season). The Navy then used this protocol to identify the best density data from available sources, including habitat-based density models, line-transect analyses, and peer-reviewed published studies. These data were incorporated into a Geographic Information System database that includes seasonal (summer/fall and winter/spring) density values for every marine mammal species present within the Study Area. Detailed information on the Navy's selection protocol, datasets, and specific density values are provided in a Pacific Navy Marine Species Density Database Technical Report (U.S. Department of the Navy 2014a).

The following sections present information on the status and management, abundance, and distribution of species with possible or confirmed presence within the Study Area (Table 3.8-1).

3.8.2.6 North Pacific Right Whale (*Eubalaena japonica*)

3.8.2.6.1 Status and Management

North Pacific right whales are listed as depleted under the MMPA and endangered under the ESA. Once abundant, the North Pacific right whale is one of the most endangered whale species in the world. This species has been listed as endangered under the ESA since 1973 when it was considered the "northern right whale" (including both the North Atlantic [*Eubalaena glacialis*] and North Pacific right whales). In 2008, NMFS listed the right whales as two separate, endangered species. Previously designated critical habitat within the Gulf of Alaska and the Bering Sea was then re-designated as North Pacific right whale critical habitat (Figure 3.8-1; see National Oceanic and Atmospheric Administration 2008b; National Marine Fisheries Service 2013a). In March 2012, NMFS announced a 5-year review of North Pacific right whale under the ESA (National Marine Fisheries Service 2012a). A recovery plan for this species has been prepared (National Marine Fisheries Service 2013a). Although there is designated critical habitat for this species in the western Gulf of Alaska and an area in the southeastern Bering Sea, there is no designated critical habitat for this species within the Study Area. NMFS currently recognizes two stocks of North Pacific right whale: (1) an Eastern North Pacific stock; and (2) a Western North Pacific stock, thought to

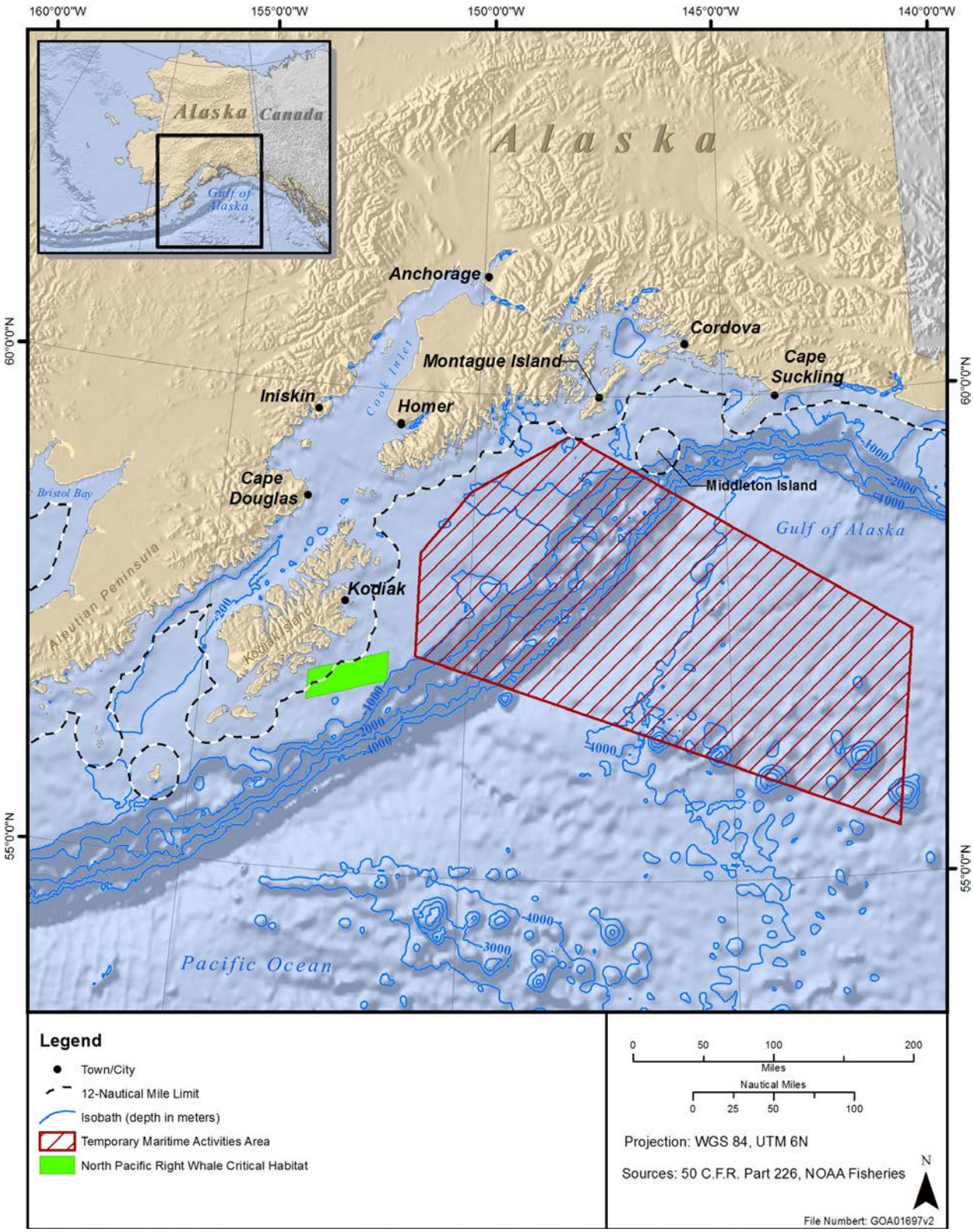

Figure 3.8-1: North Pacific Right Whale Critical Habitat in the Vicinity of the Temporary Maritime Activities Area

feed primarily in the Sea of Okhotsk (Allen and Angliss 2014). It is assumed that any North Pacific right whale in the Study Area would be from the Eastern North Pacific stock.

3.8.2.6.2 Abundance

The most recent estimated population for the North Pacific right whale is between 28 and 31 individuals, and although this estimate may be reflective of a Bering Sea subpopulation, the total Eastern North Pacific population is unlikely to be much larger (Wade et al. 2011b; see also Marques et al. 2011; National Marine Fisheries Service 2013a). Far to the southwest of the TMAA (from 170° E longitude west to Japan), Matsuoka et al. (2014) documented as many as 55 North Pacific right whale sightings representing 77 animals between 1994 and 2013; many of these were likely the same individuals re-sighted in subsequent years.

3.8.2.6.3 Distribution

North Pacific right whales occur in subpolar to temperate waters. They are generally migratory, with at least a portion of the population moving between summer feeding grounds in temperate or high latitudes and winter calving areas in warmer waters (Clapham et al. 2004, Kraus et al. 1986). The rarity of reports for right whales in more southern coastal areas in winter in either historical or recent times suggests that their breeding grounds may have been offshore (Clapham et al. 2004). Historical whaling records provide virtually the only information on North Pacific right whale distribution. This species historically occurred across the Pacific Ocean north of 35°N, with concentrations in the Gulf of Alaska, eastern Aleutian Islands, south-central Bering Sea, Okhotsk Sea, and the Sea of Japan (Clapham et al. 2004, Shelden et al. 2005, Gregr 2011, Ivashchenko et al. 2012, Omura et al. 1969, Scarff 1986).

Habitat modeling using historic whaling records suggests that the Gulf of Alaska currently provides suitable habitat for North Pacific right whales, although this has not been validated (Gregr 2011). Presently, sightings are extremely rare, occurring primarily in the Okhotsk Sea and the eastern Bering Sea (Brownell et al. 2001, Shelden and Clapham 2006, Shelden et al. 2005, Wade et al. 2006, Zerbini et al. 2010). Recently, there are far fewer sightings of North Pacific right whales in the Gulf of Alaska than the Bering Sea (Brownell et al. 2001, Wade et al. 2011a, Zerbini et al. 2010). In the summers of 2008 and 2009, satellite transmitters were deployed on four North Pacific right whales on the Bering Sea feeding grounds and the results demonstrated that the movements of these animals were restricted to a relatively small region between 56° and 58° north and 163° and 167° west in the Bering Sea (Zerbini et al. 2010). From the 1960s through 2002, there were only two documented sightings of North Pacific right whales in the Gulf of Alaska. In March 1979, there was an opportunistic sighting near Yakutat Bay in the eastern Gulf of Alaska (Shelden et al. 2005). A single North Pacific right whale was sighted southeast of Kodiak Island in July 1998 during an aerial survey and, subsequently, two passive acoustic recorders were placed in the northern Gulf of Alaska near Kodiak Island (Waite et al. 2003). Recordings from these instruments, and an additional five placed in the central Gulf of Alaska in 2000–2001, were later analyzed for North Pacific right whale calls. Very few right whale calls were positively identified, and all were detected on the westernmost recorder in the Gulf of Alaska during August and September (Moore et al. 2006).

From 2004 to 2006, there were an additional four sightings of North Pacific right whales in the Gulf of Alaska, all in the Barnabus Trough region on Albatross Bank, southeast of Kodiak Island (Wade et al. 2011a, b). These sightings triple the number of sightings in the Gulf of Alaska over the last 40 years and suggest that this area represents important habitat for the remaining animals in this population (Wade et al. 2011a). A portion of this area, located to the west/southwest of the Study Area, was designated as critical habitat in 2006 (National Marine Fisheries Service 2013a).

Zerbini et al. (2010) documented fine scale localized small scale movements in the eastern Bering Sea between July and October based on satellite tag tracking of four North Pacific right whales.

During a marine mammal survey in July 2012, a lone North Pacific right whale was seen approximately 40 miles (mi.) south of the Study Area in deep water, approximately 130 mi. east of Kodiak Island (Matsuoka et al. 2013). In July 2013, during the GOALS II survey, three North Pacific right whales were acoustically detected in the Barnabus Trough region on Albatross Bank, southeast of Kodiak Island (Rone et al. 2014). This is the same area as the 2004–2006 sightings noted above (Wade et al. 2011a, b). A bottom-moored passive acoustic monitoring device also detected North Pacific right whale calls between July and September 2013. This passive acoustic device was located in the extreme southeast edge of the GOA TMAA on Quinn Seamount (Debich et al. 2014). Given limitations of the passive acoustic detection technology deployed, it is unclear at this time if these detections were within or outside of the TMAA. Researchers analyzing these detections believe calls could have originated over 100 km from the sensor based on received levels at the hydrophone and simple propagation estimates (Debich et al. 2014). Previously, North Pacific right whales had not been detected on any of the passive acoustic buoys deployed in the shelf and slope regions of the Study Area, based on recordings collected between July 2011 and June 2013 (Baumann-Pickering et al. 2012a, b; Debich et al. 2013).

Far to the south of the Study Area in June 2013, a single right whale was sighted in the waters off Haida Gwaii, British Colombia (Hume 2013). In October another (different) single right whale was sighted off the mouth of San Juan de Fuca (Canada/Washington) with a group of humpback whales (Pynn 2013). These detections indicate at least two North Pacific right whales have recently ranged beyond the Bering Sea and Kodiak Island waters in the Gulf of Alaska, if they are in fact part of the small North Pacific population of right whales as described by Wade et al. (2011b).

Given their current extremely low population numbers, and the general lack of sightings in the Gulf of Alaska, the occurrence of right whales in the Study Area is considered rare. North Pacific right whales have not been seen in the Study Area since at least the 1960s. Further, they have not been detected on any of the passive acoustic buoys deployed in the shelf and slope regions of the Study Area, based on recordings collected from July 2011 through June 2013 (Baumann-Pickering et al. 2012b, Debich et al. 2013).

3.8.2.7 Humpback Whale (*Megaptera novaeangliae*)

3.8.2.7.1 Status and Management

Humpback whales are listed as depleted under the MMPA and endangered under the ESA, but there is no designated critical habitat for this species in the North Pacific. Based on evidence of population recovery in many areas, the North Pacific humpback whale population is being considered by NMFS as a Distinct Population Segment (DPS) and to delist this population from the U.S. Endangered Species List (National Marine Fisheries Service 2013b). The 90-day finding is the first step in the delisting process. A complete status review is being conducted by NMFS to determine if delisting is warranted by April 2014 (National Marine Fisheries Service 2013b). NMFS has designated four stocks for management purposes: (1) the Central North Pacific stock, consisting of winter and spring populations of the Hawaiian Islands that migrate to feeding areas from southeast Alaska to the Alaska Peninsula; (2) the Western North Pacific stock, consisting of winter and spring populations off Asia that migrate to feeding areas off Russia, the Aleutian Islands, and the Bering Sea; (3) the California, Oregon, and Washington stock, consisting of winter and spring populations in coastal Central America and coastal Mexico that migrate to feed off the west coast of the United States; and (4) the American Samoa stock, with feeding areas largely undocumented but occurring as far south as the Antarctic Peninsula (Carretta et al. 2014).

Whales from both the Central North Pacific and Western North Pacific stocks occur in the Study Area. For the Central North Pacific stock, an overall minimum estimate of mortality and serious injury due to fisheries is 7.45 humpback whales annually, and the mean vessel collision mortality and serious injury rate is 4.23 humpback whales annually (Allen and Angliss 2014).

In addition to being listing as endangered, there are regulations that have been issued governing the approach to humpback whales "within 200 miles of the coast" in Alaska waters (National Marine Fisheries Service 2001a). These regulations were issued to manage the threat caused by whale-watching activities by: (1) prohibiting approach to within 100 yards (yd.) (91 m) of humpback whales, (2) implementation of a "slow safe speed" in proximity to humpbacks, and (3) creating exemptions for some vessels, including military vessels engaged in "official duty" (training).

3.8.2.7.2 Abundance

A large-scale photo-identification sampling study of humpback whales was conducted from 2004 to 2006 throughout the North Pacific (Barlow et al. 2011, Calambokidis et al. 2008). Known as the SPLASH (Structure of Populations, Levels of Abundance, and Status of Humpbacks) Project, the study was designed to sample all known North Pacific feeding and breeding populations. Overall humpback whale abundance in the North Pacific based on the SPLASH Project was estimated at 21,808 individuals (CV = 0.04), confirming that this population of humpback whales has continued to increase and is now greater than some pre-whaling abundance estimates (Barlow et al. 2011). Data indicate that the North Pacific population has been increasing at a rate of between 5.5 percent and 6.0 percent per year, approximately doubling every 10 years (Calambokidis et al. 2008). Baker et al. (2013) commented that humpback whales display a complex population structure based on DNA samples taken across 10 humpback whale feeding areas and eight breeding regions within the Pacific.

The Central North Pacific stock has been estimated at 10,103 individuals based on data from their wintering grounds throughout the main Hawaiian Islands (Allen and Angliss 2014). In summer, the majority of humpback whales from the Central North Pacific stock are found in the Aleutian Islands, Bering Sea, Gulf of Alaska, and southeast Alaska/northern British Columbia, where relatively high densities of whales occur (Allen and Angliss 2014).

The current best estimate for the Western North Pacific stock is 938 individuals, based on data from their Asian wintering grounds (Allen and Angliss 2014). In summer, animals from this stock are found feeding mainly in waters off Russia, the Aleutian Islands, and the Bering Sea; although to a limited extent they mix with whales from the Central North Pacific stock through the central Gulf of Alaska (Allen and Angliss 2014).

Based on sighting data collected during a Navy-funded line-transect survey of the Study Area in April 2009, there were 219 (CV = 0.57) and 56 (CV = 0.57) humpback whales in the inshore and offshore stratums, respectively (Rone et al. 2009). Data collected during line-transect surveys in shelf and nearshore waters from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands during July and August 2001, 2002, and 2003 suggest that humpback whale populations in the Gulf of Alaska are increasing (Zerbini et al. 2006). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area. Abundance estimates for unidentified large whales were prorated among blue, fin, and humpback whales within each stratum and proportionally incorporated into each species density estimate, resulting in the following abundance estimates for humpback

whales: 2,927 (CV = 0.74) inshore stratum, 65 (CV = 0.76) offshore stratum, 53 (CV = 0.64) seamount stratum, and 9 (CV = 1.03) slope stratum (Rone et al. 2014).

3.8.2.7.3 Distribution

Humpback whales are distributed worldwide in all major oceans and most seas. They typically are found during the summer on high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs (Barlow et al. 2011, Calambokidis et al. 2008). Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep water during migrations such as the route to and from the Hawaiian Islands (Barlow et al. 2011, Calambokidis et al. 2001). Migratory transits between the Hawaiian Islands and southeastern Alaska have been documented to take as little as 36–39 days (Calambokidis et al. 2001, Gabriele et al. 1996).

Identifications made between feeding areas and wintering areas indicate that the majority of humpbacks in the GOA winter in Hawaii (about 60 percent of the population), with the remainder wintering in Mexican waters around the Revillagigedo Islands, Baja, and the Mexican mainland (Barlow et al. 2011, Calambokidis et al. 2008). This suggests that whales migrating between breeding areas in Hawaii and feeding areas in northern British Columbia and southeast Alaska must cross paths with whales migrating between breeding areas near Mexico's offshore islands and feeding areas in the Gulf of Alaska (Barlow et al. 2011).

Prior to the SPLASH study, there had been few matches made between humpbacks in the western Pacific and any of the known feeding areas (Calambokidis et al. 2001). Barlow et al. (2011) found that the whales wintering near Japan and the Philippines migrate primarily to Kamchatka and to some extent, the Aleutian Islands, Bering Sea, and Gulf of Alaska. However, approximately 15–17 percent of the whales identified in the western Gulf of Alaska could not be matched to known wintering areas, suggesting the existence of undocumented humpback wintering areas (Calambokidis et al. 2008).

There were eight on-effort humpback whale sightings during the Navy-funded line-transect survey of the Study Area in April 2009, and only one of these sightings was in the offshore stratum in waters deeper than 2,000 m (Rone et al. 2009). Results from a recent study of humpback whales in the Gulf of Alaska suggest that there may be regional feeding aggregations within the Gulf of Alaska (Witteveen et al. 2011). This study confirmed that humpback whale feeding aggregations exhibit high site fidelity and indicated that, while inshore and offshore aggregations of humpbacks off Kodiak Island and southeastern Alaska represent single feeding aggregations, inshore and offshore whale aggregations off Prince William Sound may be unique (Witteveen et al. 2011).

Humpback whales have been known to occur within the Gulf of Alaska primarily in summer and fall, migrating to southerly breeding grounds in winter and returning to the north in spring (Calambokidis et al. 2008). However, based on recordings from moored hydrophones deployed in six locations in the Gulf of Alaska from October 1999 to May 2002, humpback calls were most commonly detected during the fall and winter (Stafford et al. 2007). More recently, HARPs deployed in the shelf and slope regions of the Study Area confirmed that some humpbacks remain in the area throughout the winter (Baumann-Pickering et al. 2012b). Based on both sighting data and acoustic detections, humpback whales are now known to occur year-round in the Gulf of Alaska (National Oceanic and Atmospheric Administration 2012b, Stafford et al. 2007). Humpback whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.8 Blue Whale (*Balaenoptera musculus*)

3.8.2.8.1 Status and Management

The blue whale is listed as depleted under the MMPA and as endangered under the ESA, but there is no designated critical habitat for this species. Analyses of acoustic data suggest that blue whales in the North Pacific comprise two distinct stocks based on different call types, an eastern and western population (Stafford 2003, Stafford et al. 2001; Monnahan et al. 2014). Acoustic call types from both populations have been detected in the Gulf of Alaska (Baumann-Pickering et al. 2012b, Stafford 2003, Stafford et al. 2007). For the MMPA Stock Assessment Reports, the Eastern North Pacific stock of blue whales includes animals found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific and the Central (formerly Western) North Pacific stock includes animals found in waters off Hawaii during the winter (Carretta et al. 2014).

3.8.2.8.2 Abundance

Widespread whaling over the last century is believed to have decreased the blue whale population to approximately 1 percent of its pre-whaling population size (Sirovic et al. 2004; Branch et al. 2007; Monnahan et al. 2014). The current best available abundance estimate for the Eastern North Pacific stock of blue whales is 1,647 (CV = 0.07) (Carretta et al. 2014). There was a documented increase in the blue whale population size between 1979/80 and 1991 (Barlow 1994) and between 1991 and 1996 (Barlow 1997), but there has not been evidence to suggest an increase in the population of the Eastern North Pacific stock since then (Barlow and Taylor 2001; Carretta et al. 2014). Based on sighting data collected during a 2010 summer/fall shipboard line-transect survey of the entire Hawaiian Islands EEZ, the central North Pacific stock of blue whales is estimated at 81 animals (CV = 1.14) (Carretta et al. 2014). This is most likely an underestimate because the majority of blue whales are expected to be at higher latitudes during the summer and fall, when the 2010 survey was conducted (Bradford et al. 2013; Carretta et al. 2014). Calambokidis et al. (2009a) suggested that when feeding conditions off California are not optimal, blue whales may move to other regions to feed, including waters further north. A comparison of survey data from the 1990s to 2008 indicates that there has been a northward shift in blue whale distribution within waters off California, Oregon, and Washington (Barlow 2010). Subsequent mark-recapture estimates “indicated a significant upward trend in abundance of blue whales” at a rate of increase just under 3 percent per year for the U.S. west coast blue whale population in the Pacific (Calambokidis et al. 2009b; Calambokidis and Barlow 2013). Consistent with the earlier suggested variability in the distribution patterns, Carretta et al. (2013) report that blue whales from the U.S. west coast have been increasingly found feeding to the north and south of the U.S. west coast during summer and fall. Sighting data collected during a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA provided an abundance estimate for blue whales of 78 (CV = 1.22) based on pooled sightings from all strata and incorporation of prorated estimates for unidentified large whale species (Rone et al. 2014).

3.8.2.8.3 Distribution

Blue whales inhabit all oceans and are distributed from the ice edges to the tropics in both hemispheres (Jefferson et al. 1993). Most blue whale sightings are in nearshore and continental shelf waters; however, blue whales frequently travel through deep oceanic waters during migration (Širović et al. 2004). Most baleen whales spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes (Širović et al. 2004). Recently, it has been suggested that the migration patterns of blue whales in the North Pacific change during different oceanographic conditions (Calambokidis et al. 2009a).

Data indicate that whales from the Eastern North Pacific stock winter off Mexico, central America, and south to about 8°S (Stafford et al. 1999), and migrate to summer feeding grounds off the U.S. west coast and to a lesser extent to the Gulf of Alaska (Calambokidis et al. 2009a). Blue whales observed in the spring, summer, and fall off California, Washington, and British Columbia are known to be part of a group that returns to feeding areas off British Columbia and Alaska (Calambokidis and Barlow 2004; Calambokidis et al. 2009). These animals have shown site fidelity, returning to their mother's feeding grounds on their first migration (Calambokidis and Barlow 2004).

Blue whales from the Central North Pacific stock feed in summer off Kamchatka, the Aleutians, and in the Gulf of Alaska, and migrate to lower latitudes in the winter, including the Western Pacific and to a lesser degree the Central Pacific, including Hawaii (Stafford 2003, Stafford et al. 2001). Based on a photo-identification match of a blue whale observed during the 2013 GOALS II survey in the TMAA, Rone et al. (2014) determined the whale had been previously identified in Mexican waters off Baja California in 2005.

There were no blue whale sightings during an August 1994 line-transect survey south of the Aleutian Islands that covered waters over the continental shelf, the Aleutian Trench, and the northern portion of the abyssal plains of the Gulf of Alaska (Forney and Brownell 1996). A large-scale, inter-disciplinary monitoring program for the North Pacific Ocean and the southern Bering Sea, conducted seasonally from June 2002 through October 2004, included surveys of marine birds and mammals. The cruises followed a survey track from British Columbia, Canada, to Hokkaido, Japan, crossing the Gulf of Alaska between roughly 51°N and 55°N (Sydeman et al. 2004). On six separate crossings, covering all seasons and including waters of all depths, no blue whales were seen (Sydeman et al. 2004). There also were no blue whale sightings during the Navy-funded survey of the Study Area in April 2009 (Rone et al. 2009). During the 2013 GOALS II survey, there were five on-effort blue whale sightings of seven individuals (Rone et al. 2014).

Despite the lack of sighting data, blue whale calls have been acoustically detected in the Gulf of Alaska from mid-July to mid-December, with peak occurrence from August through November (Moore et al. 2006). Calls from the Eastern North Pacific population are detected from late July to mid-December, and calls from the Western (now Central) North Pacific population are detected from mid-July to mid-December (Stafford et al. 2007). More recently, two Navy-funded HARPs were deployed in the shelf and slope regions of north-central Gulf of Alaska and recordings collected from July 2011 through February 2012 (Baumann-Pickering et al. 2012b). Blue whale calls were detected from both the Eastern North Pacific and Central North Pacific stocks, although calls from the latter were substantially less common. Overall, blue whale calls were detected from the start of HARP deployment in July 2011 through early January 2012, when blue whale calling decreased dramatically (Baumann-Pickering et al. 2012b). The highest number of hours with calls occurred from mid-August until early December, indicating the presence of blue whales in the Study Area from summer through early winter. Blue whale occurrence in the Study Area is considered seasonally likely, primarily from July through December.

3.8.2.9 Fin Whale (*Balaenoptera physalus*)

3.8.2.9.1 Status and Management

The fin whale is listed as depleted under the MMPA and as endangered under the ESA, but there is no designated critical habitat for this species. Fin whale population structure in the Pacific Ocean is not well known. In the North Pacific, NMFS recognizes three fin whale stocks: (1) a Northeast Pacific stock; (2) a California, Oregon, and Washington stock; and (3) a Hawaii stock (Allen and Angliss 2014, Carretta et al. 2014). Animals from the Northeast Pacific stock are those that are expected to occur in the Study Area.

3.8.2.9.2 Abundance

Currently there are no reliable population estimates for the Northeast Pacific stock of fin whales. A minimum estimate for the stock is 1,214, based on surveys west of the Kenai Peninsula that covered only a portion of the stock's range (Allen and Angliss 2014).

Based on sighting data collected during the Navy-funded line-transect survey of the Study Area in April 2009, there were 594 (CV = 0.29) and 889 (CV = 0.57) fin whales in the inshore and offshore stratums, respectively (Rone et al. 2009). Data collected during line-transect surveys in shelf and nearshore waters from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands during July and August 2001, 2002, and 2003 suggest that fin whale populations in the Gulf of Alaska are increasing (Zerbini et al. 2006). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area. Abundance estimates for unidentified large whales were prorated among blue, fin, and humpback whales within each stratum and proportionally incorporated into each species density estimate, resulting in the following abundance estimates for fin whales: 1,610 (CV = 0.49) inshore stratum, 1,265 (CV = 0.27) offshore stratum, 207 (CV = 0.39) seamount stratum, and 499 (CV = 0.21) slope stratum (Rone et al. 2014).

3.8.2.9.3 Distribution

The fin whale is found in all the world's oceans (Jefferson et al. 2008) but appears to have a preference for temperate and polar waters (Reeves et al. 2002). Locations of breeding and calving grounds for the fin whale are largely unknown, but they typically migrate seasonally to higher latitudes every year to feed and migrate to lower latitudes to breed (Kjeld et al. 2006, MacLeod et al. 2006b, Mizroch et al. 2009). During the summer in the Pacific, fin whales are distributed from the southern Chukchi Sea (69°N) south to 32°N off the California coast (Mizroch et al. 2009). They have been observed during the summer in the central Bering Sea (Moore et al. 2000). During the winter, fin whales are sparsely distributed from 60°N, south to the northern edge of the tropics, near which it is assumed that they mate and calve (Mizroch et al. 2009). Location data from whales implanted with markers indicate that fin whales show local site fidelity, move consistently within and between summer feeding grounds (including the Gulf of Alaska), and undertake long migrations between the high-latitude summer grounds and the low-latitude winter grounds (Mizroch et al. 2009).

In previous years, fin whales have been acoustically detected in the Gulf of Alaska year-round, with highest call occurrence rates from August through December and lowest call occurrence rates from February through July (Moore et al. 2006, Stafford et al. 2007). More recently, two Navy-funded HARPs were deployed in the shelf and slope regions of north-central Gulf of Alaska and recordings collected from July 2011 through February 2012 (Baumann-Pickering et al. 2012b). Fin whale calls were recorded at both sites during all months, with a peak in calling from late August until the end of December.

There were 20 on-effort fin whale sightings (56 total animals) during the Navy-funded line-transect survey of the Study Area in April 2009; animals were distributed in both the inshore and offshore strata (Rone et al. 2009). During a 2012 survey in summer and early fall, Matsuoka et al. (2013) reported 149 fin whale sightings of 210 individuals. These sightings were made across both shelf and offshore strata within and adjacent to the Gulf of Alaska. During the June–July 2013 GOALS II Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area. Abundance estimates for unidentified large whales were prorated among blue, fin, and humpback whales within each stratum and proportionally incorporated into each species density estimate, resulting in the following abundance estimates for fin whales: 1,610

(CV = 0.49) inshore stratum, 1,265 (CV = 0.27) offshore stratum, 207 (CV = 0.39) seamount stratum, and 499 (CV = 0.21) slope stratum (Rone et al. 2014). Fin whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.10 Sei Whale (*Balaenoptera borealis*)

3.8.2.10.1 Status and Management

The sei whale is listed as depleted under the MMPA and as endangered under the ESA, but there is no designated critical habitat for this species. A recovery plan for the sei whale was completed in 2011 and provides a research strategy for obtaining data required to estimate population abundance and trends, and to identify factors that may be limiting the recovery of this species (National Marine Fisheries Service 2011d). Only a single Eastern North Pacific stock is recognized in the U.S. EEZ of the North Pacific (Carretta et al. 2014). However, some mark-recapture, catch distribution, and morphological research indicate that multiple stocks exist (Carretta et al. 2014; Masaki 1976, 1977). The Eastern North Pacific population has been protected since 1976, but is likely still impacted by the effects of continued unauthorized takes from whaling (Carretta et al. 2014).

3.8.2.10.2 Abundance

Estimates of sei whale abundance in the eastern North Pacific based on survey data are not available. The best current estimate of abundance for the Eastern North Pacific stock of sei whales that occur off California, Oregon, and Washington waters out to 300 nautical miles [nm] is 126 animals (CV = 0.53) (Carretta et al. 2014). There are no abundance data specific to the Gulf of Alaska and no data available on current population trends. Ivanshcheniko et al. (2013) commented that North Pacific sei whale populations were severely depleted up through 1979 by a combination of high Soviet and Japanese whaling takes.

3.8.2.10.3 Distribution

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes (Horwood 1987). Sei whales spend the summer months feeding in the subpolar higher latitudes and return to the lower latitudes to calve in the winter. Whaling data provide some evidence of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males (Horwood 1987, Perry et al. 1999). In the North Pacific, sei whales are thought to occur mainly south of the Aleutian Islands. In the summer they are present across the temperate Pacific from 35°N to 50°N (Horwood 2009, Masaki 1977, Smultea et al. 2010) and in the winter were recently found south of 20°N near the Mariana Islands (Fulling et al. 2011). Sei whales are most often found in deep, oceanic waters of the cool temperate zone. They appear to prefer regions of steep relief, such as the continental shelf break, canyons, or basins between banks and ledges (Best and Lockyer 2002, Gregr and Trites 2001, Kenney and Winn 1987, Schilling et al. 1992). Characteristics of preferred breeding grounds are unknown, since they have generally not been identified.

Whaling records from the 1900s indicate there were high densities of sei whales in the northwestern and northeastern portions (i.e., near Portlock Bank) of the Gulf of Alaska during May through August (U.S. Department of the Navy 2006). There were no sei whales sighted during the April 2009 survey of the Study Area (Rone et al. 2009). During a 2012 survey in summer and early fall, Matsuoka et al (2013) reported 87 sei whale sightings of 1,647 individuals. The majority of these sightings were in the offshore waters in the central to southern Gulf of Alaska and adjacent eastern North Pacific south of the Gulf of Alaska. Hakamada and Matsuoka (2014) provided North Pacific sighting data for sei whales collected during surveys from 2010 to 2012 that included areas within the Gulf of Alaska, including a portion of

the Navy's Study Area. There were no sightings of sei whales in the TMAA, and all the sightings were south of 53° N latitude, far south of the Navy's Study Area. During the 2013 GOALS II survey, although sei whales were acoustically detected there were no confirmed visual sightings of sei whale (Rone et al. 2014). Sei whale occurrence in the Study Area during the summer time period is considered rare.

3.8.2.11 Minke Whale (*Balaenoptera acutorostrata*)

3.8.2.11.1 Status and Management

The minke whale is protected under the MMPA and is not listed under the ESA. "Resident" minke whales from California to Washington appear behaviorally distinct from migratory whales farther north, so based on this distinction NMFS recognizes two minke whale stocks: (1) a California, Oregon, and Washington stock; and (2) an Alaska stock (Allen and Angliss 2014; Carretta et al. 2014). Animals from the Alaska stock are those that are expected to occur in the Study Area.

3.8.2.11.2 Abundance

Abundance estimates are not available for the Alaska stock of minke whales because only portions of the stock's range have been surveyed (Allen and Angliss 2014). Data collected during line-transect surveys in shelf and nearshore waters from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands during July and August 2001, 2002, and 2003 yielded an abundance estimate of 1,233 (CV = 0.34) for this region (Zerbini et al. 2006); however, this is considered an underestimate because correction factors for animals missed along the trackline were not incorporated.

3.8.2.11.3 Distribution

Minke whales are distributed in polar, temperate, and tropical waters (Jefferson et al. 1993); they are less common in the tropics than in cooler waters. Minke whales generally occupy waters over the continental shelf, including inshore bays, and even occasionally enter estuaries. However, records from whaling catches and research surveys worldwide indicate an open ocean component to the minke whale's habitat. Minke whales are present in the North Pacific from near the equator to the Arctic (Horwood 1990). The summer range extends to the Chukchi Sea (Perrin and Brownell 2002). In the winter, minke whales are found south to within 2° of the equator (Perrin and Brownell 2002). The distribution of minke whale vocalizations (specifically, "boings") suggests that the winter breeding grounds are the offshore tropical waters of the North Pacific Ocean (Rankin and Barlow 2005).

The migration paths of the minke whale include travel between breeding and feeding grounds and have been shown to follow patterns of prey availability (Jefferson et al. 2008). In the northern part of their range, minke whales are believed to be migratory, whereas they appear to establish home ranges in the inland waters of Washington State and along central California (Dorsey 1983, Dorsey et al. 1990), and exhibit site fidelity to these areas between years (Dorsey et al. 1990).

There were a total of 72 on-effort sightings of minke whales during line-transect surveys in shelf and nearshore waters from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands during July and August 2001, 2002, and 2003 (Zerbini et al. 2006). Most of the minke whale sightings from these surveys were in the Aleutian Islands in water depths of less than 200 m (Zerbini et al. 2006). There were two on-effort minke whale sightings (three total animals) during the Navy-funded line-transect survey of the Study Area in April 2009; both sightings were in the inshore stratum (Rone et al. 2009). During a 2012 survey in summer and early fall, Matsuoka et al (2013) reported only 2 sightings of minke whales. One sighting was on the slope within the eastern Gulf of Alaska and the other offshore in the western Gulf of Alaska. During a recent (June and July 2013) Navy-funded line-transect survey in and around the

Study Area, there were three sightings of six minke whales, but only two sightings occurred within the TMAA: one in the slope stratum and one in the seamount stratum (Rone et al. 2014). Minke whales have not been detected on either of the HARPs deployed in the shelf and slope regions of the Study Area, based on recordings collected from July 2011 through February 2012 (Baumann-Pickering et al. 2012b). Minke whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.12 Gray Whale (*Eschrichtius robustus*)

3.8.2.12.1 Status and Management

There are currently two formally recognized North Pacific populations of gray whales: the Western North Pacific stock that is critically endangered and shows no apparent signs of recovery, and the Eastern North Pacific stock that appears to have recovered from exploitation and was removed from listing under the ESA in 1994 (Carretta et al. 2014, Swartz et al. 2006). Both populations (stocks) could be present in the Study Area (Carretta et al. 2014, Mate et al. 2012). The Western subpopulation, previously known as the Western North Pacific or the Korean-Okhotsk population, has recently been designated the Western North Pacific stock (Carretta et al. 2013a). All gray whale populations are protected under the MMPA; the Western North Pacific stock is listed as depleted under the MMPA and endangered under the ESA, but there is no designated critical habitat for this species.

A group of approximately 200 gray whales known as the Pacific Coast Feeding Group feeds along the Pacific coast between southeastern Alaska and Southern California throughout the summer and fall (Calambokidis et al. 2002; Carretta et al. 2014; Weller et al. 2013). The group has been identified as far north as Kodiak Island, Alaska (Gosho et al. 2011), and has generated uncertainty regarding the stock structure of the Eastern North Pacific population (Carretta et al. 2014; Weller et al. 2013). Photo-identification, telemetry, and genetic studies suggest that the Pacific Coast Feeding Group is demographically distinct from the Eastern North Pacific population (Calambokidis et al. 2010, Frasier et al. 2011, Mate et al. 2010). Currently, however, the Pacific Coast Feeding Group is not treated as a distinct stock in the NMFS Stock Assessment Reports (SARs), but this may change in the future based on new information (Carretta et al. 2014).

Gray whales began to receive protection from commercial whaling in the 1930s. However, hunting of the western population continued for many more years. The International Whaling Commission sets a quota allowing catch of gray whales annually from the eastern population for aboriginal subsistence. In 2007 the International Whaling Commission approved a 5-year quota (2008–2012) of 620 whales, with an annual maximum of 140 whales for Russian and U.S. (Makah Indian Tribe) aboriginals. Russia and the United States agreed to a shared annual harvest of 120 and 4 whales, respectively; however, all takes during this time period were from Russia (International Whaling Commission 2013). In 2013, a total of 127 gray whales were “struck” in subsistence whaling in the aboriginal harvest by Chukotka indigenous hunters from the Russian Federation (Ilyashenko & Zharikov 2014). Alaskan hunters no longer intentionally pursue gray whales, and the United States has not pursued a gray whale catch limit from the International Whaling Commission for Alaska hunters (Norberg 2013).

3.8.2.12.2 Abundance

Recent abundance estimates for the Eastern North Pacific gray whale population have ranged between 17,000 and 20,000 (Rugh et al. 2008, Swartz et al. 2006). For stock assessment purposes, NMFS currently uses an abundance estimate of 19,126 animals (CV = 0.071; Carretta et al. 2014). The eastern population has increased, despite the 1999 event in which an unusually large number of gray whales stranded along the coast from Mexico to Alaska (Gulland et al. 2005; Carretta et al. 2014).

Based on a defined range for the Pacific Coast Feeding Group of between 41°N and 52°N, the latest (2010) abundance estimate is 188 (CV = 0.10) whales (Carretta et al. 2014).

The Western North Pacific gray whale was once considered extinct but now small numbers are known to exist (Weller et al. 2002). The most recent estimate of this population is 155 individuals (95 percent confidence interval = 142 to 165 whales; International Union for Conservation of Nature 2012).

3.8.2.12.3 Distribution

The Eastern North Pacific stock of gray whales migrates along the U.S. west coast as they travel between summer arctic feeding grounds and coastal temperate and subtropical winter mating and calving grounds. Winter grounds extend from central California south along Baja California, the Gulf of California, and the mainland coast of Mexico. Beginning in the fall, whales start the southward migration from the northern summer feeding areas to the winter calving areas, mainly following the coast to Mexico. The trip averages 2 months. The northward migration to the feeding grounds occurs in two phases. The first phase in late January through March consists of newly pregnant females, who go first to maximize feeding time, followed by adult females and males, then juveniles. The second phase, in April through May, consists primarily of mothers and calves that have remained in the breeding area longer, allowing calves to strengthen and rapidly increase in size before the northward migration (Herzing and Mate 1984; Jones and Swartz 2009).

Most of the Eastern North Pacific stock summers in the shallow waters of the northern Bering Sea, Chukchi Sea, and western Beaufort Sea, but as noted above, the Pacific Coast Feeding Group feeds along the Pacific coast throughout the summer and fall (Calambokidis et al. 2002). Gray whales are found along the shore in the northern Gulf of Alaska during migrations between the breeding and feeding grounds. One group consisting of an estimated 25 gray whales was sighted off Kodiak Island (outside the TMAA) during the off-effort portion of the GOALS II survey (Rone et al. 2013). The southbound migration begins in early October, when gray whales move from the Bering Sea through the Unimak Pass and along the coast of the Gulf of Alaska (Braham 1984). The southbound migration continues into the winter season between October and January. Migration of gray whales past Kodiak Island peaks in mid-December (Rugh et al. 2001). During the northbound migration, the peak of migration in the Gulf of Alaska is in mid-April (Braham 1984). As noted above, although most gray whales migrate to the Bering Sea to feed, some Pacific Coast Feeding Group whales do not complete the migration but feed in coastal waters in the Gulf of Alaska (Gosho et al. 2011).

Most gray whales follow the coast during migration and stay within 1.2 mi. (2 kilometers [km]) of the shoreline, except when crossing major bays, straits, and inlets from southeastern Alaska to the eastern Bering Sea (Braham 1984). However, gray whales are known to move farther offshore between the entrance to Prince William Sound and Kodiak Island and between Kodiak Island and the southern part of the Alaska Peninsula (Consiglieri et al. 1982). Gray whales use the nearshore areas of the Alaska Peninsula during the spring and fall migrations and are often found within the bays and lagoons, primarily north of the peninsula, during the summer (U.S. Department of the Navy 2006). During the April 2009 survey of the Study Area, one group of two gray whales was sighted while on-effort within the Study Area (Rone et al. 2009). Outside the TMAA, there was one off-effort sighting (25 individuals) southeast of Kodiak Island during the recent (June and July 2013) GOALS II survey of the central Gulf of Alaska (Rone et al. 2014).

Gray whale calls were detected during a single hour on a single day, 29 September 2012, at the HARP deployed in the slope region of north-central Gulf of Alaska (Baumann-Pickering et al. 2012b). Since gray

whales tend to stay close to shore during their migration, the HARP deployment locations are likely too far offshore to capture more gray whale signals (Baumann-Pickering et al. 2012b). The occurrence of Eastern North Pacific gray whales in the Study Area during the summer time period is considered likely.

The migration routes of the Western North Pacific population of gray whale are poorly known (Weller et al. 2002). Previous sighting data suggested that the remaining population of gray whales in the western Pacific had a limited range extending between the Okhotsk Sea off the coast of Sakhalin Island (Russia) and the South China Sea (Weller et al. 2002). However, recent long-term studies of radio-tracked whales indicate that the coastal waters of eastern Russia, the Korean Peninsula, and Japan are part of the migratory route (Weller et al. 2012). There is also photographic evidence of a match between a whale found off Sakhalin Island and the Pacific coast of Japan, more than 932 mi. (1,500 km) south of the Sakhalin feeding area (Weller et al. 2008). Mate et al. (2012) documented movement of western Pacific gray whale from Sakhalin Island to the nearshore waters off Washington state. This whale tracked via long-term satellite tag traveled directly across the southern Gulf of Alaska via a direct path from the Aleutian Islands to Washington state. Further, photo-catalog comparisons of eastern and western North Pacific gray whale populations suggest that there is more exchange between the western and eastern populations than previously thought, since “Sakhalin” whales were sighted off Santa Barbara, California; British Columbia, Canada; and Baja California, Mexico (Weller et al. 2013). The occurrence of Western North Pacific gray whales in the Study Area during the summer time period is considered rare.

3.8.2.13 Sperm Whale (*Physeter macrocephalus*)

3.8.2.13.1 Status and Management

The sperm whale is listed as depleted under the MMPA and has been listed as endangered since 1970 under the precursor to the ESA, but there is no designated critical habitat for this species in the North Pacific. Sperm whales are managed as three stocks in the Pacific: (1) the Alaska/North Pacific stock; (2) the California, Oregon, and Washington stock; and (3) the Hawaii stock (Allen and Angliss 2014; Carretta et al. 2014). Animals from the Alaska/North Pacific stock are those that are expected to occur in the Study Area.

3.8.2.13.2 Abundance

Currently there is no reliable abundance estimate for the Alaska/North Pacific stock of sperm whales and the number of animals occurring within Alaska waters is unknown (Allen and Angliss 2014). The number of sperm whales within the eastern temperate North Pacific was estimated at 26,300 (CV = 0.81) from visual surveys and 32,100 (CV = 0.36) from acoustic detections (Barlow and Taylor 2005). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area. During the survey there were 19 on-effort sightings of sperm whales and 241 acoustic detections from the towed hydrophone array, 174 of which were localized. Based on the localized acoustic detections, the following abundance estimates were derived for sperm whales: 78 (CV = 0.36) offshore stratum, 16 (CV = 0.55) seamount stratum, and 121 (CV = 0.18) slope stratum (Rone et al. 2014). There were no sperm whale sightings or acoustic detections within the inshore stratum, and 18 of the 19 sperm whale sightings occurred within the slope stratum (Rone et al. 2014).

3.8.2.13.3 Distribution

In the North Pacific, sperm whales appear to be nomadic, showing widespread movements between areas of concentration, and this suggests there are no divisions that would represent separate stocks

(Mizroch and Rice 2013). Male sperm whales are found from tropical to polar waters in all oceans of the world, between approximately 70°N and 70°S (Rice 1998). The female distribution is more limited and corresponds approximately to the 40° parallels but extends to 50° in the North Pacific (Whitehead 2003). Sperm whales are somewhat migratory. General shifts occur during summer months for feeding and breeding, while in some tropical areas, sperm whales appear to be largely resident (Whitehead 2003, Whitehead et al. 2008). Pods of females with calves remain on breeding grounds throughout the year, between 40°N and 45°N (Rice 1989, Whitehead 2003), while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Pierce et al. 2007). In the northern hemisphere, "bachelor" groups (males typically 15–21 years old and bulls [males] not taking part in reproduction) generally leave warm waters at the beginning of summer and migrate to feeding grounds that may extend as far north as the perimeter of the arctic zone. In fall and winter, most return south, although some may remain in the colder northern waters during most of the year (Pierce et al. 2007). Sperm whales show a strong preference for deep waters (Rice 1989, Whitehead 2003). Off the U.S. west coast, their distribution is typically associated with waters over the continental shelf break, over the continental slope, and into deeper waters (Becker et al. 2012b, Forney et al. 2012). This was also the case in the 2014 GOALS II survey during which 18 of 19 sperm whale sightings occurred within the slope stratum (Rone et al. 2014).

Summer surveys between 2001 and 2010 in the coastal waters around the central and western Aleutian Islands have found sperm whales to be the most frequently sighted large cetacean (Allen and Angliss 2014). Acoustic surveys have detected the presence of sperm whales year-round in the Gulf of Alaska, although about twice as many are present in summer as in winter (Mellinger et al. 2004a, Moore et al. 2006). Sperm whale echolocation clicks were detected by two HARPs deployed in the shelf and slope region of north-central Gulf of Alaska in July 2011; however, there were much higher detection rates at the deeper site (Baumann-Pickering et al. 2012b). In contrast to the findings of Mellinger et al. (2004a), Baumann-Pickering et al. (2012b) found high numbers of sperm whale detections in November and December, with a drop off to low numbers of detections throughout January and February. During the April 2009 survey of the Study Area, there were no sperm whale sightings, but they were acoustically detected on 28 different occasions (Rone et al. 2009). During a 2012 survey in summer and early fall, Matsuoka et al (2013) reported 50 sightings of 57 individual sperm whales. All sightings were of large male sperm whales and distributed on the shelf and offshore waters of the Gulf of Alaska and adjacent areas of the eastern North Pacific. As noted above, during the 2013 GOALS II survey there were 19 sightings of sperm whales totaling 22 individuals and sperm whales were acoustically detected from the towed hydrophone array on 241 occasions (Rone et al. 2014). Sperm whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.14 Killer Whale (*Orcinus orca*)

A single species of killer whale is currently recognized, but strong and increasing evidence indicates the possibility of several different species of killer whales worldwide, many of which are called "ecotypes" (Ford 2008, Morin et al. 2010, Pilot et al. 2009). The different geographic forms of killer whale are distinguished by distinct social and foraging behaviors and other ecological traits (Morin et al. 2010). In the North Pacific, these recognizable geographic forms are variously known as "residents," "transients," and "offshore" ecotypes (Hoelzel et al. 2007).

3.8.2.14.1 Status and Management

The killer whale is protected under the MMPA, and the overall species is not listed on the ESA. The Eastern North Pacific Southern Resident population is listed as depleted under the MMPA and as

endangered under the ESA. The AT1 Transient stock of killer whales is also designated as depleted under the MMPA but is not listed under the ESA; this stock's current abundance estimate is seven animals (Allen and Angliss 2014), and extinction appears likely for this population (Matkin et al. 2012). Eight killer whale stocks are recognized within the Pacific U.S. EEZ, including (1) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock (Prince William Sound through the Aleutian Islands and Bering Sea); (2) the AT1 Transient stock (Alaska from Prince William Sound through the Kenai Fjords); (3) the Alaska resident stock (southeastern Alaska to the Aleutian Islands and Bering Sea); (4) the Northern Resident stock (Washington state through part of southeastern Alaska); (5) the West Coast Transient stock (California through southeastern Alaska); (6) the Eastern North Pacific Offshore stock (California to Alaska); (7) the Southern Resident stock (mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from Southeast Alaska through California); and (8) the Hawaii stock (Allen and Angliss 2014, Carretta et al. 2014). Killer whales most likely to occur in the Study Area based on dominant distribution patterns include the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock and the Alaska Resident stock; while whales from the AT1 Transient stock and the Eastern North Pacific Offshore stock could also occur in the Study Area, occurrence is considered rare and infrequent, respectively.

3.8.2.14.2 Abundance

The current best available abundance estimates for the four killer whale stocks that occur or rarely occur in the Study Area are as follows: Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock = 587 animals; the AT1 Transient stock = 7 animals; Alaska Resident stock = 2,347 animals (Allen and Angliss 2014); and the Eastern North Pacific Offshore stock = 211 animals (Carretta et al. 2014). The estimate for the Eastern North Pacific Offshore stock reflects the number of offshore killer whales that occur along the U.S. west coast, Canada, and Alaska; since this is a trans-boundary stock, an abundance estimate specific to Alaska waters is not available (Carretta et al. 2014).

Line-transect surveys conducted in coastal waters of the Gulf of Alaska and Aleutian Islands in July and August 2001, 2002, and 2003 yielded a total of 41 on-effort sightings of killer whales (Zerbini et al. 2007). Sighting data from these surveys were used to derive abundance estimates for the different killer whale ecotypes. The abundance estimate for resident killer whales was 991 (CV = 0.52) and for transients was 200 (CV = 0.48). There were insufficient data (a total of two sightings) to estimate abundance for the offshore ecotype (Zerbini et al. 2007). These estimates were based on ecotype and were not necessarily directly applicable to the different stocks occurring in the Study Area, since ecotype estimates could include members from different stocks (e.g., as noted above, at least four different stocks of transient killer whales may occur in the Study Area during the summer time period). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area, and resulted in the following abundance estimates for killer whales: 117 (CV = 0.60) inshore stratum, 107 (CV = 0.77) seamount stratum, and 726 (CV = 1.93) slope stratum (Rone et al. 2014).

3.8.2.14.3 Distribution

Killer whales are found in all marine habitats from the coastal zone (including most bays and inshore channels) to deep oceanic basins and from equatorial regions to the polar pack ice zones of both hemispheres. Although killer whales are also found in tropical waters and the open ocean, they are most numerous in coastal waters and at higher latitudes (Dahlheim and Heyning 1999, Forney and Wade 2006). Killer whales are known to inhabit both the western and eastern temperate Pacific and likely have a continuous distribution across the North Pacific (Steiger et al. 2008). In most areas of their range,

killer whales do not show movement patterns that would be classified as traditional migrations. However, there are often seasonal shifts in density, both onshore/offshore and north/south.

Sightings of killer whales are widely distributed, mostly occurring in waters over the continental shelf, but also quite frequently in offshore waters. Based on sightings, strandings, and acoustic detections, all three killer whale ecotypes (residents, transients, and offshore) are known to occur in the Gulf of Alaska (Barbieri et al. 2013, Dahlheim et al. 2008, Forney and Wade 2006, Zerbini et al. 2007). Individuals belonging to the Alaska Resident stock and the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock are the killer whales most likely to occur in the Study Area (Allen and Angliss 2014). The range of the Alaska Resident stock extends across the Gulf of Alaska from Southeast Alaska to the Aleutian Islands, and into the Bering Sea. In 2011 and 2012, Andrews and Matkin (2014) deployed satellite tags on 6 Alaska Resident killer whales and found mean travel distances exceeded 80 km per day, with movements offshore as far as 160 km and as far as 570 km from the tagging site. This correlates with the findings of Fearnbach et al. (2013), who took a 10-year dataset of 3,058 whale photoidentifications from 331 encounters in Alaska waters demonstrating a median distance between repeated encounters of approximately 197 km with a maximum of 1,443 km. The Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock has a range that includes all of the U.S. EEZ in Alaska, although sightings in Southeast Alaska are uncommon (Allen and Angliss 2014).

AT1 transients are seen primarily in Prince William Sound and in the Kenai Fjords region, and given their limited numbers and more limited distribution, are less likely to occur in the Study Area (Matkin et al. 2012). Eastern North Pacific Offshore killer whales are most commonly sighted off the coasts of California and Oregon, and less frequently in Southeast Alaska (Carretta et al. 2014), but have been identified in the western Gulf of Alaska near Kodiak Island (Dahlheim et al. 2008, Zerbini et al. 2007). Based on sightings of killer whales along the U.S. west coast and Alaska from 1976 to 2006, only 59 sightings of offshore killer whales have been documented, and of these, 40 have occurred off California (Dahlheim et al. 2008).

During the April 2009 survey of the Study Area, six groups of killer whales totaling 119 animals were sighted, and there were an additional 16 acoustic detections (Rone et al. 2009). During a 2012 survey in summer and early fall, Matsuoka et al. (2013) reported only 17 sightings of 99 killer whales although ecotype was unknown. Sightings were made on the near shore shelf, within the TMAA, and in the very southern part of the Gulf of Alaska south through the eastern North Pacific. Killer whales were detected at both HARPs deployed in the shelf and slope region of north-central Gulf of Alaska (Baumann-Pickering et al. 2012b). Based on the analysis of recordings from July 2011 through early January 2012, peak presence was during mid-July and mid-August, with sporadic detections during the rest of the recording period. Initial evaluation indicates that the burst pulses and whistles most likely were generated from the resident ecotype, but further investigation is required for confirmation (Baumann-Pickering et al. 2012b). Killer whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.14.4 Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*)

3.8.2.14.5 Status and Management

The Pacific white-sided dolphin is protected under the MMPA and is not listed under the ESA. NMFS divides Pacific white-sided dolphin management stocks within the U.S. Pacific EEZ into two discrete areas: (1) the Alaska/North Pacific stock; and (2) the California, Oregon, and Washington stock (Allen and Angliss 2014, Carretta et al. 2014). Morphological studies and genetic analyses suggest the existence of several populations of Pacific white-sided dolphins throughout their range (Hayano et al. 2004, Lux et al. 1997). Four populations have been suggested: (1) in the offshore waters of Baja California, (2) in the

offshore waters of California to Oregon, (3) offshore of British Columbia and Alaska, and (4) in the offshore waters west of 160°W (Hayano et al. 2004). However, the population boundaries are dynamic, and there is no reliable way to distinguish animals in the field. Thus, populations occurring in the U.S. Pacific EEZ are managed by NMFS as the two stocks noted above. Animals from the Alaska/North Pacific stock are those that are expected to occur in the Study Area.

3.8.2.14.6 Abundance

There is currently no reliable population estimate for the Alaska/North Pacific stock of Pacific white-sided dolphins (Allen and Angliss 2014). However, based on sighting data collected from surveys north of 45°N from 1987 to 1990, an abundance estimate specific to the Gulf of Alaska is 26,880 animals (Allen and Angliss 2014). There were no Pacific white-sided dolphin sightings during a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA (Rone et al. 2014).

3.8.2.14.7 Distribution

The Pacific white-sided dolphin is found in cold temperate waters across the northern rim of the Pacific Ocean (Jefferson et al. 2008, Reeves et al. 2002). It is typically found in deep waters along the continental margins and outer shelf and slope waters. It is also known to inhabit inshore regions of southeast Alaska, British Columbia, and Washington, and occurs seasonally off Southern California (Brownell et al. 1999, Forney and Barlow 1998).

Pacific white-sided dolphins occur regularly year-round throughout the Gulf of Alaska, with peak abundance between July and August (U.S. Department of the Navy 2006). Cetacean surveys near Kenai Peninsula, within Prince William Sound and around Kodiak Island in summer 2003, reported sighting two large groups (an average group size of 56) just off Kenai Peninsula (Waite 2003). During the April 2009 survey of the Study Area, Pacific white-sided dolphins were sighted only once (a group of 60 individuals), although the location of the sighting was outside the Study Area and inside the shelf break to the southeast of Kodiak Island (Rone et al. 2009). Pacific white-sided dolphin clicks were not detected during passive acoustic monitoring from two HARPs deployed in the shelf and slope region of north-central Gulf of Alaska from July 2011 to January 2012 (Baumann-Pickering et al. 2012b). There were no Pacific white-sided dolphin sightings during a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA (Rone et al. 2014). Pacific white-sided dolphin occurrence in the Study Area during the summer time period is considered likely.

3.8.2.15 Harbor Porpoise (*Phocoena phocoena*)

3.8.2.15.1 Status and Management

The harbor porpoise is protected under the MMPA and is not listed under the ESA. Based on genetic differences and discontinuities identified from aerial surveys for populations off California, Oregon, and Washington, and based on somewhat arbitrary boundaries for Alaska populations, nine separate stocks are recognized within U.S. Pacific EEZ waters, six off the U.S. west coast (Carretta et al. 2014) and three off Alaska: (1) a Bering Sea stock, occurring throughout the Aleutian Islands and waters north of Unimak Pass; (2) a Gulf of Alaska stock, occurring from Cape Suckling to Unimak Pass; and (3) a Southeast Alaska stock, occurring from the northern border of British Columbia to Cape Suckling (Allen and Angliss 2014). Harbor porpoise from both the Gulf of Alaska and Southeast Alaska stocks may occur in the Study Area. For the Gulf of Alaska stock, the estimated minimum annual mortality rate incidental to U. S. commercial fisheries is 71.4 harbor porpoises (Allen and Angliss 2014).

3.8.2.15.2 Abundance

The most recent abundance estimates for harbor porpoise stocks that may occur in the Study Area are as follows: Gulf of Alaska stock = 31,046 individuals (CV = 0.21) and Southeast Alaska stock = 11,146 individuals (CV = 0.24; Allen and Angliss 2014). These estimates were derived from aerial survey data collected in summer 1997 in Southeast Alaska and 1998 in the Gulf of Alaska and include correction factors for both perception and availability bias (Hobbs and Waite 2010).

3.8.2.15.3 Distribution

Harbor porpoise are generally found in cool temperate to subarctic waters over the continental shelf in both the North Atlantic and North Pacific (Read 1999). In the eastern North Pacific, harbor porpoise are found in nearshore coastal (generally within a mile or two of shore) and inland waters from Alaska south to Point Conception, California, which is considered the southern extent of this species' normal range (Carretta et al. 2009, Dohl et al. 1983, Hamilton et al. 2009, Hobbs and Waite 2010).

In Alaskan waters, harbor porpoises inhabit nearshore areas and are common in bays, estuaries, and tidal channels. Harbor porpoises are often found in coastal waters in the Gulf of Alaska and occur most frequently in waters less than 328 ft. (100 m) deep (Hobbs and Waite 2010). The majority of the Study Area is offshore and beyond the normal habitat range for harbor porpoise. During the April 2009 survey of the Study Area, there were 30 harbor porpoise sightings (a total of 89 individuals); however, only one of the sightings was within the Study Area and in one of the shallowest regions (Rone et al. 2009). The remaining sightings were in shallow waters south of Kodiak Island and the Alaska Peninsula. During the recent (June and July 2013) survey of the Study Area, there were a total of eight harbor porpoise sightings in the inshore stratum and on the shelf in the slope stratum (Rone et al. 2014). Harbor porpoise occurrence in the nearshore areas of the Study Area during the summer time period is considered likely.

3.8.2.16 Dall's Porpoise (*Phocoenoides dalli*)

3.8.2.16.1 Status and Management

Dall's porpoise is protected under the MMPA and is not listed under the ESA. Dall's porpoise is managed by NMFS within U.S. Pacific EEZ waters as two stocks: (1) an Alaska stock; and (2) a California, Oregon, and Washington stock (Allen and Angliss 2014, Carretta et al. 2014). Dall's porpoise from the Alaska stock occur in the Study Area.

3.8.2.16.2 Abundance

Dall's porpoises are very abundant, probably one of the most abundant small cetaceans in the cooler waters of the North Pacific Ocean. However, population structure within North American waters has not been well studied. The estimate for the Alaska stock of Dall's porpoise reported in the 2011 Stock Assessment Report was 83,400 animals (CV = 0.97), corrected for vessel attraction behavior (Allen and Angliss 2012). This estimate is now considered unreliable since it is based on survey data that are more than 21 years old (Allen and Angliss 2014). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area, and resulted in the following abundance estimates for Dall's porpoise: 4,873 (CV = 0.50) inshore stratum, 1,658 (CV = 0.52) offshore stratum, 486 (CV = 0.41) seamount stratum, and 4,907 (CV = 0.36) slope stratum (Rone et al. 2014).

3.8.2.16.3 Distribution

Dall's porpoise is one of the most common odontocete species in North Pacific waters (Calambokidis and Barlow 2004, Ferrero and Walker 1999, Jefferson 1991, Williams and Thomas 2007, Zagzebski et al. 2006). Dall's porpoise is found from northern Baja California, Mexico, north to the northern Bering Sea and south to southern Japan (Jefferson et al. 1993). However, the species is only common between 32°N and 62°N in the eastern North Pacific (Houck and Jefferson 1999, Morejohn 1979). Dall's porpoise are found in outer continental shelf, slope, and oceanic waters, typically in temperatures less than 63°F (17°C) (Becker et al. 2012b, Forney et al. 2012, Houck and Jefferson 1999, Jefferson et al. 2008, Reeves et al. 2002).

Fiscus et al. (1976a) suggested that Dall's porpoise was probably the most common cetacean from the northeast Gulf of Alaska to Kodiak Island. During an August 1994 line-transect survey south of the Aleutian Islands, there were 151 sightings of Dall's porpoise, comprising 59 percent of all cetacean sightings (Forney and Brownell 1996). The region covered by this survey abuts the Study Area, extending between Kodiak Island to the west and covering waters over the continental shelf, the Aleutian Trench, and the northern portion of the abyssal plains of the Gulf of Alaska. Dall's porpoise sightings were widespread across this survey region, occurring in all water depths (Forney and Brownell 1996).

A large-scale, inter-disciplinary monitoring program for the North Pacific Ocean and the southern Bering Sea, conducted seasonally from June 2002 through October 2004, included surveys of marine birds and mammals. The cruises followed a survey track from British Columbia, Canada to Hokkaido, Japan, crossing the Gulf of Alaska between roughly 51°N and 55°N (Sydeman et al. 2004). On six separate crossings, covering all seasons, Dall's porpoise was the most frequently sighted marine mammal, accounting for 48 to 76 percent of the sightings on each cruise, and occurring in waters of all depths (Sydeman et al. 2004).

During the April 2009 survey in the Study Area, 10 groups of Dall's porpoise were sighted, totaling 59 individuals in both inshore and offshore strata (Rone et al. 2009). During a 2012 survey in summer and early fall (Matsuoka et al 2013), Dall's porpoise was the most commonly seen dolphin/porpoise species with 132 sightings of 636 individual. Sightings occurred throughout their survey area and included shelf and offshore water within and adjacent to the Gulf of Alaska. During the 2013 GOALS II survey, there were 320 on-effort sightings of Dall's porpoise totaling 859 individuals (Rone et al. 2014). Unidentified porpoise echolocation clicks, likely Dall's porpoise, were detected at the HARP deployed in the shelf region of north-central Gulf of Alaska (Baumann-Pickering et al. 2012b). The clicks were detected in low numbers from the start of deployment in mid-July 2011 through August 2011. There was a gap in detections until October 2011, when clicks were detected in high numbers, with decreased detections in early November 2011 followed by another gap through early February 2012 (Baumann-Pickering et al. 2012b). Seasonal movements of Dall's porpoise in the Gulf of Alaska are largely unknown. Dall's porpoise occurrence in the Study Area during the summer time period is considered likely.

3.8.2.17 Cuvier's Beaked Whale (*Ziphius cavirostris*)

3.8.2.17.1 Status and Management

Cuvier's beaked whale is protected under the MMPA and is not listed under the ESA. Cuvier's beaked whale is managed by NMFS within U.S. Pacific EEZ waters as three stocks: (1) an Alaska stock; (2) a California, Oregon, and Washington stock; and (3) a Hawaii stock (Allen and Angliss 2014, Carretta et al. 2014). Cuvier's beaked whales in the Study Area are assumed to be from the Alaska stock.

3.8.2.17.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Cuvier's beaked whale (Allen and Angliss 2014).

3.8.2.17.3 Distribution

Cuvier's beaked whales have an extensive range that includes all oceans, from the tropics to the polar waters of both hemispheres (Barlow and Gisner 2006, Ferguson et al. 2006b, Jefferson et al. 2008, Pitman et al. 1988). A single population likely exists in offshore waters of the eastern North Pacific, ranging from Alaska south to Mexico, and there are no apparent seasonal changes in distribution (Carretta et al. 2014, Mead 1989, Pitman et al. 1988). Little is known about potential migration. Repeated sightings of the same individuals have been reported off San Clemente Island in Southern California, which indicates some level of site fidelity (Falcone et al. 2009).

Worldwide, beaked whales normally inhabit continental slope and deep oceanic waters. Cuvier's beaked whales are generally sighted in waters with a bottom depth greater than 656 ft. (200 m) and are frequently recorded in waters with bottom depths greater than 3,280 ft. (1,000 m) (Falcone et al. 2009, Jefferson et al. 2008). In the North Pacific, Cuvier's beaked whales range from Canadian waters north to the northern Gulf of Alaska, the Aleutian Islands, and the Commander Islands off Russia (Rice 1998). Rice and Wolman (1982) observed a group of six Cuvier's beaked whales in deep waters of approximately 17,716 ft. (5,400 m) southeast of Kodiak Island. During surveys off the Aleutian Islands in August 1994, Forney and Brownell (1996) made one sighting of Cuvier's beaked whale in waters with a bottom depth of 13,123–16,404 ft. (4,000–5,000 m). Waite (2003) reported one sighting of a group of four Cuvier's beaked whales at the shelf break within the Study Area.

There were no beaked whales detected acoustically or visually during the April 2009 survey of the Study Area (Rone et al. 2009). Cuvier's beaked whales were detected only three times during passive acoustic monitoring from the HARP deployed in the slope region of north-central Gulf of Alaska from July 2011 to February 2012 (Baumann-Pickering et al. 2012b). Acoustic detections were made in October 2011 and January and February 2012. All detections were made at the passive acoustic recording site deployed in the slope region, consistent with this species apparent preference for deep waters (Baumann-Pickering et al. 2012b). During the recent (June and July 2013) survey of the Study Area, one individual Cuvier's beaked whale was identified in the offshore stratum, although there were five additional unidentified sightings of beaked whales (Rone et al. 2014). Cuvier's beaked whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.18 Baird's Beaked Whale (*Berardius bairdii*)

3.8.2.18.1 Status and Management

Baird's beaked whale is protected under the MMPA and is not listed under the ESA. Baird's beaked whale is managed within Pacific U.S. EEZ waters as two stocks: (1) an Alaska stock; and (2) a California, Oregon, and Washington stock (Allen and Angliss 2014; Carretta et al. 2014). Baird's beaked whales in the Study Area are assumed to be from the Alaska stock.

3.8.2.18.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Baird's beaked whale (Allen and Angliss 2014).

3.8.2.18.3 Distribution

Baird's beaked whale occurs mainly in deep waters over the continental slope, near oceanic seamounts, and areas with submarine escarpments, although they may be seen close to shore where deep water approaches the coast (Jefferson et al. 2008, Kasuya 2009). This species is generally found throughout the colder waters of the North Pacific, ranging from off Baja California, Mexico, to the Aleutian Islands of Alaska (Jefferson et al. 2008, MacLeod and D'Amico 2006). In the North Pacific, the range of Baird's beaked whale extends from Cape Navarin (62°N) and the central Sea of Okhotsk (57°N) to St. Matthew Island, the Pribilof Islands in the Bering Sea, and the northern Gulf of Alaska (Allen and Angliss 2014, Kasuya 2009, Rice 1998).

During surveys off the Aleutian Islands in August 1994, Forney and Brownell (1996) made one sighting of Baird's beaked whale, in waters with a bottom depth of 13,123–16,404 ft. (4,000–5,000 m). Waite (2003) reported a group of four Baird's beaked whales at the shelf break to the east of the Study Area. There were no beaked whales detected acoustically or visually during the April 2009 survey of the Study Area (Rone et al. 2009). Baird's beaked whales were detected regularly from September through February during passive acoustic monitoring from the HARP deployed in the slope region of north-central Gulf of Alaska from July 2011 to February 2012 (Baumann-Pickering et al. 2012b). Higher numbers of detections occurred during November 2011–January 2012. Acoustic detections were not made at the passive acoustic recording site deployed in the shelf region, consistent with this species apparent preference for deep waters (Baumann-Pickering et al. 2012b). During the recent (June and July 2013) survey of the Study Area, there were six on-effort Baird's beaked whale sightings of 49 individuals (Rone et al. 2014). Baird's beaked whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.19 Stejneger's Beaked Whale (*Mesoplodon stejnegeri*)

3.8.2.19.1 Status and Management

Stejneger's beaked whale is protected under the MMPA but is not listed under the ESA. In the Study Area, Stejneger's beaked whales are recognized as an Alaska stock (Allen and Angliss 2014; Carretta et al. 2014).

3.8.2.19.2 Abundance

There is currently no reliable abundance estimate for the Alaska stock of Stejneger's beaked whale (Allen and Angliss 2014).

3.8.2.19.3 Distribution

Worldwide, beaked whales normally inhabit continental slope and deep oceanic waters (greater than 656 ft. [200 m]) (Canadas et al. 2002, Ferguson et al. 2006b, MacLeod and Mitchell 2006, Pitman 2008, Waring et al. 2001). They are occasionally reported in waters over the continental shelf (Pitman and Stinchcomb 2002). Stejneger's beaked whale appears to prefer cold temperate and subpolar waters (Loughlin and Perez 1985, MacLeod et al. 2006a). This species has been observed in waters ranging in depth from 2,395 to 5,120 ft. (730 to 1,560 m) on the steep slope of the continental shelf (Loughlin and Perez 1985). The farthest south this species has been recorded in the eastern Pacific is Cardiff, California (33°N), but this is considered an extralimital occurrence (Loughlin and Perez 1985, MacLeod et al. 2006a, Mead 1989).

Stejneger's beaked whales were detected almost continually during passive acoustic monitoring from the HARP deployed in the slope region of north-central Gulf of Alaska from July 2011 to February 2012

(Baumann-Pickering et al. 2012b, 2014). More acoustic detections of Stejneger's beaked whales occurred in late September and early October 2012, although the current data are not yet sufficient to demonstrate true seasonality (Baumann-Pickering et al. 2014). Acoustic detections were not made at the passive acoustic recording site deployed in the shelf region, consistent with this species apparent preference for deep waters (Baumann-Pickering et al. 2012b). No Stejneger's beaked whales were identified during the recent (June and July 2013) survey of the Study Area, although five unidentified beaked whale sightings were reported (Rone et al. 2014). Stejneger's beaked whale occurrence in the Study Area during the summer time period is considered likely.

3.8.2.20 Steller Sea Lion (*Eumetopias jubatus*)

3.8.2.20.1 Status and Management

In the North Pacific, NMFS has designated two Steller sea lion stocks corresponding to two Distinct Population Segments (DPS) having the same names as the stocks: (1) the Western U.S. stock/DPS, consisting of populations at and west of Cape Suckling, Alaska (144°W); and (2) the Eastern U.S. stock/DPS, consisting of populations east of Cape Suckling, Alaska. Both stocks of Steller sea lions occur within the Study Area (Jemison et al. 2013). The Western U.S. stock/DPS of Steller sea lions is listed as depleted under the MMPA and endangered under the ESA. The Eastern U.S. stock/DPS of Steller sea lions is listed as depleted under the MMPA. In October 2013, NMFS removed the eastern distinct population segment (the Eastern U.S. stock) of Steller sea lion from the List of Endangered and Threatened Wildlife because they had met the recovery criteria (National Oceanic and Atmospheric Administration 2013a). There is "strong evidence" that western stock females have permanently emigrated to the East of 144°W as well as evidence of males mixing between the two stocks and making long-distance movements (Jemison et al. 2013; see also Allen and Angliss 2014 regarding unpublished data documenting mixing of these stocks).

For Alaskan waters, critical habitat has been defined for Steller sea lions in the Aleutian Islands and Western Alaska. At this time, there has been no change in the designation of critical habitat despite the recent delisting of the Eastern U.S. DPS (National Oceanic and Atmospheric Administration 2013a). There is no Steller sea lion critical habitat present in the Study Area (Figure 3.8-2); as a conservation measure, the TMAA boundary was specifically drawn to exclude any nearby critical habitat and associated terrestrial, air, or aquatic zones.

For the Western U.S. stock, the minimum estimated mortality rate incidental to U. S. commercial fisheries is 29.6 sea lions per year, and the mean annual subsistence harvest is estimated at 199 Steller sea lions per year (Allen and Angliss 2014). For the Eastern U.S. stock, the minimum estimated mortality rate incidental to U. S. and Canadian commercial fisheries is 49 sea lions per year, and the mean annual subsistence harvest is estimated at 12 Steller sea lions per year (Allen and Angliss 2014).

3.8.2.20.2 Abundance

The most recent comprehensive estimate (pups and non-pups) of abundance of the western stock of Steller sea lions in Alaska is based on aerial surveys of non-pups conducted in June–July 2008–2011 and aerial and ground-based pup counts conducted in June–July 2009–2011 (Allen and Angliss 2014).

The combination of the survey results yielded a minimum abundance estimate of 45, 659 Steller sea lions, an increase from the minimum estimate of 38,988 individuals reported in the 2009 GOA Final EIS/OEIS (as reported in the 2008 Stock Assessment Report; Angliss and Allen 2009).

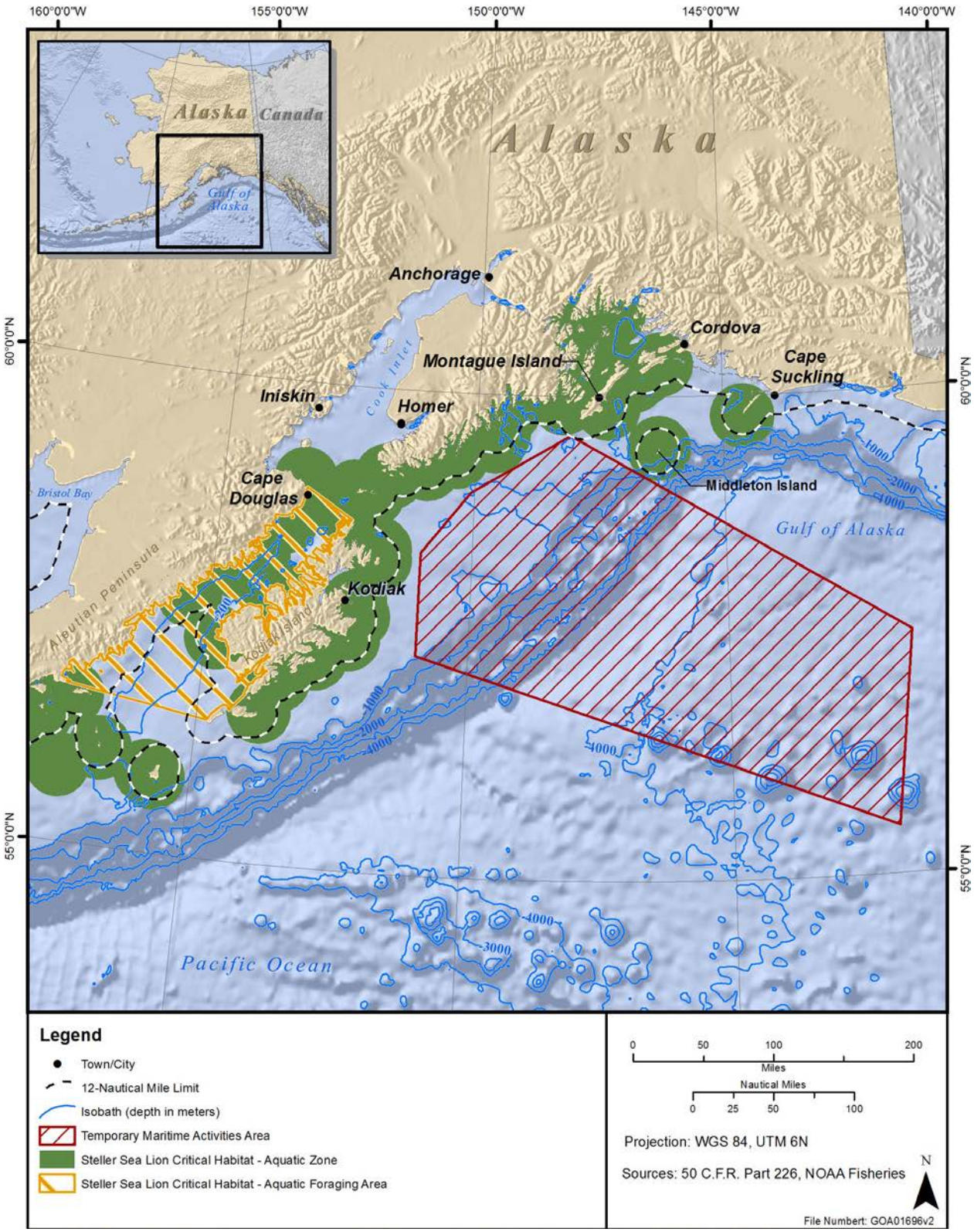

Figure 3.8-2: Steller Sea Lion Western Distinct Population Segment Critical Habitat in the Vicinity of the Temporary Maritime Activities Area

The most recent minimum population estimate of abundance of the eastern stock of Steller sea lions is 57,966 individuals (Allen and Angliss 2014), with approximately half of the individuals being reported at southeast Alaska trend sites (the rest being counted at trend sites in British Columbia, Washington, Oregon, and California). Counts of Steller sea lion pups from 2005 to 2011 indicate an upward trend in number of pups counted, with 9,950 pups reported in 2005 and 11,547 pups counted in 2011 (DeMaster 2011). Between 1979 and 2009, the Eastern DPS increased at a rate of approximately 4.18 percent per year (NOAA 2013a).

3.8.2.20.3 Distribution

Given the wide dispersal of individuals, both the western DPS and eastern DPS may occur in the Study Area (Allen and Angliss 2014). Steller sea lions do not migrate, but they often disperse widely outside of the breeding season. An area of high occurrence extends from the shore to water depths of 273 fathoms (500 m). In the Gulf of Alaska, foraging habitat is primarily shallow, nearshore, and continental shelf waters 4.3–13 nm offshore with a secondary occurrence inshore of the 3,280 ft. (1,000 m) isobath, and a rare occurrence seaward of the 3,280 ft. (1,000 m) isobath. Six groups of Steller sea lions, which totaled 28 individuals, were sighted during the April 2009 survey of the Study Area, in both the inshore and offshore strata (Rone et al. 2009). No Steller sea lions were identified during the recent (June and July 2013) survey of the Study Area, although there were six sightings of unidentified pinnipeds (Rone et al. 2014). Steller sea lion occurrence in the Study Area during the summer time period is considered likely.

3.8.2.21 California Sea Lion (*Zalophus californianus*)

3.8.2.21.1 Status and Management

The California sea lion is protected under the MMPA and is not listed under the ESA. In the North Pacific, NMFS recognizes a single California sea lion stock, the U.S. stock (Carretta et al. 2014).

3.8.2.21.2 Abundance

The estimated abundance of the U.S. stock of California sea lions is 296,750 individuals (Carretta et al. 2014). This number is from counts of animals that were ashore at the four major rookeries in Southern California and at haulout sites north to the Oregon-California border during the 2008 breeding season. Sea lions that were at sea or were hauled out at other locations were not counted. The general trend for this stock is that the population is growing (Carretta et al. 2014).

Sighting data collected during the Navy-funded line-transect survey of the Study Area in April 2009 did not include any confirmed sightings of California sea lions, although four unidentified pinnipeds were reported (Rone et al. 2009). No California sea lions were identified during the recent (June and July 2013) survey of the Study Area, although there were six sightings of unidentified pinnipeds (Rone et al. 2014).

3.8.2.21.3 Distribution

The primary rookeries for California sea lions are located on the California Channel Islands, far to the south of the Study Area. California sea lions appear to be extending their feeding range farther north, and increasing numbers of sightings are recorded in Alaskan waters (Maniscalco et al. 2004), which are positively correlated with the growth of the California sea lion population.

California sea lions have been sighted throughout Alaska from Forrester Island in southeast Alaska to St. Matthews Bay, Prince William Sound, and St. Paul Island in the Bering Sea. Both male and female California sea lions have been observed as far north as the Pribilof Islands in the Bering Sea (Maniscalco

2002, U.S. Department of the Navy 2006). The few California sea lions recorded in Alaska usually are observed at Steller sea lion rookeries and haulout sites, with most sightings recorded between March and May, although they may be found in the Gulf of Alaska throughout the year (Maniscalco et al. 2004; U.S. Department of the Navy 2006). However, between 1973 and 2003, only 52 sightings of California sea lions were reported (Maniscalco et al. 2004). California sea lion occurrence in the Study Area during the summer time period is considered rare.

3.8.2.22 Northern Fur Seal (*Callorhinus ursinus*)

3.8.2.22.1 Status and Management

NMFS has identified two stocks of northern fur seals based on high natal site fidelity, as well as substantial differences in population dynamics between Pribilof Islands (located in the Bering Sea) and San Miguel Island (Mexico) populations. Animals from the Pribilof Islands are recognized as the Eastern Pacific stock, and those from San Miguel Island are the San Miguel Island stock (Allen and Angliss 2014; Carretta et al. 2014). The Eastern Pacific stock of northern fur seals is listed as depleted under the MMPA and not listed under the ESA. The San Miguel Island stock of northern fur seals is not listed as depleted under the MMPA and not listed under the ESA. Animals from Eastern Pacific stock are the only ones that may occur in the Study Area during the summer time period.

Between 2007 and 2011, there was an annual average of 496 northern fur seals harvested per year in the subsistence harvest, and an estimated minimum annual mortality rate of 4.6 fur seals per year incidental to commercial fisheries (Allen and Angliss 2014).

3.8.2.22.2 Abundance

The Eastern Pacific stock of northern fur seals includes the Pribilof Island breeding group in the Bering Sea. The most recent population estimate for this stock based on pup counts on Bogoslof Island, on Sea Lion Rock, and on St. Paul and St. George Islands, is 639,545 individuals (Allen and Angliss 2014). During a recent (June and July 2013) Navy-funded line-transect survey in and around the TMAA, sighting data were collected from four survey strata designed to sample the diverse habitat present in the Study Area, and resulted in the following abundance estimates for northern fur seals: 345 (CV = 0.28) inshore stratum, 1,013 (CV = 0.35) offshore stratum, 256 (CV = 0.31) seamount stratum, and 156 (CV = 0.39) slope stratum (Rone et al. 2014).

The most recent (2011) population estimate for the San Miguel Island stock of northern fur seals is 12,368 individuals (Carretta et al. 2014). It is unlikely that individuals of the San Miguel Island stock of northern fur seals would be present in the Study Area.

3.8.2.22.3 Distribution

Northern fur seals occur from Southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (Carretta et al. 2014). They are a coldwater species, and when at sea they are usually sighted in foraging areas along the continental shelf and slope and 38–70 nm from land (Kajimura 1984). The Eastern Pacific stock spends May–November in northern waters and at northern breeding colonies (north of the Gulf of Alaska). There are no rookeries or haulout sites in the vicinity of the Study Area. In late November, females and young begin to arrive in offshore waters of California, with some animals moving south into continental shelf and slope waters. Adult males from the Eastern Pacific stock generally migrate only as far south as the Gulf of Alaska (Kajimura 1984). Olesiuk (2012) reported that evidence from various sources indicates that juvenile and non-breeding northern fur seal are virtually ubiquitous throughout the Northeastern Pacific Ocean, albeit in densities lower than at the

coastal margins. Tagging data presented by Ream et al. (2005) indicate the main foraging areas and the main migration route through the Gulf of Alaska are located far to the west of the Study Area. Northern fur seals were not sighted during the 2009 survey of the Study Area (Rone et al. 2009) but there were 69 on-effort northern fur seal sightings (74 individuals) during the 2013 GOALS II survey (Rone et al. 2014). Northern fur seal occurrence in the Study Area during the summer time period is considered likely.

3.8.2.23 Northern Elephant Seal (*Mirounga angustirostris*)

3.8.2.23.1 Status and Management

The northern elephant seal is protected under the MMPA and is not listed under the ESA. NMFS recognizes one stock for the northern elephant seal, the California Breeding stock, which is geographically distinct from a population in Baja California.

3.8.2.23.2 Abundance

The California Breeding stock of northern elephant seal has recovered from near extinction in the early 1900s to an estimated 124,000 in 2005 (Carretta et al. 2014). Current census data suggest an increasing population at an average annual rate of 3.8 percent (Lowry et al. 2014), although the population estimate for this stock has not been updated. Lowry et al. (2014) estimate that in 2010 the total population in the U.S. and Mexico was between 210,000 and 239,000 individuals.

3.8.2.23.3 Distribution

Northern elephant seals are endemic to the North Pacific Ocean, occurring almost exclusively in the eastern and central North Pacific. Adult males and females segregate while foraging and migrating (Stewart and DeLong 1995). Adult females mostly range east to about 173°W, between the latitudes of 40°N and 45°N, remaining far to the west of the Study Area. In contrast, adult males range further north and east into the Gulf of Alaska and along the Aleutian Islands to between 47°N and 58°N (Le Boeuf et al. 2000, Stewart and DeLong 1995, Stewart and Huber 1993).

Northern elephant seal males regularly occur in the Gulf of Alaska year-round. Adults stay offshore during migration, while juveniles and subadults are often seen along the coasts of Oregon, Washington, and British Columbia. Northern elephant seals were not sighted during the 2009 survey of the Study Area (Rone et al. 2009). This result is not wholly unexpected, as the elephant seal pupping/breeding season occurs from December through March on the rookeries in California and Mexico, and the survey was conducted in April. During the recent (June and July 2013) survey of the Study Area, there were 15 on-effort sightings of northern elephant seals (Rone et al. 2014). Northern elephant seal occurrence in the Study Area during the summer time period is considered likely.

3.8.2.24 Harbor Seal (*Phoca vitulina*)

3.8.2.24.1 Status and Management

The harbor seal is protected under the MMPA and is not listed under the ESA. NMFS currently recognizes 12 stocks of harbor seals in Alaskan waters (Aleutian Islands, Pribilof Islands, Bristol Bay, N. Kodiak, S. Kodiak, Prince William Sound, Cook Inlet/Shelikof, Glacier Bay/Icy Strait, Lynn Canal/Stephens, Sitka/Chatham, Dixon/Cape Decision, and Clarence Strait) and three additional stocks associated with the Pacific Northwest (Washington Inland Waters stock, Washington and Oregon Coast stock, and California stock). This represents a significant increase in the number of harbor seal stocks from the three stocks (Bering Sea, Gulf of Alaska, and Southeast Alaska) previously recognized in Alaskan waters. The Northern Kodiak, Southern Kodiak, Prince William Sound, Glacier Bay/Icy Strait,

Sitka/Chatham, and Dixon/Cape Decision stocks would be considered rare in the inshore waters of the Study Area, whereas the Aleutian Islands, Pribilof Islands, Bristol Bay, Cook Inlet/Shelikof, Lynn Canal/Stephens, and Clarence Strait stocks would be considered extralimital in the Study Area.

3.8.2.24.2 Abundance

The current statewide abundance estimate for Alaskan harbor seals is 152,602 (Allen and Angliss 2014). This is a summation of population estimates from the 12 Alaska stocks from aerial surveys made from 2003 to 2007. The most recent estimates for the individual stocks are Aleutian Islands (3,579), Pribilof Islands (232), Bristol Bay (18,577), N. Kodiak (4,509), S. Kodiak (11,117), Prince William Sound (31,503), Cook Inlet/Shelikof (22,900), Glacier Bay/Icy Strait (5,042), Lynn Canal/Stephens (8,870), Sitka/Chatham (8,586), Dixon/Cape Decision (14,388), and Clarence Strait (23,289).

3.8.2.24.3 Distribution

The harbor seal is one of the most widespread of the pinniped species, distributed from the eastern Baltic Sea, west across the Atlantic and Pacific Oceans to southern Japan, along the coast and offshore islands of the Gulf of Alaska. Harbor seals are coastal animals that primarily occur within 11 nm from shore. In Alaska, harbor seals range from the Dixon Entrance to Kuskokwim Bay, are widely distributed along the coastal Gulf of Alaska (Allen and Angliss 2014), and are also found at haulout sites on offshore islands. The harbor seal's preferred coastal habitat does not extend into the waters of the Study Area. Studies using satellite tags have documented the movements and home range of harbor seals in the vicinity of the Study Area (Lowry et al. 2001, Small et al. 2005). Although these tagging studies have documented harbor seal movement into deep water (beyond the shelf break) in the Gulf of Alaska, these movements are the exception. One of these exceptions was noted during the April 2009 line-transect survey (Rone et al. 2009), during which two harbors seals were observed. One sighting was along the shelf break west of Kodiak Island, and the other was in the west-central portion of the Study Area, well offshore of the shelf break. No harbor seals were identified during the recent (June and July 2013) survey of the Study Area, although there were six sightings of unidentified pinnipeds (Rone et al. 2014). Harbor seal occurrence in the Study Area during the summer time period is considered likely.

3.8.2.25 Ribbon Seal (*Histriophoca fasciata*)

3.8.2.25.1 Status and Management

NMFS currently recognizes a single stock of ribbon seal in the north Pacific and Bering Sea, the Alaska stock. The Alaska stock of ribbon seal is not designated as depleted under the MMPA and is not listed as endangered or threatened under the ESA. A petition to list the ribbon seal under the ESA was received by NMFS in late 2007. Following the publication of a finding on that petition (73 Federal Register [FR] 16617), NMFS determined in 2013 that the ribbon seal does not currently warrant listing under the ESA (73 FR 79822; 78 FR 41371). However, the ribbon seal remains designated as a Species of Concern under the ESA, which means that NMFS has some concerns regarding status and threats, but insufficient information is available to indicate a need for listing.

Subsistence harvest data are no longer collected, although the subsistence harvest database previously indicated an annual harvest of 193 ribbon seals per year (Allen and Angliss 2014).

3.8.2.25.2 Abundance

Due to a lack of available data, there currently are no reliable abundance estimates for the ribbon seal. However, the overall population size is estimated to be near 200,000 (Boveng et al. 2008), and a provisional estimate of 61,100 ribbon seals (95 percent CI 35,200-189,300) in the eastern and central

Bering Sea is based on aerial surveys conducted in portions of the Bering Sea in 2003, 2007, and 2008 (Allen and Angliss 2014).

3.8.2.25.3 Distribution

The distribution of ribbon seals is restricted to the northern North Pacific Ocean and adjoining sub-Arctic and Arctic seas, where they occur most commonly in the Sea of Okhotsk and Bering Sea in the open sea and on pack ice (Boveng et al. 2008). From January to May, adults generally remain with the pack ice of the Bering, Chukchi, and western Beaufort seas, moving with the ice farther south in colder years. Ribbon seals are strongly associated with sea ice during the breeding season (March–June) and are not known to breed on shore. Jones et al. (2011) studied long-term autonomous recordings and found that ribbon seal calls occurred only when there was open water in the fall. Satellite telemetry data presented by Boveng et al. (2008) indicated that outside of the breeding season, ribbon seals disperse widely, from remaining in the Bering Sea to following the seasonal ice to the Bering Strait, Chukchi Sea, or Arctic Basin and south to the Aleutian Islands. In 2007, one adult female ribbon seal was observed and captured onshore in upper Cook Inlet and in autumn 2009 another was observed on the Copper River Delta (Boveng, pers. comm.). Additional tagging studies in 2009 (unpublished) showed one of 14 tagged seals spent time in the western Gulf of Alaska and the TMAA or in vicinity of the TMAA (Cameron, pers. comm.). Given the small sample size represented by the tagging and these two other observations, use of the Gulf of Alaska by a small fraction of the ribbon seal population may be more common than currently known (Boveng pers. comm.). Ribbon seals were not observed during the April survey of the Study Area (Rone et al. 2009) or the recent June/July 2013 GOALS II survey (Rone et al. 2014). Ribbon seal occurrence in the Study Area during the summer time period is considered rare.

3.8.2.26 Northern Sea Otter (*Enhydra lutris kenyoni*)

3.8.2.26.1 Status and Management

The USFWS recognizes five stocks of sea otters in U.S. waters under MMPA guidelines. These include single stocks each in California (i.e., the southern sea otter [*Enhydra lutris nereis*]) and Washington (i.e., the northern sea otter [*Enhydra lutris kenyoni*]) and three stocks in Alaska that are designated as Southeast, Southcentral, and Southwest stocks. The ranges of these stocks are defined as follows: (1) the Southeast Alaska stock extends from Dixon Entrance to Cape Yakataga; (2) the Southcentral Alaska stock extends from Cape Yakataga to Cook Inlet, including Prince William Sound, the Kenai Peninsula coast, and Kachemak Bay; and (3) the Southwest Alaska stock includes the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof Islands. All sea otter stocks are protected under the MMPA, but only the southwest Alaska stock of the northern sea otter is listed as threatened under the ESA (70 FR 46366–46386). All three of the Alaska stocks of sea otters could potentially occur in the northern portions of the Study Area. Critical habitat has been designated for the Southwest Alaska population of northern sea otters, and it encompasses approximately 15,000 km^2 of nearshore habitat, none of which is within the Study Area (Figure 3.8-3).

3.8.2.26.2 Abundance

Aerial surveys of the Alaskan stocks were performed between 2000 and 2005. The population estimate for the Southwest Alaska stock of sea otters derived from these surveys was 47,676 individuals (U.S. Fish and Wildlife Service 2008a). The population estimate for the Southcentral Alaska stock of sea otters derived from these surveys was 15,090 individuals (U.S. Fish and Wildlife Service 2008b). The population estimate for the Southeast Alaska stock of sea otters derived from these surveys was 10,563 individuals (U.S. Fish and Wildlife Service 2008c).

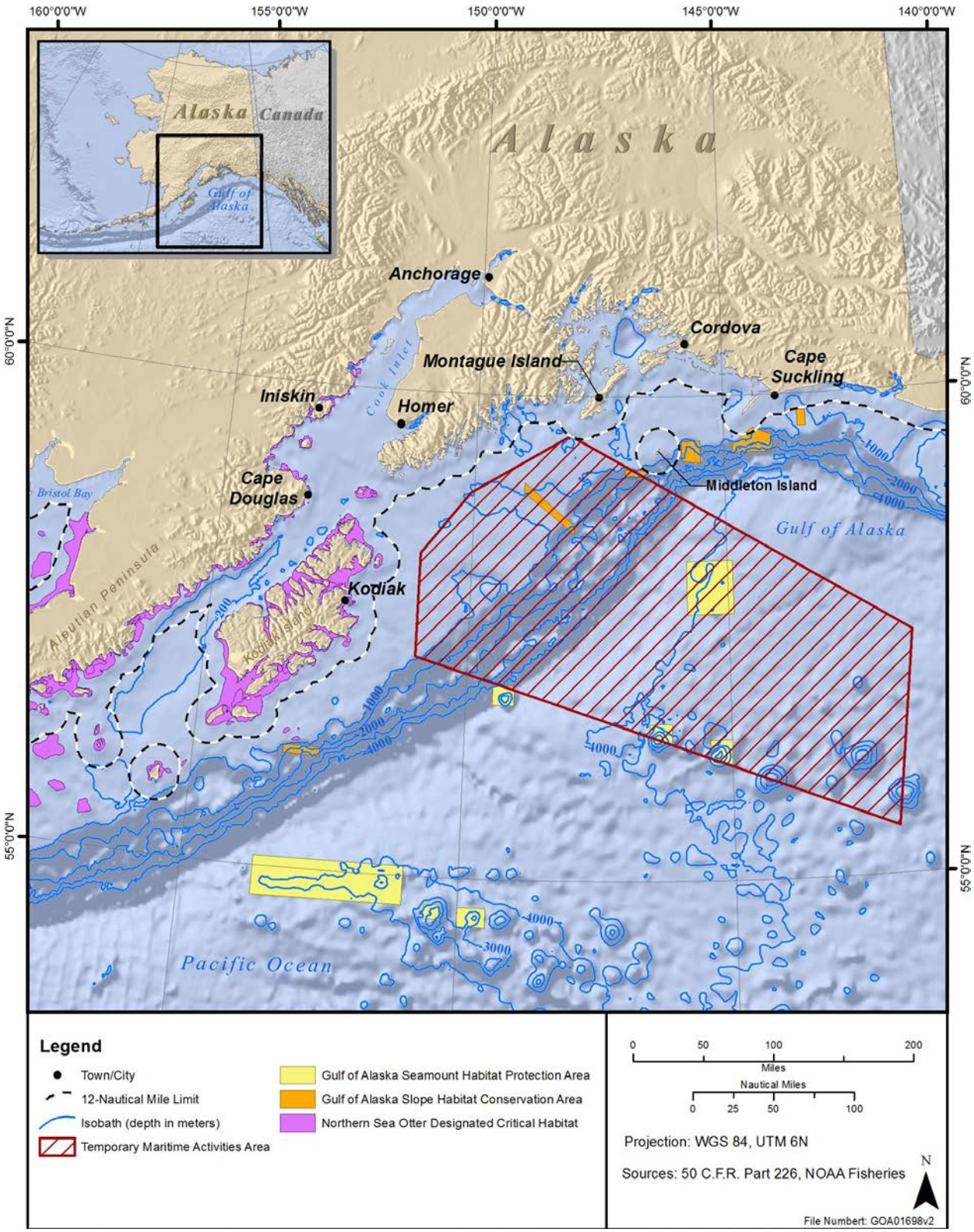

Figure 3.8-3: Southwest Alaska Stock Sea Otter Designated Critical Habitat in the Vicinity of the Temporary Maritime Activities Area

3.8.2.26.3 Distribution

Sea otters occupy nearly all coastal marine habitats, from bays and estuaries to rocky shores exposed to oceanic swells (Riedman and Estes 1990; U.S. Fish and Wildlife Service 2003). Although sea otters prefer rocky shoreline and relatively shallow water (< 131 ft. [40 m] deep) with kelp beds, this is not an essential habitat requirement, and some individuals use soft-sediment areas where kelp is absent (Riedman and Estes 1990; U.S. Fish and Wildlife Service 2003). Sea otters seldom range more than 1.2 mi. (2 km) from shore, although some individuals, particularly juvenile males, travel farther offshore (Ralls et al. 1995, 1996; Riedman and Estes 1990; U.S. Fish and Wildlife Service 2003). Sea otters move seasonally to areas where there is food or where sheltered water offers protection from storms and rough seas (Kenyon 1975; Riedman and Estes 1990). As sea otters seldom range more than 1.2 mi. (2 km) from shore and are not known to migrate, it is not anticipated that they would be present in the Study Area. During the 2009 survey, one northern sea otter was observed; however, this sighting was made in the nearshore waters south of Kodiak Island, approximately 170 km southwest of the Study Area. No sea otters were sighted during the recent (June and July 2013) survey of the Study Area (Rone et al. 2014) Northern sea otter occurrence in the Study Area during the summer time period is considered rare.

3.8.3 Environmental Consequences

As first noted in Section 1.2 (The Navy's Environmental Compliance and At-Sea Policy), Section 3.8.3 of the Supplemental EIS/OEIS provides the re-analysis of potential impacts on marine mammals in the Study Area from the training activities that were proposed and presented in the 2011 *Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement* (hereafter referred to as the 2011 EIS/OEIS). There have been no substantial changes to the activities analyzed as the Proposed Action in the 2011 EIS/OEIS. Use of sonar and other active acoustic sources has occurred since the signing of the GOA Navy Training Activities Record of Decision and receipt of the MMPA Authorization and ESA Biological Opinion, all of which were finalized in May 2011. Continuation of training at-sea in the Gulf of Alaska, conducted as a Carrier Strike Group exercise, is required to support the readiness of combat-capable naval forces.

All stressors that may impact marine mammals were analyzed in the 2011 EIS/OEIS. As described in Section 3.0.1 (Approach to Analysis), a comprehensive review of literature and scientific publications pertaining to marine mammals and the marine environment since completion of the 2011 EIS/OEIS has been undertaken. The literature cited and those publications reviewed and considered in this Supplemental EIS/OEIS have been presented in Section 3.8.8 (References Cited and Considered). In consideration of that material, it has been determined that there have been no substantive changes in the best available science or new information available that would present significantly different conclusions or necessitate any change in the findings presented in the 2011 EIS/OEIS (see Section 3.8.7, Environmental Consequences, in the 2011 EIS/OEIS) regarding the following stressors:

- Vessel noise, disturbance, and strikes
- Aircraft overflight noise
- Weapons firing noise
- Non-explosive ordnance use (impact noise, ingestion, and strikes)
- Electronic combat (electromagnetic energy stressors)
- Discharges of expended materials (physical disturbance, strikes, entanglement, ingestion, sediments and water quality)

In summary, for stressors other than acoustic stressors including sonar and other active acoustic sources and explosives, there have been no changes to the Region of Influence, existing conditions, species life histories, or any new information available since 2011 that would otherwise substantively change the conclusions presented in the 2011 EIS/OEIS.

As a result of the analysis summarized above, the focus of this Supplemental EIS/OEIS and the discussion in this section is the re-analysis of activities involving use of sonar and other active acoustic sources and explosives using the best available science and analytical methodologies that have become available since the 2011 EIS/OEIS. Since training activities involving use of sonar and other active acoustic sources and explosives only occur in the TMAA, the re-analysis of acoustic stressor impacts for marine mammals will only address the TMAA portion of the 2011 EIS/OEIS Study Area.

Identical to the alternatives in the 2011 EIS/OEIS, the No Action Alternative in this Supplemental EIS/OEIS consists of training activities of the types and levels of intensity as conducted prior to 2011, does not include Anti-Submarine Warfare training activities involving the use of active sonar and other active acoustic sources, but does include the use of explosives as an underwater acoustic stressor. Alternative 1, in addition to accommodating training activities addressed in the No Action Alternative, supports an increase in training activities (if needed), as well as the inclusion of Anti-Submarine Warfare training activities involving the use of active sonar and other active acoustic sources. Alternative 1 also proposes training required by force structure changes to be implemented for new weapons systems, instrumentation, and technology as well as new classes of ships, submarines, and new types of aircraft. In addition, specific training instrumentation enhancements would be implemented, to include development and use of the portable undersea tracking range. Alternative 2 would include all elements of Alternative 1 plus one additional Carrier Strike Group exercise and Sinking Exercise during the summer months. Alternative 2 was the Preferred Alternative previously chosen for implementation by the May 2011 GOA Navy Training Activities Record of Decision. Alternative 2 is the preferred alternative for this Supplemental EIS/OEIS.

As presented in Section 1 of this Supplemental EIS/OEIS, the 2011 EIS/OEIS used impact thresholds, criteria, an acoustic modeling methodology, and marine mammal density information developed by the Navy, in cooperation with NMFS, which reflected the best available science at the time (National Oceanic and Atmospheric Administration 2011a, b). A subsequent review on behalf of the NMFS by the Center for Independent Experts analyzed the various approaches the Navy used for acoustic effects analyses, such as that in the 2011 EIS/OEIS, leading to the refinement of the previous acoustic impact methodology. The result was the development of a standard Navy model for acoustic effects, the Navy Acoustic Effects Model (NAEMO). By using this more comprehensive modeling software, updated marine mammal densities, and revised acoustic criteria[1], the predicted number of effects are expected to change from those quantified in the 2011 EIS/OEIS. While the model predicted number of effects should be expected to change, the actual impacts to populations of marine mammals should have remained the same since the training activities and the associated stressors are unchanged since 2011. The change represented by the Supplemental EIS/OEIS quantification of impacts pursuant to requirements of the MMPA is only a difference arising as a result of more accurate marine mammal density data, revised acoustic impact criteria, and improvements in the computer modeling of predicted effects to marine mammals. Assessment of likely long-term consequences to populations of marine mammals are provided by empirical data gathered from areas where Navy routinely trains and tests.

[1] The criteria used by the Navy in this analysis parallels the recent National Oceanic and Atmospheric Administration's "Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals," which was proposed in December 2013 and is in review as of June 2014. Details can be found at http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

Since the 2011 EIS/OEIS, substantial Navy-funded marine mammal survey data, monitoring data, and scientific research have been completed. This empirical data are beginning to provide insight on the qualitative analysis of the actual (as opposed to model predicted numerical) impact to marine mammals resulting from Navy training and testing based on observations of marine mammals generally in and around Navy Range Complexes.

The following subsections of the Supplemental EIS/OEIS presents the environmental consequences based on the new modeling methodology and the scientific observations and investigations made over 8 years of monitoring Navy training and testing activities in the Pacific. The majority of this new analysis involves a new quantification of effects from underwater acoustic stressors using new thresholds and criteria for measuring those effects and involves integration of:

- updated marine mammal density data
- new acoustic impact thresholds developed in coordination with NMFS
- new modeling software (Navy Acoustic Exposure Model)
- post-modeling analysis to more fully account for likely marine mammal behaviors based on emergent science and to account for the implementation of standard mitigation measures.

The acoustic stressors used during the training may vary in intensity, frequency, duration, and location within the TMAA during the period of the Carrier Strike Group exercise (called the “Northern Edge Exercise” in the 2011 EIS/OEIS). The acoustic stressors applicable to the re-analysis in this Supplemental EIS/OEIS include the following non-impulse and impulse sources:

- sonar and other active acoustic sources
- explosives (underwater)

In the analysis of acoustic stressors, marine mammal species are grouped together based on similar biology (e.g., hearing) or behaviors (e.g., feeding or expected reaction to stressors) when most appropriate for the discussion. In addition, species are grouped based on their taxonomic relationship and discussed as follows: mysticetes (baleen whales), odontocetes (toothed whales), pinnipeds (seals and sea lions), and mustelids (sea otter). When impacts are expected to be similar to all species or when it is determined there is no impact on any species, the discussion will be general and not species-specific. However, when impacts are not the same to certain species or groups of species, the discussion will be as specific as the best available data allow.

All training activities involving underwater acoustic stressors would occur within the TMAA. Analysis of these activities included all the areas of TMAA in a manner representative of the way training would be conducted so that conclusions presented in the following discussions apply equally to marine mammals in the entire TMAA. Based on acoustic thresholds and criteria developed with NMFS, impacts from sound sources as stressors will be quantified at the species or stock level as is required pursuant to authorization of the proposed actions under the MMPA.

A qualitative analysis of likely impacts is also presented in this Supplemental EIS/OEIS, which has expanded from that presented in the 2011 EIS/OEIS due to the increase and availability of monitoring data and scientific research recently conducted in various Navy Range Complexes and the TMAA. As detailed in Section 3.8.5 (Summary of Observations During Previous Navy Activities), this includes over 80 exercise reports (as of December 2013) and monitoring reports submitted to NMFS, which are

available for review at multiple website locations.[2]

In cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to minimize the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). Some of these mitigations have been refined since the 2011 EIS/OEIS based on the new marine mammal impact thresholds and criteria in coordination with NMFS. These mitigation measures have been previously and recently analyzed, reviewed, and subject to public comment (U.S Department of the Navy 2013d) and authorized by NMFS pursuant to the MMPA (National Oceanic and Atmospheric Administration 2013b) for other identical Navy training activities in the Pacific. In addition to the measures presented, additional mitigations or different mitigations or both may subsequently be implemented in future coordination with NMFS resulting from the MMPA authorization and ESA consultation processes.

3.8.3.1 Acoustic Stressors

3.8.3.1.1 Non-Impulsive and Impulsive Sound Sources

Long recognized by the scientific community (Payne and Web 1971), and summarized by the National Academies of Science, human-generated sound could possibly harm marine mammals or significantly interfere with their normal activities (National Research Council 2005). Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging (National Research Council 2003, 2005), there are many unknowns in assessing impacts such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al. 2007; Southall et al. 2007, 2009a). Furthermore, many other factors besides just the received level of sound may affect an animal's reaction such as the animal’s physical condition, prior experience with the sound, and proximity to the source of the sound (Ellison et al. 2012).

3.8.3.1.2 Analysis Background and Framework

3.8.3.1.2.1 Direct Injury

The potential for direct injury in marine mammals has been inferred from terrestrial mammal experiments and from post-mortem examination of marine mammals believed to have been exposed to underwater explosions (Ketten et al. 1993, Richmond et al. 1973, Yelverton et al. 1973). Additionally, non-injurious effects on marine mammals (e.g., Temporary Threshold Shift [TTS]) are extrapolated to injurious effects (e.g., Permanent Threshold Shift [PTS]) based on data from terrestrial mammals to derive the criteria serving as the potential for injury (Southall et al. 2007). Actual effects on marine mammals may differ from terrestrial animals due to anatomical and physiological adaptations to the marine environment, e.g., some characteristics such as a reinforced trachea and flexible thoracic cavity (Ridgway and Dailey 1972) may or may not decrease the risk of lung injury.

Potential non-auditory direct injury from non-impulsive sound sources, such as sonar, is unlikely due to relatively lower peak pressures and slower rise times than potentially injurious sources such as explosives. Even for the most sensitive auditory tissues, including strandings associated with use of sonar, Ketten (2012) has recently summarized, “to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result [of]

[2] These reports are publically available at the Navy website, www.navymarinespeciesmonitoring.us/, and from the NMFS Office of Protected Resources website, www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

anthropogenic sound exposures, including sonar." Non-impulsive sources such as sonar also lack the strong shock wave such as that associated with an explosion. Therefore, primary blast injury and barotrauma (i.e., injuries caused by large, rapid pressure changes) could not be caused by non-impulsive sources such as sonar. The theories of sonar induced acoustic resonance and sonar induced bubble formation are discussed below. These phenomena, if they were to occur, would require the co-occurrence of a precise set of circumstances that in the natural environment under real-world conditions are unlikely to occur.

Primary Blast Injury and Barotrauma

The greatest potential for direct, non-auditory tissue effects is primary blast injury and barotrauma after exposure to high amplitude impulsive sources, such as explosions. Primary blast injury refers to those injuries that result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., lung and gut) and the auditory system (Craig and Hearn 1998, Craig Jr. 2001, Phillips and Richmond 1990). Barotrauma refers to injuries caused when large pressure changes occur across tissue interfaces, normally at the boundaries of air-filled tissues such as the lungs. Primary blast injury to the respiratory system, as measured in terrestrial mammals, may consist of pulmonary contusions, pneumothorax, pneumomediastinum, traumatic lung cysts, or interstitial or subcutaneous emphysema (Phillips and Richmond 1990). These injuries may be fatal depending upon the severity of the trauma. Rupture of the lung may introduce air into the vascular system, possibly producing air emboli that can cause a cerebral infarct or heart attack by restricting oxygen delivery to these organs. Though often secondary in life-threatening severity to pulmonary blast trauma, the gastrointestinal tract can also suffer contusions and lacerations from blast exposure, particularly in air-containing regions of the tract. Potential traumas include hematoma, bowel perforation, mesenteric tears, and ruptures of the hollow abdominal viscera. Although hemorrhage of solid organs (e.g., liver, spleen, and kidney) from blast exposure is possible, rupture of these organs is rarely encountered.

The only known occurrence of mortality or injury to a marine mammal due to a U.S. Navy training or testing event involving impulsive sources (use of underwater explosives) occurred in March 2011 in nearshore waters off San Diego, California, at the Silver Strand Training Complex. This area has been used for underwater demolitions training for at least three decades without incident. On this occasion, however, a group of long-beaked common dolphins entered the mitigation zone and approximately 1 minute after detonation, three animals were observed dead at the surface. Navy recovered those animals and transferred them to the local stranding network for necropsy. A fourth animal was discovered 3 days later stranded dead approximately 42 mi. (68 km) to the north of the detonation site. Upon necropsy, all four animals were found to have sustained typical mammalian primary blast injuries (Danil and St. Ledger 2011). See Section 3.8.3.1.2.8 (Stranding) and U.S. Department of the Navy (2013c) for more information on the topic of stranding. There is no similar current or future training event proposed for the TMAA Study Area.

Auditory Trauma

Relatively little is known about auditory system trauma in marine mammals resulting from a known sound exposure. A single study spatially and temporally correlated the occurrence of auditory system trauma in humpback whales with the detonation of a 5,000-kilogram (kg) (11,023-pound [lb.]) explosive used off Newfoundland during demolition of an offshore oil rig platform (Ketten et al. 1993). The exact magnitude of the exposure in this study cannot be determined, but it is likely the trauma was caused by the shock wave produced by the explosion. There are no known occurrences of direct auditory trauma in marine mammals exposed to tactical sonar or other non-impulsive sound sources (Ketten 2012). The

potential for auditory trauma in marine mammals exposed to impulsive sources (e.g., explosions) is inferred from tests of submerged terrestrial mammals exposed to underwater explosions (Ketten et al. 1993, Richmond et al. 1973, Yelverton et al. 1973).

Acoustic Resonance

Acoustic resonance has been proposed as a hypothesis suggesting that acoustically induced vibrations (sound) from sonar or sources with similar operating characteristics could be damaging tissues of marine mammals. In 2002, NMFS convened a panel of government and private scientists to consider the hypothesis of mid-frequency sonar-induced resonance of gas-containing structures (i.e., lungs) (National Oceanic and Atmospheric Administration 2002). They modeled and evaluated the likelihood that Navy mid-frequency sonar caused resonance effects in beaked whales that eventually led to their stranding (U.S. Department of the Navy 2013c). The conclusions of that group were that resonance in air-filled structures was not likely to have caused the Bahamas stranding (National Oceanic and Atmospheric Administration 2002). The frequencies at which resonance was predicted to occur in uncollapsed lungs were below 50 Hz; well below the frequencies utilized by the mid-frequency sonar systems associated with the Bahamas event. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the worst-case scenario in which air volumes would be undamped by surrounding tissues and the amplitude of the resonant response would be maximal. These same conclusions would apply to other training and testing activities involving acoustic sources. Therefore, the Navy concludes that acoustic resonance is not likely under realistic conditions during training and testing activities, and this type of impact is not considered further in this analysis.

Bubble Formation (Acoustically Induced)

A suggested cause of injury to marine mammals is rectified diffusion (Crum and Mao 1996), the process of increasing the size of a bubble by exposing it to a sound field (see Section 3.8.3.1.2.8, Stranding, regarding strandings that gave rise to the debate about bubble formation). The process is dependent upon a number of factors including the sound pressure level and duration. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage (injury) occurs, (2) bubbles develop to the extent that a complement immune response is triggered or the nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury), or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based upon what is known about the specific process involved. Rectified diffusion is facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). The dive patterns of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser et al. 2001b). If surface intervals between dives are short, there is insufficient time to clear nitrogen in tissues accumulated due to pressures experienced while diving. Subsequent dives can increase tissue nitrogen accumulation, leading to greater levels of nitrogen saturation at each ascent. If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness (e.g., nausea, disorientation, localized pain, breathing problems).

It is unlikely that the short duration of sonar or explosion sounds would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related

hypothesis has also been suggested: stable microbubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario, the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become a problematic size. Recent research with *ex vivo* supersaturated bovine tissues suggested that for a 37 kHz signal, a sound exposures of approximately 215 dB re 1 µPa would be required before microbubbles became destabilized and grew (Crum et al. 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 µPa at 1 m, a whale would need to be within 10 yd. (10 m) of the sonar dome to be exposed to such sound levels. Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400–700 kilopascals for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high as 400–700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser et al. 2001b; Saunders et al. 2008). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

There is considerable disagreement among scientists as to the likelihood of this phenomenon (Evans and Miller 2003, Piantadosi and Thalmann 2004). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Fernández et al. 2005; Jepson et al. 2003), nitrogen bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology (Bernaldo de Quiros et al. 2012, 2013a, 2013b; Dennison et al. 2011, Moore et al. 2009). Prior experimental work has also demonstrated that post-mortem presence of bubbles following decompression in laboratory animals can occur as a result of invasive investigative procedures (Stock et al. 1980).

3.8.3.1.2.2 Nitrogen Decompression

Although not a direct injury, variations in marine mammal diving behavior or avoidance responses could possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular and tissue bubble formation (Hooker et al. 2012, Jepson et al. 2003, Saunders et al. 2008). The mechanism for bubble formation from nitrogen saturated tissues would be indirect and also different from rectified diffusion, but the effects would be similar. Although hypothetical, the potential process is under debate in the scientific community (Hooker et al. 2012, Saunders et al. 2008). The hypothesis speculates that if exposure to a startling sound elicits a rapid ascent to the surface, tissue gas saturation sufficient for the evolution of nitrogen bubbles might result (Fernández et al. 2005, Hooker et al. 2012, Jepson et al. 2003). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation.

Previous modeling by Zimmer and Tyack (2007) suggested that even unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected in beaked whales. Tyack et al. (2006) suggested that emboli observed in animals exposed to mid-frequency active (MFA) sonar (Fernández et al. 2005, Jepson et al. 2003) could stem instead from a behavioral response that involves repeated dives, shallower than the depth of lung collapse. A bottlenose dolphin was trained to repetitively dive to specific depths to elevate nitrogen saturation to the point that asymptomatic nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of any nitrogen gas bubbles (Houser et al. 2010a).

More recently, modeling has suggested that the long, deep dives performed regularly by beaked whales over a lifetime could result in the saturation of long-halftime tissues (e.g., fat, bone lipid) to the point that they are supersaturated when the animals are at the surface (Hooker et al. 2009, 2012; Saunders et al. 2008). Proposed adaptations for prevention of bubble formation under conditions of persistent tissue saturation have been suggested (Fahlman et al. 2006, Hooker et al. 2009), while the condition of supersaturation required for bubble formation has been demonstrated in by-catch animals drowned at depth and brought to the surface (Moore et al. 2009). Since bubble formation is facilitated by compromised blood flow, it has been suggested that rapid stranding may lead to bubble formation in animals with supersaturated, long-halftime tissues because of the stress of stranding and the cardiovascular collapse that can accompany it (Houser et al. 2010a).

A fat embolic syndrome was identified by Fernández et al. (2005) coincident with the identification of bubble emboli in stranded beaked whales. The fat embolic syndrome was the first pathology of this type identified in marine mammals, and was thought to possibly arise from the formation of bubbles in fat bodies, which subsequently resulted in the release of fat emboli into the blood stream. Recently, Dennison et al. (2011) reported on investigations of dolphins stranded in 2009–2010 and, using ultrasound, identified gas bubbles in kidneys of 21 of 22 live-stranded dolphins and in the liver of 2 of 22. The authors postulated that stranded animals are unable to recompress by diving, and thus may retain bubbles that are otherwise re-absorbed in animals that can continue to dive. The researchers concluded that the minor bubble formation observed can be tolerated since the majority of stranded dolphins released did not re-strand (Dennison et al. 2011). Recent modeling by Kvadsheim et al. (2012) determined that while behavioral and physiological responses to sonar have the potential to result in bubble formation, the actually observed behavioral responses of cetaceans to sonar did not imply any significantly increased risk of over what may otherwise occur normally in individual marine mammals.

As a result of these recent findings and for purposes of this analysis, the potential for acoustically mediated bubble growth and the potential for bubble formation as a result of behavioral altered dive profiles are not addressed further.

3.8.3.1.2.3 Hearing Loss

The most familiar effect of exposure to high intensity sound is hearing loss, meaning an increase in the hearing threshold or loss of hearing sensitivity. The meaning of the term “hearing loss” does not equate to “deafness.” The type of hearing loss discussed in the analysis of marine mammal impacts is called a noise-induced threshold shift, or simply a threshold shift (Miller 1974). If high-intensity sound over-stimulates tissues in the ear, causing a threshold shift, the impacted area of the ear (associated with and limited by the sound’s frequency band) no longer provides the same auditory impulses to the brain as before the exposure (Ketten 2012); the result is a loss in hearing sensitivity. The distinction between PTS and TTS is based on whether there is a complete recovery of a threshold shift or loss of sensitivity following a sound exposure. If the threshold shift eventually returns to zero (i.e., hearing returns to the pre-exposure ”normal”), the threshold shift is a TTS.

For TTS, full recovery of the hearing loss (to the pre-exposure threshold) has been determined from studies of marine mammals, and this recovery occurs within minutes to hours for the small amounts of TTS that have been experimentally induced (Finneran et al. 2005, Nachtigall et al. 2004). The time required for recovery is related to the exposure duration, sound exposure level, and the magnitude of the threshold shift, with larger threshold shifts and longer exposure durations requiring longer recovery times (Finneran et al. 2005, Mooney et al. 2009a). In some cases, threshold shifts as large as 50 dB (loss in sensitivity) have been temporary, although recovery sometimes required as much as 30 days (Ketten

2012). If the threshold shift does not return to zero but leaves some finite amount of threshold shift (loss in hearing sensitivity), then that remaining threshold shift is a PTS. Again for clarity, PTS as discussed in this document is not the loss of hearing, but instead is the loss of hearing sensitivity over a particular range of frequencies. Figure 3.8-4 shows one hypothetical threshold shift that completely recovers, a TTS, and one that does not completely recover, leaving some PTS. The actual amount of threshold shift depends on the amplitude, duration, frequency, temporal pattern of the sound exposure, and on the susceptibility of the individual animal.

Both auditory trauma and auditory fatigue may result in hearing loss. Many are familiar with hearing protection devices (i.e., ear plugs) required in many occupational settings where pervasive noise could otherwise cause auditory fatigue and possibly result in hearing loss. The mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic fatigue and exhaustion of the hair cells and cochlear tissues. Note that the term "auditory fatigue" is often used to mean "temporary threshold shift"; however, in this Supplemental EIS/OEIS a more general meaning is used to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure). The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure.

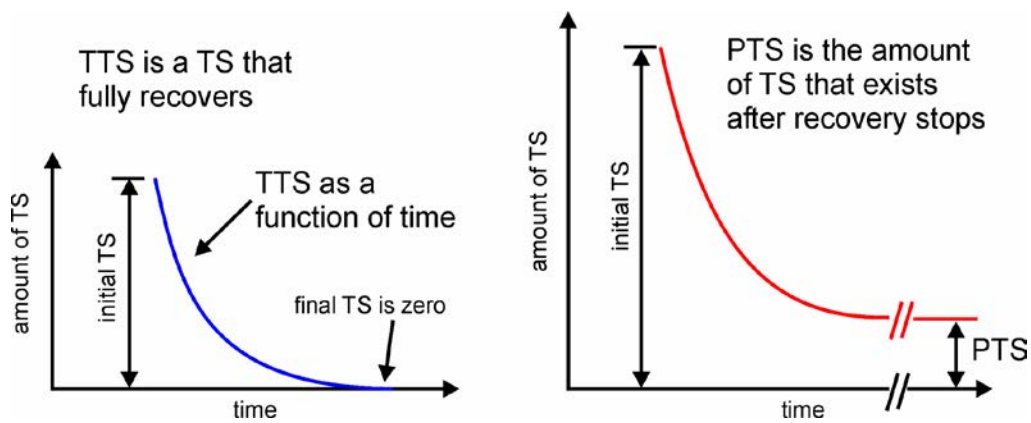

Figure 3.8-4: Two Hypothetical Threshold Shifts, Temporary and Permanent

Hearing loss, or auditory fatigue, in marine mammals has been studied by a number of investigators (Finneran et al. 2000, 2002, 2005, 2007, 2010; Kastak et al. 2007; Lucke 2009; Mooney et al. 2009a; Nachtigall et al. 2003, 2004; Schlundt et al. 2000). The studies of marine mammal auditory fatigue were all designed to determine relationships between TTS and exposure parameters such as level, duration, and frequency. In these studies, hearing thresholds were measured in trained marine mammals before and after exposure to intense sounds. The difference between the pre-exposure and post-exposure thresholds indicated the amount of TTS. Species studied include the bottlenose dolphin (total of 9 individuals), beluga (2), harbor porpoise (1), finless porpoise (2), California sea lion (3), harbor seal (1), and Northern elephant seal (1). Some of the more important data obtained from these studies are onset-TTS levels—exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (e.g., Schlundt et al. 2000). These criteria for onset-TTS are very conservative and it is not clear that this level of threshold shift would have a functional effect on the hearing of a marine mammal in the ocean.

The primary findings of the marine mammal TTS studies are:

- The growth and recovery of TTS are analogous to those in terrestrial mammals. This means that, as in terrestrial mammals, threshold shifts primarily depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure.
- The amount of TTS increases with exposure sound pressure level (SPL) and the exposure duration.
- For continuous sounds, exposures of equal energy lead to approximately equal effects (Ward 1997). For intermittent sounds, less hearing loss occurs than from a continuous exposure with the same energy (some recovery will occur during the quiet period between exposures) (Kryter et al. 1965, Ward 1997). Ward (1997) studied the effects of noise on humans, and Kryter et al. (1965) analyzed research conducted on the hearing sensitivity of humans.
- Sound exposure level is correlated with the amount of TTS and is a good predictor for onset-TTS from single, continuous exposures with similar durations. This agrees with human TTS data presented by Ward et al. (1958, 1959a). However, for longer duration sounds—beyond 16–32 seconds—the relationship between TTS and sound exposure level breaks down and duration becomes a more important contributor to TTS (Finneran et al. 2010). Ward et al. (1958, 1959) conducted studies using human subjects. Finneran et al. (2010) studied the hearing sensitivity of marine mammals.
- The maximum TTS after tonal exposures occurs one-half to one octave above the exposure frequency (Finneran et al. 2007; Schlundt et al. 2000). Temporary threshold shift from tonal exposures can thus extend over a large (greater than one octave) frequency range. Finneran et al. (2007) and Schlundt et al. (2000) conducted studies on marine mammals.
- For bottlenose dolphins, non-impulsive sounds with frequencies above 10 kHz are more hazardous than those at lower frequencies (i.e., lower sound exposure levels required to affect hearing) (Finneran et al. 2010).
- The amount of observed TTS tends to decrease with increasing time following the exposure; however, the relationship is not monotonic. The amount of time required for complete recovery of hearing depends on the magnitude of the initial shift; for relatively small shifts recovery may be complete in a few minutes, while large shifts (e.g., 40 dB) require several days for recovery.
- Temporary threshold shift can accumulate across multiple intermittent exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same sound exposure level. This means that predictions based on total, cumulative sound exposure level (such as the predictions made in this analysis) will overestimate the amount of TTS from intermittent exposures.

Although there have been no marine mammal studies designed to measure PTS, the potential for PTS in marine mammals can be estimated based on known similarities between the inner ears of marine and terrestrial mammals. Experiments with marine mammals have revealed their similarities with terrestrial mammals with respect to features such as TTS, age-related hearing loss (called Presbycusis), ototoxic drug-induced hearing loss, masking, and frequency selectivity. Therefore, in the absence of marine mammal PTS data, onset-PTS exposure levels may be estimated by assuming some upper limit of TTS that equates the onset of PTS, then using TTS growth relationships from marine and terrestrial mammals to determine the exposure levels capable of producing this amount of TTS.

Loss of hearing sensitivity resulting from auditory fatigue could effectively reduce the distance over which animals can communicate, detect biologically relevant sounds such as predators, and echolocate (for odontocetes). The costs to marine mammals with TTS, or even some degree of PTS have not been studied; however, it is likely that a relationship between the duration, magnitude, and frequency range of a loss of hearing sensitivity could have consequences to biologically important activities (e.g.,

intraspecific communication, foraging, and predator detection) that affect survivability and reproduction.

3.8.3.1.2.4 Auditory Masking

Auditory masking occurs when a sound, or noise in general, limits the perception of another sound. As with a loss in hearing sensitivity, auditory masking can effectively limit the distance over which a marine mammal can communicate, detect biologically relevant sounds, and echolocate (odontocetes). Unlike auditory fatigue, which always results in a localized stress response, behavioral changes resulting from auditory masking may or may not be coupled with a stress response. Another important distinction between masking and hearing loss is that masking only occurs in the presence of the sound stimulus, whereas hearing loss can persist after the stimulus is gone.

Critical ratios have been determined for pinnipeds (Southall et al. 2000, 2003) and bottlenose dolphins (Johnson 1967) and detections of signals under varying masking conditions have been determined for active echolocation and passive listening tasks in odontocetes (Au and Pawloski 1989, Erbe 2000, Johnson 1971). These studies provide baseline information from which the probability of masking can be estimated.

Clark et al. (2009) developed a methodology for estimating masking effects on communication signals for low-frequency cetaceans, including calculating the cumulative impact of multiple continuous noise sources. For example, their technique calculates that in Stellwagen Bank National Marine Sanctuary, when two commercial vessels pass through a North Atlantic right whale's optimal communication space (estimated as a sphere of water with a diameter of 20 km), that space is decreased by 84 percent. Subsequent research for the same species and location estimated that an average of 63–67 percent of North Atlantic right whale's communication space has been reduced by an increase in ambient noise levels, and that noise associated with transiting vessels is a major contributor to the increase in ambient noise (Hatch et al. 2012). This methodology relies on empirical data on source levels of calls (which is unknown for many species), and requires many assumptions about ancient ambient noise conditions and simplifications of animal behavior, but it is an important step in determining the impact of anthropogenic noise on animal communication.

Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes to vocal behavior and call structure may result from a need to compensate for an increase in background noise (Hotchkin and Parks 2013). In cetaceans, vocalization changes have been reported from exposure to anthropogenic sources such as sonar, vessel noise, and seismic surveying (Gordon et al. 2003; Holt et al. 2009, 2010; Rosalind et al. 2012).

Dunlop et al. (2010) found that humpbacks changed the proportions of their communication signal types in response to higher natural background noise. As the wind speed and wind-dependent background noise levels rose, the proportion of active surface sounds (e.g., breaching) also increased while the proportion of vocalizations decreased. (Dunlop et al. 2010). In the presence of low frequency active sonar, humpback whales have been observed to increase the length of their "songs" (Fristrup et al. 2003, Miller et al. 2000), possibly due to the overlap in frequencies between the whale song and the low frequency active sonar (note that low frequency active sonar is not part of the proposed action in this SEIS/OEIS). Holt et al. (2009, 2010) showed that southern resident killer whales in the waters surrounding the San Juan Islands increased their call source level as vessel noise increased. North Atlantic right whales have been observed to shift the frequency content of their calls upward while

reducing the rate of calling in areas of increased anthropogenic noise from vessel traffic (Parks et al. 2007; Rosalind et al. 2012) as well as increasing the amplitude (intensity) of their calls (Parks 2009; Parks et al. 2010). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles et al. 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Differential vocal responding in marine mammals has been documented in the presence of seismic survey sound (note that seismic survey and use of air guns is not part of the proposed action in this SEIS/OEIS). An overall decrease in vocalization during active surveying has been noted in large marine mammal groups (Potter et al. 2007), while detection of blue whale feeding/social calls increased when seismic exploration was underway (Di Iorio and Clark 2010), indicative of a potentially compensatory response to the increased sound level. Melcón et al. (2012) recently documented that blue whales decreased the proportion of time spent producing certain types of calls when simulated mid-frequency sonar was present. Castellote et al. (2012) found that vocalizing fin whales in the Mediterranean left the area where a seismic survey was being conducted and that their displacement persisted beyond the completion of the survey. A seismic survey has very little if any relationship to the Navy activities analyzed in this SEIS/OEIS.

At present it is not known if changes in vocal behavior corresponded to changes in other behaviors. Controlled exposure experiments in 2007 and 2008 in the Bahamas recorded responses of false killer whales, short-finned pilot whales, and melon-headed whales to simulated MFA sonar (De Ruiter et al. 2013b). The responses to exposures between species were variable. After hearing each MFA signal, false killer whales were found to “increase their whistle production rate and made more-MFA-like whistles” (De Ruiter et al. 2013b). In contrast, melon-headed whales had “minor transient silencing” after each MFA signal, while pilot whales had no apparent response. Consistent with the findings of other previous research (see, for example, Southall et al. 2007), De Ruiter et al. (2013b) found the responses were variable by species and with the context of the sound exposure.

Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke et al. 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators. Whether or not this is a possibility depends on the duration of the masking/hearing impairment and the likelihood of encountering a predator during the time that predator cues are impeded.

3.8.3.1.2.5 Physiological Stress

Marine mammals may exhibit a behavioral response or combinations of behavioral responses upon exposure to anthropogenic sounds. If a sound is detected by a marine mammal, a stress response (e.g., startle or annoyance) or a cueing response (based on a past stressful experience) can occur. Marine mammals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, and interactions with predators all contribute to the stress a marine mammal experiences. In some cases, naturally occurring stressors can have profound impacts on marine mammals; for example, chronic stress, as observed in stranded

animals with long-term debilitating conditions (e.g., disease), has been demonstrated to result in an increased size of the adrenal glands and an increase in the number of epinephrine-producing cells (Clark et al. 2006).

Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. Various efforts have been undertaken to investigate the impact from vessels (both whale-watching and general vessel traffic noise), and demonstrated impacts do occur (Bain 2002; Erbe 2002; Noren et al. 2009; Williams et al. 2006, 2009, 2014a, 2014b). For example, in an analysis of energy costs to killer whales, Williams et al. (2009) suggested that whale-watching in Canada's Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest.

Although preliminary because of the small numbers of samples collected, different types of sounds have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine (hormones released in situations of stress) response to the playback of oil drilling sounds (Thomas et al. 1990) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic water gun (Romano et al. 2004). A bottlenose dolphin exposed to the same seismic water gun signals did not demonstrate a catecholamine response, but did demonstrate an elevation in aldosterone, a hormone that has been suggested as being a significant indicator of stress in odontocetes (St. Aubin and Dierauf 2001, St. Aubin and Geraci 1989). Increases in heart rate were observed in bottlenose dolphins to which conspecific calls were played, although no increase in heart rate was observed when tank noise was played back (Miksis et al. 2001). A beluga's heart rate was observed to increase during exposure to noise, with increase dependent upon frequency band of noise and duration of exposure, with a sharp decrease to normal or below normal levels upon cessation of the exposure (Lyamin et al. 2011). It is unknown how chronic exposure to acoustic stressors may affect marine mammals. Opportunistic comparison of levels of stress-related hormone metabolites in North Atlantic right whale feces collected before and after the tragic events of 11 September 2001 showed a decrease in metabolite levels corresponding to lower levels of ambient noise due to reduced ship traffic (Rolland et al. 2012). Collectively, these results suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal.

Other types of stressors include the presence of vessels, fishery interactions, acts of pursuit and capture, the act of stranding, and pollution. In contrast to the limited amount of work performed on stress responses resulting from sound exposure, a considerably larger body of work exists on stress responses associated with pursuit, capture, handling and stranding. Many cetaceans exhibit an apparent vulnerability in the face of these particular situations when taken to the extreme. A recent study compared pathological changes in organs/tissues of odontocetes stranded on beaches or captured in nets over a 40-year period (Cowan and Curry 2008). The type of changes observed indicate multisystemic harm caused in part by an overload of catecholamines into the system, as well as a restriction in blood supply capable of causing tissue damage and/or tissue death. This extreme response to a major stressor(s) is thought be mediated by the overactivation of the animal's normal physiological adaptations to diving or escape. Pursuit, capture and short-term holding of belugas have been observed to result in a decrease in thyroid hormones (St. Aubin and Geraci 1988) and increases in epinephrine (St. Aubin and Dierauf 2001). In dolphins, the trend is more complicated with the duration of the handling time potentially contributing to the magnitude of the stress response (Ortiz and Worthy 2000, St. Aubin 2002, St. Aubin et al. 1996). Male grey seals subjected to capture and short-term restraint showed an increase in cortisol levels accompanied by an increase in testosterone (Lidgard et al. 2008). This result may be indicative of a compensatory response that enables the seal to maintain reproduction capability

in spite of stress. Elephant seals demonstrate an acute cortisol response to handling, but do not demonstrate a chronic response; on the contrary, adult females demonstrate a reduction in the adrenocortical response following repetitive chemical immobilization (Engelhard et al. 2002). Similarly, no correlation between cortisol levels and heart/respiration rate changes were seen in harbor porpoises during handling for satellite tagging (Eskesen et al. 2009). Taken together, these studies illustrate the wide variations in the level of response that can occur when faced with these stressors.

Factors to consider when trying to predict a stress or cueing response include the mammal's life history stage and whether they are naïve or experienced with the sound. Prior experience with a stressor may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf 2001; Bejder et al. 2009).

The sound characteristics that correlate with specific stress responses in marine mammals are poorly understood. Therefore, in practice, a stress response is assumed if a physiological reaction such as a hearing loss or trauma is predicted, or if a significant behavioral response is predicted.

3.8.3.1.2.6 Behavioral Reactions

The response of a marine mammal to an anthropogenic sound will depend on the frequency, duration, temporal pattern and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al. 2003). For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson and others (Richardson et al. 1995). More recent reviews (Ellison et al. 2012; Nowacek 2007; Southall et al. 2007, 2009a) address studies conducted since 1995 and focus on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated.

Except for some vocalization changes that may be compensating for auditory masking, all behavioral reactions are assumed to occur due to a preceding stress or cueing response; however, stress responses cannot be predicted directly due to a lack of scientific data (see preceding section on Physiological Stress). Responses can overlap; for example, an increased respiration rate is likely to be coupled to a flight response. Differential responses between and within species are expected since hearing ranges vary across species and the behavioral ecology of individual species is unlikely to completely overlap.

Southall et al. (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions at specific sound levels. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Southall et al. 2007). After examining all of the available data, the authors felt that the derivation of thresholds for behavioral response based solely on exposure level was not supported because context of the animal at the time of sound exposure was an important factor in estimating response. Nonetheless, in some conditions consistent avoidance reactions were noted at higher sound levels dependent on the marine mammal species or group allowing conclusions to be drawn. Most low-frequency cetaceans (mysticetes) observed in studies usually avoided sound sources at levels of less than or equal to 160 dB re 1 µPa. Published studies of mid-frequency cetaceans analyzed include sperm whales, belugas, bottlenose dolphins, and river dolphins. These groups showed no clear tendency, but for non-impulsive sounds, captive animals tolerated levels in excess of 170 dB re 1 µPa before showing behavioral reactions, such as avoidance, erratic swimming, and attacking the test apparatus. High-frequency

cetaceans (observed from studies with harbor porpoises) exhibited changes in respiration and avoidance behavior at levels between 90 and 140 dB re 1 µPa, with profound avoidance behavior noted for levels exceeding this. Phocid seals showed avoidance reactions at or below 190 dB re 1 µPa; thus, seals may actually receive levels adequate to produce TTS before avoiding the source. Recent studies with beaked whales have shown them to be particularly sensitive to noise, with animals during three playbacks of sound breaking off foraging dives at levels below 142 dB re 1 µPa, although acoustic monitoring during actual sonar exercises revealed some beaked whales continuing to forage at levels up to 157 dB re 1 µPa (Tyack et al. 2011).

Behavioral Reactions to Impulsive Sound Sources

Mysticetes

Baleen whales have shown a variety of responses to impulsive sound sources (e.g., explosives and seismic research air guns), including avoidance, reduced surface intervals, altered swimming behavior, and changes in vocalization rates (Castellote et al. 2012, Gordon et al. 2003, Richardson et al. 1995, Southall et al. 2007). While most bowhead whales did not show active avoidance until within 5 mi. (8 km) of seismic vessels (Richardson et al. 1995), some whales avoided vessels by more than 12 mi. (19 km) at received levels as low as 120 dB re 1 µPa root mean square (rms). Additionally, Malme et al. (1988) observed clear changes in diving and respiration patterns in bowheads at ranges up to 45 mi. (72 km) from seismic vessels, with received levels as low as 125 dB re 1 µPa.

Gray whales migrating along the U.S. west coast showed avoidance responses to seismic vessels by 10 percent of animals at 164 dB re 1 µPa, and by 90 percent of animals at 190 dB re 1 µPa, with similar results for whales in the Bering Sea (Malme 1986, 1988). In contrast, sound from seismic surveys was not found to impact feeding behavior or exhalation rates while resting or diving in western gray whales off the coast of Russia (Gailey et al. 2007, Yazvenko et al. 2007).

Humpback whales showed avoidance behavior at ranges of 3–5 mi. (5–8 km) from a seismic array during observational studies and controlled exposure experiments in western Australia (McCauley 1998; Todd et al. 1996) found no clear short-term behavioral responses by foraging humpbacks to explosions associated with construction operations in Newfoundland, but did see a trend of increased rates of net entanglement and a shift to a higher incidence of net entanglement closer to the noise source.

Seismic pulses at average received levels of 131 dB re 1 micropascal squared second (μPa^2-s) caused blue whales to increase call production (Di Iorio and Clark 2010). In contrast, McDonald et al. (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 6 mi. (10 km) from the seismic vessel (estimated received level 143 dB re 1 µPa peak-to-peak). Castellote et al. (2012) found that vocalizing fin whales in the Mediterranean left the area where a seismic survey was being conducted and that their displacement persisted beyond the completion of the survey. These studies demonstrate that even low levels of sound received far from the sound source can induce behavioral responses.

Odontocetes

Madsen et al. (2006) and Miller et al. (2009) tagged and monitored eight sperm whales in the Gulf of Mexico exposed to seismic airgun surveys. Sound sources were from approximately 2 to 7 nm away from the whales and based on multipath propagation received levels were as high as 162 dB SPL re 1 µPa with energy content greatest between 0.3 and 3.0 kHz (Madsen et al. 2006). The whales showed no horizontal avoidance, although the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing (Miller et al. 2009). The remaining

whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were 6 percent lower during exposure than control periods, suggesting subtle effects of sound on foraging behavior (Miller et al. 2009).

Captive bottlenose dolphins sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran et al. 2002).

Pinnipeds

A review of behavioral reactions by pinnipeds to impulsive noise can be found in Richardson et al. (1995) and Southall et al. (2007). Blackwell et al. (2004) observed that ringed seals exhibited little or no reaction to pipe-driving noise with mean underwater levels of 157 dB re 1 µPa rms and in air levels of 112 dB re 20 µPa, suggesting that the seals had habituated to the noise. In contrast, captive California sea lions avoided sounds from an underwater impulsive source at levels of 165–170 dB re 1 µPa (Finneran et al. 2003).

Experimentally, Götz and Janik (2011) tested underwater startle responses to a startling sound (sound with a rapid rise time and a 93 dB sensation level [the level above the animal's threshold at that frequency]) and a non-startling sound (sound with the same level, but with a slower rise time) in wild-captured gray seals. The animals exposed to the startling treatment avoided a known food source, whereas animals exposed to the non-startling treatment did not react or habituated during the exposure period. The results of this study highlight the importance of the characteristics of the acoustic signal in an animal's response of habituation.

Behavioral Reactions to Sonar and Other Active Acoustic Sources

Mysticetes

Specific to U.S. Navy systems using low frequency sound, studies were undertaken in 1997–98 pursuant to the Navy's Low Frequency Sound Scientific Research Program. These studies found only short-term responses to low frequency sound by mysticetes (fin, blue, and humpback) including changes in vocal activity and avoidance of the source vessel (Clark and Fristrup 2001, Croll et al. 2001, Fristrup et al. 2003, Miller et al. 2000, Nowacek et al. 2007). Recent work by Risch et al. (2012) found that humpback whale vocalizations ("songs") were reduced concurrent with pulses from the low frequency Ocean Acoustic Waveguide Remote Sensing source located approximately 200 km away. Baleen whales exposed to moderate low-frequency signals demonstrated no variation in foraging activity (Croll et al. 2001). However, five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives, although the alarm signal was long in duration, lasting several minutes, and purposely designed to elicit a reaction from the animals as a prospective means to protect them from ship strikes (Nowacek et al. 2004). Although the animal's received sound pressure level was similar in the latter two studies (133–150 dB SPL), the frequency, duration, and temporal pattern of signal presentation were different. Additionally, the right whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics, species differences, and individual sensitivity in producing a behavioral reaction.

Low-frequency signals of the Acoustic Thermometry of Ocean Climate sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark 2000) or to overtly affect elephant seal dives off California (Costa et al. 2003). However, they did produce subtle effects that varied in direction and degree among the individual seals, again illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Blue whales exposed to mid-frequency simulated sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón et al. 2012). It is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact because the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón et al. 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a sound pressure level of approximately 110–120 dB re 1 µPa (Melcón et al. 2012).

Blue whales also responded to a simulated mid-frequency sound source at a received sound level up to 160 dB re 1 µPa, by exhibiting generalized avoidance responses and changes to dive behavior during controlled exposure experiments (Goldbogen et al. 2013). However, reactions were not consistent across individuals based on received sound levels alone, and likely were the result of a complex interaction between sound exposure factors such as proximity to sound source and sound type (mid-frequency sonar simulation vs. pseudo-random noise), environmental conditions, and behavioral state. Surface feeding whales did not show a change in behavior during controlled exposure experiments, but deep feeding and non-feeding whales showed temporary reactions that quickly abated after sound exposure. Whales were sometimes less than a mile from the sound source during the controlled exposure experiments. Furthermore, the more dramatic reactions reported by Goldbogen et al. (2013) were from non-sonar like signals, a pseudorandom noise that could likely have been a novel signal to blue whales. These preliminary findings from Melcón et al. (2012) and Goldbogen et al. (2013) are consistent with the Navy's criteria and thresholds for predicting behavioral effects to mysticetes (including blue whales) from sonar and other active acoustic sources used in the quantitative acoustic effects analysis (Section 3.8.3.1.6, Quantitative Analysis). The behavioral response function predicts a probability of a substantive behavioral reaction for individuals exposed to a received sound pressure level of 120 dB re 1 µPa or greater, with an increasing probability of reaction with increased received level as demonstrated in Melcón et al. (2012). Although the long-term implications of disruption in call production to blue whale foraging and other behaviors are currently not well understood, vessel noise is much more pervasive in both time and space compared to the intermittent use of various types of sonar, including fathometers, fish-finders, research sonar, and Navy mid-frequency sonar. Understanding the impacts of vessel noise on blue whale call production is likely more of a concern given its broader implications.

Odontocetes

From 2007 to 2011, behavioral response studies were conducted through the collaboration of various research organizations in the Bahamas, Southern California, the Mediterranean, Cape Hatteras, and Norwegian waters. These studies attempted to define and measure responses of beaked whales and other cetaceans to controlled exposures of sonar and other sounds to better understand their potential impacts. Through analysis of the behavioral response studies, a preliminary overarching effect of greater sensitivity to all anthropogenic exposures was seen in beaked whales compared to the other odontocetes studied (Southall et al. 2009a). Therefore, recent studies have focused specifically on beaked whale responses to active sonar transmissions or controlled exposure playback of simulated sonar on various military ranges (Defence Science and Technology Laboratory 2007; Claridge and Durban 2009; Moretti et al. 2009; McCarthy et al. 2011; Tyack et al. 2011). Results from the 2007–2008 study conducted near the Bahamas showed a change in diving behavior of an adult Blainville's beaked whale to playback of simulated mid-frequency source and predator sounds (Boyd et al. 2008; Southall et al. 2009b; Tyack et al. 2011). Reaction to mid-frequency sounds included premature cessation of clicking

and termination of a foraging dive, and a slower ascent rate to the surface. Blainville's beaked whales located on the range were found to move off-range during sonar use and return only after the sonar transmissions have stopped, sometimes taking several days to do so (Claridge and Durban 2009; Moretti et al. 2009; McCarthy et al. 2011; Tyack et al. 2011). Preliminary results from a similar behavioral response study in Southern California waters have been presented for the 2010–2011 field season. De Ruiter et al. (2013a) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated mid-frequency active sonar during the 2010 and 2011 field seasons of the southern California behavioral response study. One of the 2011 tagged whales was also incidentally exposed to mid-frequency active sonar from a distant naval exercise. Received levels from the mid-frequency active sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa rms, respectively. Both tagged whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by De Ruiter et al. (2013a) as energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure from distant naval sonar exercises at comparable received levels, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor. Results from Schorr et al. (2014) with a larger sample (eight tagged Cuvier's beaked whales) noted: "the reactive dive durations observed in the experimental exposures do not appear far outside the normal behavioral range of some *Ziphius* in this region."

During a Submarine Commander Course at Pacific Missile Range Facility (PMRF) in Hawaii involving three surface ships and a submarine using mid-frequency sonar over the span of a multiple-day event, Manzano-Roth et al. (2013) determined that beaked whales (tentatively identified as Blainville's beaked whales) continued to make foraging dives at estimated distances of 13–52 km from the active mid-frequency sonar. The animals shifted to the southern edge of the instrumented range with differences in the dive vocal period duration, and dive rate. There also was a diel shift after the training event, with more dives occurring at night than prior to or during the activity. The animals closest to the source were estimated to have been exposed to levels somewhere between 137 and 162 dB re 1 µPa (rms).

The concern with beaked whales and an avoidance response is whether that displacement is likely to have long-term consequences for an animal or populations. Research involving three tagged Cuvier's beaked whales in the Southern California (SOCAL) Range Complex reported on by Falcone and Schorr (2012; 2014) has documented movements in excess of hundreds of kilometers by some those animals. Schorr et al. (2014) reported the results for an additional eight tagged Cuvier's beaked whale in the same area. Five of these eight whales made journeys of approximately 250 km from their tag deployment location, and one of these five made an extra-regional excursion over 450 km south to Mexico and back again. Given that some beaked whales may routinely move hundreds of kilometers as part of their normal pattern, temporarily leaving an area to avoid sonar or other anthropogenic activity may have little if any cost to such an animal. Photo identification studies in the SOCAL Range Complex have identified approximately 100 individual Cuvier's beaked whale individuals, with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart (Falcone and Schorr 2014). An increasing number of the beaked whales identified in a subsequent survey year, indicate that there may be a small resident population of beaked whales where the Navy routinely conducts training and testing with sonar. The results of this on-going, multi-year study suggest that training and testing activities in this are not driving this population of beaked whale away from that habitat. These results indicate long-term residency by individuals in an intensively used Navy training and testing area, which may also suggest a lack of long-term consequences as a result of exposure to Navy training and testing activities.

Controlled exposure experiments in 2007 and 2008 in the Bahamas recorded responses of false killer whales, short-finned pilot whales, and melon-headed whales to simulated MFA sonar (De Ruiter et al. 2013b). The responses to exposures between species were variable and are indicative of variability in species sensitivity. After hearing each MFA signal, false killer whales were found to have "increase[d] their whistle production rate and made more-MFA-like whistles" (De Ruiter et al. 2013b). In contrast, melon-headed whales had "minor transient silencing" after each MFA signal, while pilot whales had no apparent response. Consistent with the findings of other previous research (see Southall et al. 2007 for review), De Ruiter et al. (2013b) found the responses were variable by species and with the context of the sound exposure. In the 2007–2008 Bahamas study, playback sounds of a potential predator—a killer whale—resulted in a similar but more pronounced reaction, which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area. The authors noted, however, that the magnified reaction to the predator sounds could represent a cumulative effect of exposure to the two sound types since killer whale playback began approximately 2 hours after mid-frequency source playback. In contrast, preliminary analyses suggest that none of the pilot whales or false killer whales in the Bahamas showed an avoidance response to controlled exposure playbacks (Southall et al. 2009b). Miller et al. (2011) reported on behavioral responses of pilot whales and killer whales off Norway to a transducer with outputs, including the mid-frequency 1–2 kHz and 6–7 kHz ranges (see also Kvadsheim et al. 2011). There were, however, methodological issues with the exposure experiment, given the sound sources had significant frequency output outside the intended 1–2 kHz and 6–7 kHz ranges and the simultaneous use of other high frequency sources used to track the whales. Because the two primary sources had output frequencies much broader than characterized (see Figure 4.8 in Kvadsheim et al. 2011 and Figure 9 in Miller et al. 2011), it calls into question the control of the exposures and the reported results. The authors note that "we cannot rule out that the higher source level itself or different patterns of reverberation and/or harmonics, were salient features of the source to which the subject whales were more likely to respond with higher severity levels." It is also unclear from the data if reactions could have been from the vessel itself, without sonar on, or from additional whale observing boats that were separate from the sonar source vessel. The sample size used to derive their results was very small (4 individual killer whales). The experiments also made use of prolonged, continued, and repeated approaches often to relatively close ranges to killer whale pods. The practice of continually heading towards the target whale (and course correcting to ensure that the source vessel was always heading towards the whale) also confounds the interpretation of the response. The methodology of this study makes implementation of the proposed risk function difficult. Navy vessels do not, in training conditions, continually adjust their heading to maintain an approach on individual whales. Therefore, the responses interpreted by the authors are a result of conditions that would not occur during Navy training and testing exercises. Using the risk function proposed in Miller et al. (2014) to estimate exposure impacts would likely lead to an inaccurate overestimate of avoidance responses.

As presented in more detail in Section 3.8.3.1.2.8 (Stranding) and U.S. Department of the Navy (2013c), in May 2003, killer whales in Haro Strait, Washington were observed exhibiting what were believed by some observers to be aberrant behaviors while the USS SHOUP was in the vicinity and using MFA sonar. Sound fields modeled for the USS SHOUP sonar transmissions (Fromm 2004a, b; National Marine Fisheries Service 2005b; U.S. Department of the Navy 2004) estimated a mean received sound pressure level of approximately 169 dB re 1 µPa at the location of the killer whales during the closest point of approach between the animals and the vessel (estimated sound pressure levels ranged from 150 to 180 dB re 1 µPa). For a frame of reference regarding these underwater sound pressure levels, whale watching vessels in the same waters have measured source levels ranged from 145 to 169 dB re 1 µPa at 1 m (Erbe 2002) and hydrophone measurements from a location in Admiralty Inlet (Washington) for the

Keystone/Port Townsend ferry were used to estimate the ferry's source level of to be 175 to 184 dB re 1 μPa at 1 m (Bassett et al. 2010).

In the Caribbean, research on sperm whales near the Grenadines in 1983 coincided with the U.S. intervention in Grenanda where sperm whales were observed to interrupt their activities by stopping echolocation and leaving the area in the presence of underwater sounds surmised to have originated from submarine sonar signals since the source was not visible (Watkins and Schevill 1975; Watkins et al. 1985). The authors did not provide any sound levels associated with these observations, although they did note getting a similar reaction from banging on their boat hull. It was unclear if the sperm whales were reacting to the "sonar" signal itself or to a potentially new unknown sound in general as had been demonstrated previously on another occasion in which sperm whales in the Caribbean stopped vocalizing when presented with sounds from nearby acoustic pingers (Watkins and Schevill 1975).

Researchers at the Navy's Marine Mammal Program facility in San Diego, California, have conducted a series of controlled experiments on bottlenose dolphins and beluga whales to study TTS (Finneran and Schlundt 2004; Finneran et al. 2001, 2003, 2005; Schlundt et al. 2000). Ancillary to the TTS studies, scientists evaluated whether the marine mammals performed their trained tasks when prompted, during and after exposure to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Finneran et al. 2002, Schlundt et al. 2000). Bottlenose dolphins exposed to 1-second intense tones exhibited short-term changes in behavior above received sound levels of 178–193 dB re 1 μPa rms, and beluga whales did so at received levels of 180–196 dB re 1 μPa and above. In some instances, animals exhibited aggressive behavior toward the test apparatus (Ridgway et al. 1997, Schlundt et al. 2000). While these studies were generally not designed to test avoidance behavior and animals were commonly reinforced with food, the controlled environment and ability to measure received levels provide insight on received levels at which animals will behaviorally respond to sound sources.

Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms, such as those used on fishing nets to help deter marine mammals from becoming caught or entangled (Kastelein et al. 2001, 2006) and emissions for underwater data transmission (Kastelein et al. 2005b). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein et al. 2006), again highlighting the importance in understanding species differences in the tolerance of underwater noise (Southall et al. 2007).

Pinnipeds

Different responses displayed by captive and wild phocid seals to sound judged to be "unpleasant" have been reported; captive seals habituated (did not avoid the sound), and wild seals showed avoidance behavior (Götz and Janik 2010). Captive seals received food (reinforcement) during sound playback, while wild seals were exposed opportunistically. These results indicate that motivational state (e.g., reinforcement via food acquisition) can be a factor in whether or not an animal habituates to novel or unpleasant sounds. Another study found that captive hooded seals reacted to 1–7 kHz sonar signals, in part with displacement to the areas of least sound pressure level, at levels between 160 and 170 dB re 1 μPa (Kvadsheim et al. 2010). Low-frequency signals from the Acoustic Thermometry of Ocean Climate sound source were not found to overtly affect elephant seal dives (Costa et al. 2003). However, they did produce subtle effects that varied in direction and degree among the individual seals, again illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Captive studies with other pinnipeds have shown a reduction in dive times when presented with qualitatively "unpleasant" sounds. These studies indicated that the subjective interpretation of the pleasantness of a sound, minus the more commonly studied factors of received sound level and sounds associated with biological significance, can affect diving behavior (Götz and Janik 2010).

Sea Otters

Sea otters depend on visual acuity to forage, and their eyes are able to focus both in air and underwater (Riedman and Estes 1990). Davis et al. (1988) conducted a behavioral response study that included underwater an acoustic harassment devices (10–20 kHz at 190 dB; designed to keep dolphins and pinnipeds from being caught in fishing nets). The authors found that the sea otters often remained undisturbed, quickly became tolerant of the various sounds, and even when chased from a location by presentation of a purposefully harassing sound, they generally moved only a short distance (110–220 yd. [100–200 m]) before resuming normal activity. Recently, Ghoul and Reichmuth (2013) confirmed that sea otter's underwater hearing sensitivity is significantly reduced in comparison to that of a pinniped, which suggested that sea otters are not especially well adapted for hearing underwater and that underwater hearing has been less important to their survival. USFWS has stated that they had no evidence that defense-related activities have had any adverse effects on the well-monitored experimental population of Southern sea otters at San Nicolas Island (California) or in the SOCAL Range Complex (U.S. Fish and Wildlife Service 2011).

Behavioral Reactions to Vessels

Although no re-analysis of impacts associated with vessel noise is necessary in this Supplemental EIS/OEIS, the information is presented here given that the new method of analysis for underwater acoustic stressors incorporates likely avoidance of the areas having intense vessel activity. During the training of a Carrier Strike Group, as proposed in the Study Area, high-intensity vessel activity would occur in the vicinity of sonar and other active acoustic sources.

Navy vessels during the Carrier Strike Group exercise are a small component of overall vessel traffic and vessel noise in the Gulf of Alaska. Figure 3.8-5 depicts the commercial vessel density provided by the automated identification system data for the area from Alaska to the Pacific Northwest in 2011 (it can be reasonably assumed that the vessel traffic patterns depicted are similar year to year). As evident from the graphic, commercial vessel use is highest in the U.S. EEZ, at straits and passages, and along least-distance line routes between ports. As is evident from the figure, some of those commercial vessel routes pass through the TMAA.

Data presented by Mintz and Filadelfo (2011) shows that Navy vessel-hours constitute approximately 6 percent of large vessel-hours in the U.S. EEZ and small percentages even within Navy concentration areas such as the range complexes (i.e., Virginia Capes, Hawaii Range Complex, Southern California). In addition, Navy combatant vessels have been designed to generate minimal noise and use ship quieting technology to elude detection by enemy passive acoustic devices (Mintz and Filadelfo 2011, Southall et al. 2005). Navy vessels do not purposefully approach or follow marine mammals and are generally not expected to elicit avoidance or alarm behavior.

Sound emitted from large vessels, such as shipping and cruise ships, is the principal source of low-frequency noise in the ocean today, and marine mammals are known to react to or be affected by that noise (Anderward et al. 2013; Erbe et al. 2014; Hatch and Wright 2007; Hildebrand 2005; Richardson et al. 1995; Williams et al. 2014a, 2014b). Acoustic monitoring in the TMAA has indicated ship noise has detected with some regularity at the recording site mid-shelf off Kenai Peninsula site and

relatively infrequently at the site farther offshore near the shelf-break (for the locations of these passive acoustic monitoring buoys, see Baumann-Pickering et al. 2012b).

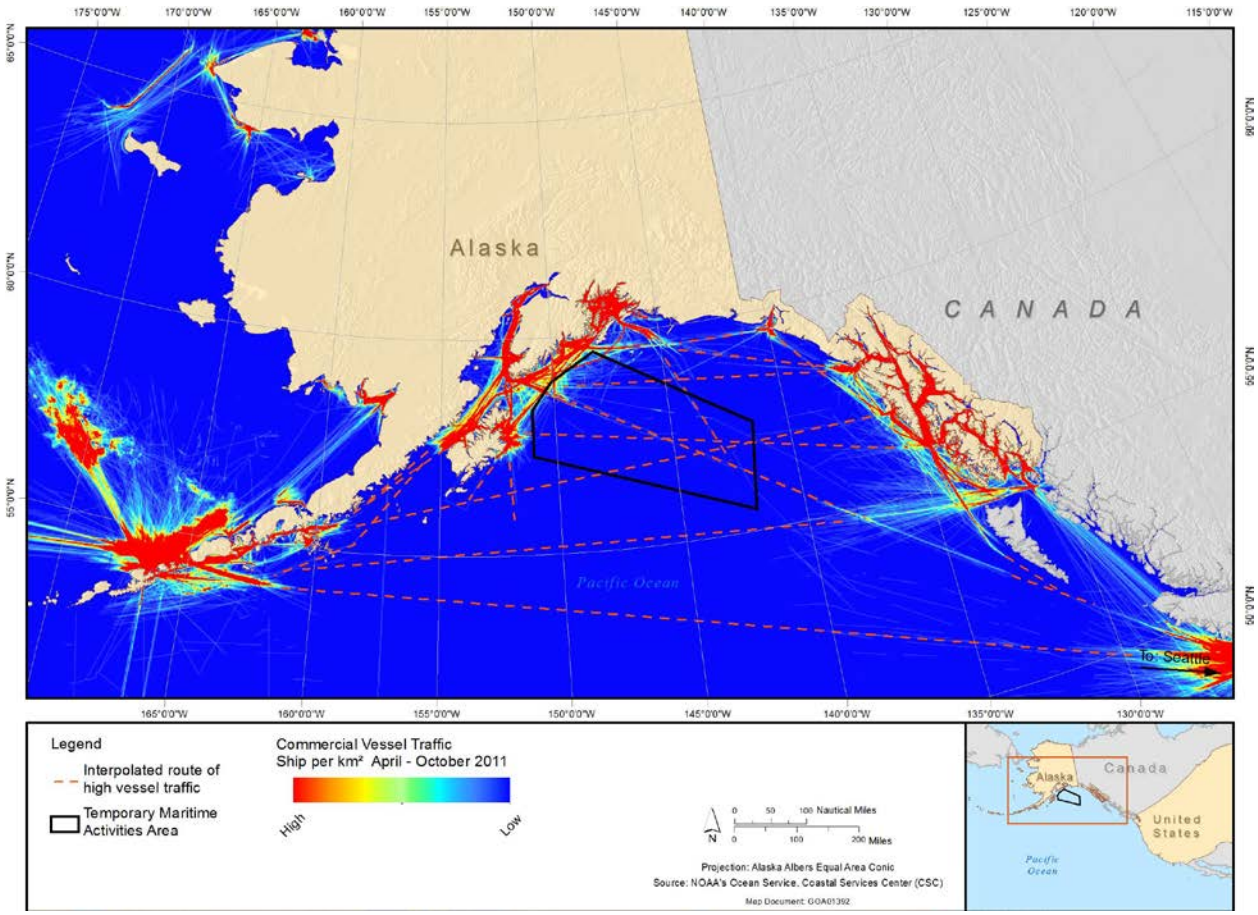

Figure 3.8-5: Commercial Vessel Density Involving the Study Area in 2011

Limited evidence suggests that beaked whales respond to vessel noise, anthropogenic noise in general, and mid-frequency sonar at similar sound levels (Aguilar de Soto et al. 2006, Tyack 2009, Tyack et al. 2011). In short term studies, researchers have noted changes in resting and surface behavior states of cetaceans to whale-watching vessels (Acevedo 1991, Aguilar de Soto et al. 2006, Arcangeli and Crosti 2009, Au and Green 2000, Christiansen et al. 2010, Erbe 2002, Noren et al. 2009, Stensland and Berggren 2007, Stockin et al. 2008, Williams et al. 2009).

Most studies of this type are opportunistic and have only examined the short-term response to vessel sound and vessel traffic (Magalhães et al. 2002, Noren et al. 2009, Richardson et al. 1995, Watkins 1981); however, the long-term and cumulative implications of ship sound on marine mammals is largely unknown (National Marine Fisheries Service 2012a). Clark et al. (2009) provided a discussion on calculating the cumulative impacts of anthropogenic noise on baleen whales and estimated that in one Atlantic setting and with the noise from the passage of two vessels, the optimal communication space for the North Atlantic right whale could be decreased by 84 percent (see also Hatch et al. 2012).

Mysticetes

Fin whales may alter their swimming patterns by increasing speed and heading away from the vessel, as

well as by changing their breathing patterns in response to a vessel approach (Jahoda et al. 2003). Vessels that remained 328 ft. (100 m) or farther from fin and humpback whales were largely ignored in one study in an area where whale-watching activities are common (Watkins 1981). Only when vessels approached more closely did the fin whales in this study alter their behavior by increasing time at the surface and exhibiting avoidance behaviors. Other studies have shown when vessels are near, some but not all fin whales change their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions (Au and Green 2000; Castellote et al. 2012; Richter et al. 2003; Williams et al. 2002).

Based on passive acoustic recordings and in the presence of sounds from passing vessels, Melcón et al. (2012) reported that blue whales had an increased likelihood of producing certain types of calls. Castellote et al. (2012) demonstrated that fin whales songs had shortened duration and decreased bandwidth, center frequency, and peak frequency in the presence of high vessel noise levels such as those found in the Strait of Gibraltar. At present it is not known if these changes in vocal behavior corresponded to changes in other behaviors.

In the Watkins (1981) study, humpback whales did not exhibit any avoidance behavior but did react to vessel presence. In a study of regional vessel traffic Baker et al. (1983) found that when vessels were in the area, the respiration patterns of the humpback whales changed. The whales also exhibited two forms of behavioral avoidance: horizontal avoidance (changing direction or speed) when vessels were between 1.24 and 2.48 mi. (2,000 and 4,000 m) away, and vertical avoidance (increased dive times and change in diving pattern) when vessels were within 1.24 mi. (2,000 m) away (Baker et al. 1983). Similar findings were documented for humpback whales that were approached by whale watch vessels in Hawaii and had responses that including increased speed, changed direction to avoid, and staying submerged for longer periods of time (Au and Green 2000).

Recently, Gende et al. (2011) reported on observations of humpback whale in inland waters of Southeast Alaska subjected to frequent cruise ship transits (i.e., in excess of 400 transits in a 4-month season in 2009). The study was focused on determining if close encounter distance was a function of vessel speed. The reported observations, however, seem in conflict with other reports of avoidance at much greater distance, so it may be that humpback whales in those waters are more tolerant of vessels (given their frequency) or are engaged in behaviors, such as feeding, that they are less willing to abandon. This example again highlights that context is critical for predicting and understanding behavioral reactions as concluded by Southall et al. (2007) and Ellison et al. (2012). Navy vessels avoid approaching large whales head on and maneuver to maintain a mitigation zone of 500 yd. (457 m) around observed large whales.

Sei whales have been observed ignoring the presence of vessels and passing close to the vessel (National Marine Fisheries Service 1998). In the presence of approaching vessels, blue whales perform shallower dives accompanied by more frequent surfacing, but otherwise do not exhibit strong reactions (Calambokidis et al. 2009a). Minke whales in the Antarctic did not show any apparent response to a survey vessel moving at normal cruising speeds (about 12 knots [22 km/hour]) at a distance of 5.5 nm; however, when the vessel drifted or moved at very slow speeds (about 1 knot [1.8 km/hour), many whales approached it (Leatherwood et al. 1982).

Anderward et al. (2013) investigated minke whale reactions to a temporary increase in vessel traffic off Ireland's coast in association with construction activities. They found the presence of minke whales decreased with the increase in vessel traffic and that low-frequency vessel noise was the likely cause of

the displacement. The results, however, suggested “slight degrees of avoidance” to the increase in the number of vessels present instead of an “extreme displacement response” (Anderward et al. 2013).

Although not present in the Study Area, North Atlantic right whales tend not to respond to the sounds of oncoming vessels and continue to use habitats in high vessel traffic areas (Nowacek et al. 2004). Studies show that North Atlantic right whales demonstrate little if any reaction to sounds of vessels approaching or the presence of the vessels themselves (Nowacek et al. 2004, Terhune and Verboom 1999). Although this may minimize potential disturbance from passing ships, it does increase the whales’ vulnerability to potential ship strike. The regulated vessel approach distance for North Atlantic right whales is 500 yd. (457 m) (National Oceanic and Atmospheric Administration 1997). It is unknown how informative observations from Atlantic right whales may be with regard to the likely behavior of North Pacific right whales.

Using historical records, Watkins (1986) showed that the reactions of four species of mysticetes to vessel traffic and whale-watching activities in Cape Cod had changed over the 25-year period examined (1957–1982). Reactions of minke whales changed from initially more positive reactions, such as coming towards the boat or research equipment to investigate, to more 'uninterested' reactions towards the end of the study. Finback [fin] whales, the most numerous species in the area, showed a trend from initially more negative reactions, such as swimming away from the boat with limited surfacing, to more uninterested (ignoring) reactions allowing boats to approach within 98.4 ft. (30 m). Right whales showed little change over the study period, with a roughly equal number of reactions judged to be negative and uninterested; no right whales were noted as having positive reactions to vessels. Humpback whales showed a trend from negative to positive reactions with vessels during the study period. The author concluded that the whales had habituated to the human activities over time (Watkins 1986).

Mysticetes have been shown to both increase and decrease calling behavior in the presence of vessel noise. An increase in feeding call rates and repetition by humpback whales in Alaskan waters is associated with vessel noise (Doyle et al. 2008). Melcón et al. (2012) also recently documented that blue whales increased the proportion of time spent producing certain types of calls when vessels were present. Conversely, decreases in singing activity have been noted near Brazil due to boat traffic (Sousa-Lima and Clark 2008). The Central North Pacific stock of humpback whales is the focus of whale-watching activities in both its feeding grounds (Alaska) and breeding grounds (Hawaii). Regulations addressing minimum approach distances and vessel operating procedures are in place in Hawaii. However, there is still concern that whales may abandon preferred habitats if the disturbance is too high (Allen and Angliss 2010).

Odontocetes

Sperm whales generally react only to vessels approaching within several hundred meters; however, some individuals may display avoidance behavior, such as quick diving (Magalhães et al. 2002; Wursig et al. 1998). One study showed that after diving, sperm whales showed a reduced timeframe from when they emitted the first click than before vessel interaction (Richter et al. 2006). The smaller whale-watching and research vessels generate more noise in higher frequency bands and are more likely to approach odontocetes directly, and to spend more time near the individual whale. Reactions to Navy vessels are not well documented, but smaller whale-watching and research boats have been shown to cause these species to alter their breathing intervals and echolocation patterns.

Wursig et al. (1998) reported most *Kogia* species and beaked whales react negatively to vessels by quick diving and other avoidance maneuvers. Cox et al. (2006) noted very little information is available on the behavioral impacts of vessels or vessel noise on beaked whales. A single observation of vocal disruption

of a foraging dive by a tagged Cuvier's beaked whale, documented when a large noisy vessel was opportunistically present, suggests that vessel noise may disturb foraging beaked whales (Aguilar de Soto et al. 2006). Tyack et al. (2011) noted the result of a controlled exposure to pseudorandom noise suggests that beaked whales would respond to vessel noise and at similar received levels to those noted previously and for mid-frequency sonar.

Most delphinids react neutrally to vessels, although both avoidance and attraction behavior is known to occur (Anderward et al. 2013; Hewitt 1985; Wursig et al. 1998). Avoidance reactions include a decrease in resting behavior or change in travel direction (Bejder et al. 2006). Incidence of attraction includes harbor porpoises approaching a vessel and common, rough-toothed, and bottlenose dolphins bow riding and jumping in the wake of a vessel (Norris and Prescott 1961; Ritter 2002; Shane et al. 1986; Wursig et al. 1998). A study of vessel reactions by dolphin communities in the eastern tropical Pacific found that populations that were often the target of tuna purse-seine fisheries (spotted, spinner and common dolphins) show evasive behavior when approached; however, populations that live closer to shore (within 100 nm; coastal spotted and bottlenose dolphins) that are not set on by purse-seine fisheries tend to be attracted to vessels (Archer et al. 2010a, b).

Killer whales, the largest of the delphinids, are targeted by numerous small whale-watching vessels in the Pacific Northwest, and research suggests that whale-watching guideline distances may be insufficient to prevent behavioral disturbances (Noren et al. 2009). These vessels have measured source levels that ranged from 145 to 169 dB re 1 µPa at 1 m, and the sound they produce underwater has the potential to result in behavioral disturbance, interfere with communication, and affect the killer whales' hearing (Erbe 2002). Killer whales foraged significantly less and traveled significantly more when boats were within 328 ft (100 m) of the whales (Kruse 1991; Lusseau et al. 2009; Noren et al. 2009; Trites and Bain 2000; Williams et al. 2002, 2009). These short-term feeding activity disruptions may have important long-term population-level effects (Lusseau et al. 2009, Noren et al. 2009; Williams et al. 2014b). The reaction of the killer whales to whale-watching vessels may be in response to the vessel pursuing them, rather than to the noise of the vessel itself, or to the number of vessels in their proximity. Williams et al. (2014b) reported moderate responses by northern resident killer whales to large ship traffic in Johnstone Strait, Canada. The authors did caveat their work by stating the evaluation of response was highly influenced by a subjective decision about the severity score used to indicate a response.

For inland waters of Washington State, regulations were promulgated in 2011, restricting approach to within 200 yd. (182.9 m) of "whales." The approach regulations do not apply to "government vessels," which includes the U.S. Navy. Although these regulations were specifically developed to protect the endangered southern resident killer whales, the regulation reads "whales" and does not specify if it applies to only killer whales, all cetaceas, or marine mammals with a common name including the word "whale" (National Oceanic and Atmospheric Administration 2011d). Navy standard practice is to avoid approaching marine mammals head on and to maneuver to maintain a mitigation zone of 500 yd. around detected whales, which is therefore more protective than the distance provided by the regulation.

Similar behavioral changes (increases in traveling and other stress-related behaviors) have been documented in Indo-Pacific bottlenose dolphins in Zanzibar (Christiansen et al. 2010, Englund and Berggren 2002, Stensland and Berggren 2007). Short-term displacement of dolphins due to tourist boat presence has been documented (Carrera et al. 2008), while longer term or repetitive/sustained displacement for some dolphin groups due to chronic vessel noise has been noted (Haviland-Howell et al. 2007; Miksis-Olds et al. 2007). Most studies of the behavioral reactions to vessel traffic of

bottlenose dolphins have documented at least short-term changes in behavior, activities, or vocalization patterns when vessels are near, although the distinction between vessel noise and vessel movement has not been made clear (Acevedo 1991; Arcangeli and Crosti 2009; Berrow and Holmes 1999; Gregory and Rowden 2001; Janik and Thompson 1996; Lusseau 2004; Mattson et al. 2005; Scarpaci et al. 2000).

Both finless porpoise (Li et al. 2008) and harbor porpoise (Polacheck and Thorpe 1990) routinely avoid and swim away from large motorized vessels. The vaquita, which is taxonomically closely related to the harbor porpoise in the Study Area, appears to avoid large vessels at about 2,995 ft (913 m) (Jaramillo-Legorreta et al. 1999). The assumption is that the harbor porpoise would respond similarly to large Navy vessels.

Odontocetes have been shown to make short-term changes to vocal parameters such as intensity (Holt et al. 2008) as an immediate response to vessel noise, as well as increase the pitch, frequency modulation, and length of whistling (May-Collado and Wartzok 2008). Likewise, modification of multiple vocalization parameters has been shown in belugas residing in an area known for high levels of commercial traffic. These animals decreased their call rate, increased certain types of calls, and shifted upward in frequency content in the presence of small vessel noise (Lesage et al. 1999). Another study detected a measurable increase in the amplitude of their vocalizations when ships were present (Scheifele et al. 2005). Killer whales are also known to modify their calls during increased noise. For example, the source level of killer whale vocalizations was shown to increase with higher background noise levels associated with vessel traffic (the Lombard effect) (Holt et al. 2008; Hotchkin and Parks 2013). In addition, killer whale calls with a high-frequency component had higher source levels than other calls, which may be related to behavioral state, or may reflect a sustained increase in background noise levels (Holt et al. 2011). On the other hand, long-term modifications to vocalizations may be indicative of a learned response to chronic noise, or of a genetic or physiological shift in the populations. This type of change has been observed from killer whales off the northwestern coast of the United States between 1973 and 2003. This population increased the duration of primary calls once a threshold in observed vessel density (e.g., whale watching) was reached, which has been suggested as a long-term response to increased masking noise produced by the vessels (Foote et al. 2004).

Pinnipeds

Little is known about pinniped reactions to underwater non-impulsive sounds (Southall et al. 2007), including vessel noise. In a review of reports on reactions of pinnipeds to small craft and ships, Richardson et al. (1995) note that information on pinniped reactions is limited and most reports are based on anecdotal observations. Specific case reports in Richardson et al. (1995) vary based on factors such as routine anthropogenic activity, distance from the vessel, engine type, wind direction, and ongoing subsistence hunting. As with reactions to sound reviewed by Southall et al. (2007), pinniped responses to vessels are affected by the context of the situation and by the animal's experience. In summary, pinniped reactions to vessels are variable; reports include a wide entire spectrum of possibilities, from avoidance and alert to cases where animals in the water are attracted and cases on land where there is lack of significant reaction suggesting "habituation" or "tolerance" of vessels (Richardson et al. 1995). Anderward et al. (2013) investigated grey seal reactions to an increase in vessel traffic off Ireland's coast in association with construction activities, and their data suggests the number of vessels had an indeterminate effect on the seals' presence.

A study of reactions of harbor seals hauled out on ice to cruise ship approaches in Disenchantment Bay, Alaska, revealed that animals are more likely to flush and enter the water when cruise ships approach within 1,640 ft (500 m) and four times more likely when the cruise ship approaches within 328 ft (100 m)

(Jansen et al. 2010). Navy vessels would generally not operate in vicinity of nearshore natural areas that are pinniped haulout or rookery locations.

Sea Otters

Sea otters depend on visual acuity to forage, and their eyes are able to focus both in air and underwater (Riedman and Estes 1990). Davis et al. (1988) conducted the one identified study of southern sea otter's reactions to various underwater and in-air acoustic stimuli. The purpose of the study was to identify a means to purposefully move sea otters from a location in the event of an oil spill. Anthropogenic sound sources used in this behavioral response study included truck air horns and an acoustic harassment device (10–20 kHz at 190 dB; designed to keep dolphins and pinnipeds from being caught in fishing nets). The authors found that the sea otters often remained undisturbed, quickly became tolerant of the various sounds, and even when the desired response occurred (chased from a location) by the presence of a harassing sound, they generally moved only a short distance (110–220 yd. [100–200 m]) before resuming normal activity.

Behavioral Reactions to Aircraft and Missile Overflights

The following paragraphs summarize what is known about the reaction of various marine mammal species to overhead flights of many types of fixed-wing aircraft, helicopters, and missiles. Although no re-analysis of impacts associated with aircraft and missile overflights is necessary in this Supplemental EIS/OEIS, the information is presented here given the new analysis of underwater acoustic stressors incorporates the potential avoidance of areas with high-intensity activity or hovering helicopters as would be present during training involving a Carrier Strike Group (see Chapter 2, Table 2.3-1). Thorough reviews of the subject and available information are presented in Richardson et al. (1995), Efroymson et al. (2001), Luksenburg and Parsons (2009), and Holst et al. (2011). The most common responses of cetaceans to overflights were short surfacing durations, abrupt dives, and percussive behavior (breaching and tail slapping) (Nowacek et al. 2007). Other behavioral responses such as flushing and fleeing the area of the source of the noise have also been observed (Holst et al. 2011, Manci et al. 1988). Richardson et al. (1995) noted that marine mammal reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations lacking clear distinction between reactions potentially caused by the noise of the aircraft and the visual cue an aircraft presents. In addition it was suggested that variations in the responses noted were due to generally other undocumented factors associated with overflight (Richardson et al. 1995). These factors could include aircraft type (single engine, multi-engine, jet turbine), flight path (centered on the animal, off to one side, circling, level and slow), environmental factors such as wind speed, sea state, cloud cover, and locations where native subsistence hunting continues.

Mysticetes

Mysticetes either ignore or occasionally dive in response to aircraft overflights (Koski et al. 1998; Efroymson et al. 2001). Richardson et al. (1995) reported that while data on the reactions of mysticetes is meager and largely anecdotal, there is no evidence that single or occasional aircraft flying above mysticetes causes long-term displacement of these mammals. In general, overflights above 1,000 ft (305 m) do not cause a reaction, and NOAA has promulgated a regulation for Hawaiian Waters and the Hawaii Humpback Whale National Marine Sanctuary adopting this stand-off distance. For right whales, the stand-off distance for aircraft is 500 yd. (427 m) (National Marine Fisheries Service 2001b).

Bowhead whales in the Beaufort Sea exhibited a transient behavioral response to fixed-wing aircraft and vessels. Reactions were frequently observed at less than 1,000 ft (305 m) above sea level, infrequently observed at 1,500 ft (457 m), and not observed at 2,000 ft (610 m) above sea level (Richardson et al.

1995). Bowhead whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns. Behavioral reactions decreased in frequency as the altitude of the helicopter increased to 492 ft (150 m) or higher. It should be noted that bowhead whales may have more acute responses to anthropogenic activity than many other marine mammals since these animals are often presented with limited egress due to limited open water between ice floes. Additionally many of these animals may be hunted by Native Alaskans, which could lead to animals developing additional sensitivity to human noise and presence.

Odontocetes

Variable responses to aircraft have been observed in toothed whales, though overall little change in behavior has been observed during flyovers. Some toothed whales dove, slapped the water with their flukes or flippers, or swam away from the direction of the aircraft during overflights; others did not visibly react (Richardson et al. 1995).

During standard marine mammal surveys at an altitude of 750 ft (229 m), some sperm whales remained on or near the surface the entire time the aircraft was in the vicinity, while others dove immediately or a few minutes after being sighted. Other authors have corroborated the variability in sperm whales' reactions to fixed-wing aircraft or helicopters (Green et al. 1992; Richter et al. 2003, 2006; Smultea et al. 2008a; Wursig et al. 1998). In one study, sperm whales showed no reaction to a helicopter until they encountered the downdrafts from the rotors (Richardson et al. 1995). A group of sperm whales responded to a circling aircraft (altitude of 800–1,100 ft [244–335 m]) by moving closer together and forming a defensive fan-shaped semicircle, with their heads facing outward. Several individuals in the group turned on their sides, apparently to look up toward the aircraft (Smultea et al. 2008a). Whale-watching aircraft apparently caused sperm whales to turn more sharply but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter et al. 2003). Navy aircraft do not fly at low altitude, hover over, or follow whales and so are not expected to evoke this type of response.

Smaller delphinids generally react to overflights either neutrally or with a startle response (Wursig et al. 1998). The same species that show strong avoidance behavior to vessel traffic (*Kogia* species and beaked whales) also react to aircraft (Wursig et al. 1998). Beluga whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns to a greater extent than mysticetes in the same area (Patenaude et al. 2002). These reactions increased in frequency as the altitude of the helicopter dropped below 492 ft (150 m).

Pinnipeds

Richardson et al. (1995) noted that data on pinniped reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations. Richardson et al.'s (1995) summary of this variable data note that responsiveness generally was dependent on the altitude of the aircraft, the abruptness of the associated aircraft sound, and life cycle stage (e.g., breeding and molting). Hauled out pinnipeds exposed to aircraft sight and/or sound often react by becoming alert and in many cases rushing into the water. Stampedes resulting in mortality to pups (by separation or crushing) have been noted in some cases, although it is rare (Holst et al. 2011 provides an up-to-date review of this subject).

Helicopters are used in studies of several species of seals hauled out and are considered an effective means of observation (Bester et al. 2002, Gjertz and Børset 1992), although they have been known to elicit behavioral reactions such as fleeing (Hoover 1988). In other studies, harbor seals showed no reaction to helicopter overflights (Gjertz and Børset 1992).

Ringed seals near an oil production island in Alaska reacted to approaching Bell 212 helicopters generally by increasing vigilance, although one seal left their basking site for the water after a helicopter approached within approximately 328 ft (100 m) (Blackwell et al. 2004). Seals in the study near an oil production platform were thought to be habituated and showed no reactions to industrial noise in water or in air, including impact pipe-driving, during the rest of the observations.

For California sea lions and Steller sea lions at a rocky haulout off Crescent City in northern California, helicopter approach to landing typically caused the most severe response (National Oceanic and Atmospheric Administration 2010a). Responses were also dependent on the species with Steller sea lions being more "skittish" and California sea lions more tolerant. The timing between subsequent approaches affected the number of animals hauled out in between exposures and fewer animals reacted upon subsequent exposures (National Oceanic and Atmospheric Administration 2010a).

Pinnipeds reactions to rocket launches and overflight at San Nicolas Island (California) are studied annually pursuant to the Navy's Incidental Harassment Authorization covering that testing. For the time period of August 2001–October 2008 (and consistent with other reports), Holst et al. (2011) documented that behavioral reactions differed between species. California sea lions startled and increased vigilance for up to 2 minutes after a rocket overflight, with some individuals moving down the beach or returning to the water. Northern elephant seals showed little reaction to any overflight. Harbor seals had the most pronounced reactions of the three species observed with most animals within approximately 2.5 mi. (4 km) of the rocket trajectory leaving their haulout sites for the water and not returning for several hours. The authors concluded that the effects of the rocket launches were minor with no effects on local populations, evidenced by the increasing populations of pinnipeds on San Nicolas Island (Holst et al. 2011).

Sea Otters

There is no specific information available indicating that overflights of any kind have an impact on sea otters. Fixed-wing aerial surveys are often recommended as a means to monitor populations of sea otter. There has been no evidence that any aircraft or missile overflight has had adverse effects on the translocated colony of sea otters at the Navy's San Nicolas Island located off the coast of Southern California (U.S. Department of the Navy 2002; U.S. Fish and Wildlife Service 2011).

3.8.3.1.2.7 Repeated Exposures

Repeated exposures of an individual to multiple sound-producing activities over a season, year, or life stage could cause reactions with costs that can accumulate over time to cause long-term consequences for the individual. Conversely, some animals habituate to or become tolerant of repeated exposures over time, learning to ignore a stimulus that in the past has not accompanied any overt threat.

Repeated exposure to acoustic and other anthropogenic stimuli has been studied in several cases, especially as related to vessel traffic and whale watching. Common dolphins in New Zealand responded to dolphin-watching vessels by interrupting foraging and resting bouts, and took longer to resume behaviors in the presence of the vessel (Stockin et al. 2008). The authors speculated that repeated interruptions of the dolphins foraging behaviors could lead to long-term implications for the population. Bejder et al. (2006) studied responses of bottlenose dolphins to vessel approaches and found stronger and longer-lasting reactions in populations of animals that were exposed to lower levels of vessel traffic overall. The authors indicated that lesser reactions in populations of dolphins regularly subjected to high levels of vessel traffic could be a sign of habituation, or it could be that the more sensitive animals in this population previously abandoned the area of higher human activity.

Marine mammals exposed to high levels of human activities may leave the area, habituate to the activity, or tolerate the disturbance and remain in the area. Marine mammals that are more tolerant may stay in a disturbed area, whereas individuals that are more sensitive may leave for areas with less human disturbance. However, animals that remain in the area throughout the disturbance may be unable to leave the area for a variety of physiological or environmental reasons. Terrestrial examples of this abound as human disturbance and development displace more sensitive species, and tolerant animals move in to exploit the freed resources and fringe habitat. Longer-term displacement can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Bejder et al. 2006, Blackwell et al. 2004, Teilmann et al. 2006). Gray whales in Baja California abandoned an historical breeding lagoon in the mid-1960s due to an increase in dredging and commercial shipping operations. Whales did repopulate the lagoon after shipping activities had ceased for several years (Bryant et al. 1984). Over a shorter time scale, studies on the Atlantic Undersea Test and Evaluation Center (AUTEC) instrumented range in the Bahamas have shown that some Blaineville's beaked whales may be resident during all or part of the year in the area, and that individuals may move off of the range for several days during and following a sonar event. However animals are thought to continue feeding at short distances (a few kilometers) from the range out of the louder sound fields (less than 157 dB re 1 µPa) (McCarthy et al. 2011, Tyack et al. 2011). Mysticetes in the northeast tended to adjust to vessel traffic over a number of years, trending towards more neutral responses to passing vessels (Watkins 1986), indicating that some animals may habituate or otherwise learn to cope with high levels of human activity. Nevertheless, the long-term consequences of these habitat utilization changes are unknown, and likely vary depending on the species, geographic areas, and the degree of acoustic or other human disturbance.

Moore and Barlow (2013) have noted a decline in beaked whales in a broad area of the Pacific Ocean area out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico. There are scientific caveats and limitations to the data used for that analysis, as well as oceanographic and species assemblage changes not thoroughly addressed in Moore and Barlow (2013) although the authors suggest Navy sonar as one possible explanation for the apparent decline in beaked whale numbers over that broad area. Interestingly, however, in the small portion of the Pacific coast overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and documented higher densities of beaked whales provide indications that the proposed decline in numbers elsewhere along the Pacific coast is not apparent where the Navy has been intensively training and testing with sonar and other systems for decades. While it is possible that a downward trend in beaked whales may have gone unnoticed at the range complex (due to a lack of survey precision) or that beaked whale densities may have been higher before the Navy began using sonar earlier in 1900s, there is no data to suggest that beaked whale numbers have declined on the range where Navy sonar use has routinely occurred, and as Moore and Barlow (2013) point out, it remains clear that the Navy range in Southern California continues to support high densities of beaked whales.

3.8.3.1.2.8 Stranding

When a live or dead marine mammal swims or floats onto shore and becomes "beached" or incapable of returning to sea, the event is termed a "stranding" (Geraci and Lounsbury 2005, Geraci et al. 1999). Animals outside of their "normal" habitat are also sometimes considered "stranded" even though they may not have beached themselves. Under the U.S. law, a stranding is an event in the wild that meets any of the following criteria: "(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in

need of medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 United States Code Section 1421h).

Marine mammals are subjected to a variety of natural and anthropogenic factors, acting alone or in combination, which may cause a marine mammal to strand on land or die at-sea (Geraci and Lounsbury 2005, Geraci et al. 1999). Even for the fractions of more thoroughly investigated strandings involving post-stranding data collection and necropsies, the cause (or causes) for the majority of strandings remain undetermined. For example, because the number of harbor porpoise strandings in the northwest had been increased beginning in 2003 and through 2006, an Unusual Mortality Event in the Pacific Northwest was declared by NMFS (see U.S. Department of the Navy [2013c], Cetacean Stranding Report for more detail on this Unusual Mortality Event). The harbor porpoise stranding numbers have continued to increase each year; between 2003 and 2013, the Northwest Marine Mammal Stranding Network has documented a total of 255 harbor porpoise strandings in Washington's inland waters over that 10-year period. Barbieri et al. (2013) state that "disease is a major mortality factor for many marine mammal species and has been the cause of numerous mortality events worldwide." Natural factors related to strandings include, for example, the availability of food, predation, disease, parasitism, climatic influences, and aging (Bradshaw et al. 2006, Culik 2002, Geraci and Lounsbury 2005, Geraci et al. 1999, Hoelzel 2003, National Research Council 2006, Perrin and Geraci 2002, Walker et al. 2005). Anthropogenic factors include, for example, pollution (Elfes et al. 2010; Hall et al. 2006a, b; Jepson et al. 2005a; Marine Mammal Commission 2010; Tabuchi et al. 2006), vessel strike (Berman-Kowalewski et al. 2010, de Stephanis and Urquiola 2006, Geraci and Lounsbury 2005, Jensen and Silber 2003, Laist et al. 2001), fisheries interactions (Look 2011, Read et al. 2006), entanglement (Baird and Gorgone 2005, Johnson and Allen 2005, Saez et al. 2013), and noise (Cox et al. 2006, National Research Council 2003, Richardson et al. 1995).

Along the coasts of the continental United States and Alaska between 2001 and 2009, there were on average approximately 1,400 cetacean strandings and 4,300 pinniped strandings (5,700 total) per year (National Marine Fisheries Service 2011a, b, c). Several "mass stranding" events—strandings that involve two or more individuals of the same species (excluding a single cow-calf pair)—that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduced sound into the marine environment. An in-depth discussion of strandings is presented in the Navy's *Marine Mammal Strandings Associated with U.S. Navy Sonar Activitie*s (U.S. Department of the Navy 2013c).

Sonar use during exercises involving U.S. Navy (most often in association with other nations' defense forces) has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira Island, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (Marine Mammal Commission 2006). These five mass stranding events resulted in about 40 known stranding deaths among cetaceans, consisting mostly of beaked whales, with a potential causal link to sonar (International Council for the Exploration of the Sea 2005a, b). The U.S. Navy-funded research involving behavioral response studies in Southern California and the Bahamas discussed previously were motivated by the desire to understand any links between the use of mid-frequency sonar and cetacean behavioral responses, including the potential for strandings. Although these events have served to focus attention on the issue of impacts resulting from the use of sonar, as Ketten (2012) recently pointed out, "ironically, to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result [of] anthropogenic noise exposures, including sonar." In these previous strandings, exposure to

non-impulsive acoustic energy has been considered a potential indirect cause of the death of marine mammals (Cox et al. 2006). One hypothesis is that strandings may result from tissue damage caused by "gas and fat embolic syndrome" (Fernández et al. 2005; Jepson et al. 2003, 2005b). Models of nitrogen saturation in diving marine mammals have been used to suggest that altered dive behavior might result in the accumulation of nitrogen gas such that the potential for nitrogen bubble formation is increased (Houser et al. 2001a, b; Zimmer and Tyack 2007). If so, this mechanism might explain the findings of gas and bubble emboli in stranded beaked whales. It is also possible that stranding is a behavioral response to a sound under certain contextual conditions and that the subsequently observed physiological effects (e.g., overheating, decomposition, or internal hemorrhaging from being on shore) were the result of the stranding rather than direct physical impact from exposure to sonar (Cox et al. 2006).

As International Council for the Exploration of the Sea (2005b) noted, taken in context of marine mammal populations in general, sonar is not a major threat, or significant portion of the overall ocean noise budget. This has also been demonstrated by monitoring in areas where Navy operates (Bassett et al. 2010, Baumann-Pickering et al. 2010, Hildebrand et al. 2011, McDonald et al. 2006, Tyack et al. 2011). Regardless of the direct cause, the Navy considers potential sonar related strandings important and continues to fund research and work with scientists to better understand circumstances that may result in strandings.

On 4 March 2011 at the Silver Strand Training Complex (San Diego, California), three long-beaked common dolphins were found dead immediately after an underwater detonation associated with a Navy training event.[3] In addition to the three dolphin mortalities at the detonation site, the remains of a fourth dolphin were discovered 3 days later approximately 42 mi. (68 km) north of the training event location (Danil and St. Ledger 2011; approximately Oceanside, California). It is not known when this fourth dolphin died, but certainly sometime between the training event and the discovery at the stranding location. Location details, such as individual dolphins' depth and distance from the explosive at the time of detonation, could not be estimated from the 250 yd. (229 m) standoff point of the observers in the dive boat or the safety boat.

These dolphin mortalities are the only known occurrence of a U.S. Navy training event involving impulse energy (underwater detonation) that has resulted in injury to a marine mammal. Despite this being a rare occurrence, the Navy has reviewed training requirements, safety procedures, and potential mitigation measures and, along with NMFS, is determining appropriate changes to implement to reduce the potential for this to occur in the future. Discussions of procedures associated with these and other training events are presented in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring), which details all mitigations.

In comparison to potential strandings or injury resulting from events associated with Navy activities, marine mammal strandings and injury from commercial vessel ship strike (e.g., Berman-Kowalewski et al. 2010, Silber et al. 2010), impacts from urban pollution (e.g., Hooker et al. 2007, Murata et al. 2009, O'Shea and Brownell 1997), and annual fishery-related entanglement, bycatch, injury, and mortality to cetaceans and pinnipeds (e.g., Baird and Gorgone 2005, Forney and Kobayashi 2007, Saez et al. 2013;

[3] During this underwater detonation training event, which is not a proposed activity in the Study Area, a pod of 100–150 dolphins were observed moving toward the explosive event's 700 yd. (640 m) exclusion zone monitored by a personnel in a safety boat and participants in a dive boat. Within the exclusion zone, approximately 5 minutes remained on a timed fuse connected to a single 8.76 lb. (3.97 kg) explosive charge weight (C-4 and detonation cord) set at a depth of 48 ft. (72.7 m), approximately 0.5–0.75 nm from shore. Although the dive boat was placed between the pod and the explosive in an effort to guide the dolphins away from the area, that effort was unsuccessful.

Carretta et al. 2013b) that have been estimated worldwide to be orders of magnitude greater than the few potential injurious impacts that could be possible as a result of Navy activities (hundreds of thousands of animals versus 3 animals under Alternative 2 for example) (Culik 2002, International Council for the Exploration of the Sea 2005b, Read et al. 2006). This does not negate the potential influence of mortality or additional stressor to small, regionalized sub-populations that may be at greater risk from human-related mortalities (fishing, vessel strike, sound) than populations with larger oceanic level distributions, but overall the Navy's impact in the oceans and inland water areas where training and testing occurs is small in comparison to other human activities.

3.8.3.1.3 Long-Term Consequences to the Individual and the Population

Long-term consequences to a population are determined by examining changes in the population growth rate. Individual effects that could lead to a reduction in the population growth rate include mortality or injury (that removes animals from the reproductive pool), loss in hearing sensitivity (which depending on severity could impact navigation, foraging, predator avoidance, or communication), chronic stress (which could make individuals more susceptible to disease), displacement of individuals (especially from preferred foraging or mating grounds), and disruption of social bonds (due to masking of conspecific signals or displacement). However, the long-term consequences of any of these effects are difficult to predict because individual experience and time can create complex contingencies, especially for intelligent, long-lived animals like marine mammals. While a lost reproductive opportunity could be a measureable cost to the individual, the outcome for the animal, and ultimately the population, can range from insignificant to significant. Any number of factors, such as maternal inexperience, years of poor food supply, or predator pressure, could produce a cost of a lost reproductive opportunity, but these events may be "made up" during the life of a normal healthy individual. The same holds true for exposure to human-generated sound sources. These biological realities must be taken into consideration when assessing risk, uncertainties about that risk, and the feasibility of preventing or recouping such risks. All too often, the long-term consequence of relatively trivial events like short-term masking of a conspecific's social sounds, or a single lost feeding opportunity, is exaggerated beyond its actual importance by focus on the single event and not the important variable, which is the individual and its lifetime parameters of growth, reproduction and survival.

The linkage between a stressor such as sound and its immediate behavioral or physiological consequences for the individual, and then the subsequent effects on that individual's vital rates (growth, survival and reproduction), and the consequences, in turn, for the population have been reviewed in National Research Council (2005). The Population Consequences of Acoustic Disturbance (PCAD) model (see National Research Council 2005) proposed a quantitative methodology for determining how changes in the vital rates of individuals (i.e., a biologically significant consequence to the individual) translate into biologically significant consequences to the population. Population models are well known from many fields in biology including fisheries and wildlife management. These models accept inputs for the population size and changes in vital rates of the population such as the mean values for survival age, lifetime reproductive success, and recruitment of new individuals into the population. The time-scale of the inputs in a population model for long-lived animals such as marine mammals is on the order of seasons, years, or life stages (e.g., neonate, juvenile, reproductive adult), and are often concerned only with the success of individuals from one time period or stage to the next. Unfortunately, for acoustic and explosive impacts to marine mammal populations, many of the inputs required by population models are not known.

Establishing a causal link between anthropogenic noise, animal communication, and individual impacts as well as population viability will be difficult to quantify and assess (McGregor et al. 2013; Reed et al. 2014). Reed et al. (2014) for instance reviewed select terrestrial literature on individual and population response to sound as well as discuss a necessary framework in order to assess future direct and indirect fitness impacts. The difficulty with assessing marine behavioral noise effects individually and cumulatively is the confounding nature of the issue where there may or may not be indirect effects with a complex interactive dependence based on age class, prior experience, and behavioral state at the time of exposure, as well as influences by other non-sound related factors (Ellison et al. 2011; Knight and Swaddle 2011; Goldbogen et al. 2013; McGregor et al. 2013; Reed et al. 2014; Williams et al. 2014). McGregor et al. (2013) summarized some studies on sound impacts and described two types of possible effects based on the studies they reviewed: 1) an apparent effect of noise on communication, but with a link between demonstrated proximate cost and ultimate cost in survival or reproductive success being inferred rather than demonstrated, and 2) studies showing a decrease in population density or diversity in relation to noise, but with a relationship that is usually a correlation, so factors other than noise or its effect on communication might account for the relationship (McGregor et al. 2013). Within the ocean environment, there is a complex interaction of considerations needed in terms of defining cumulative anthropogenic impacts that has to also be considered in context of natural variation and climate change (Boyd and Hutchins 2012). These can include environmental enhancers that improve fitness, additive effects from two or more factors, multiplicity where response from two or more factors is greater than the sum of individual effects, synergism between factors and response, antagonism as a negative feedback between factors, acclimation as a short-term individual response, and adaptation as a long-term population change (Boyd and Hutchins 2012). To address determination of cumulative effects and responses change due to processes such as habituation, tolerance, and sensitization, future experiments over an extended period of time still need further research (Bejder et al. 2009, Blickley et al. 2012, Reed et al 2014).

The best assessment of long-term consequences from training activities will be to monitor the populations over time within the Study Area. A recent U.S. workshop on Marine Mammals and Sound (Fitch et al. 2011) indicated a critical need for baseline biological data on marine mammal abundance, distribution, habitat, and behavior over sufficient time and space to evaluate impacts from human-generated activities on long-term population survival. The Navy has developed monitoring plans for protected marine mammals and sea turtles occurring on Navy ranges and within the TMAA with the goal of assessing the impacts of training and testing activities on marine species and the effectiveness of the Navy's current mitigation practices. For example, results of intensive monitoring from 2009 to 2012 by independent scientists and Navy observers in SOCAL Range Complex and Hawaii Range Complex have recorded an estimated 256,000 marine mammals with no evidence of distress or unusual behavior observed during Navy activities (see Section 3.8.5, Summary of Observations During Previous Navy Activities, provides a broader discussion on this topic). Continued monitoring efforts over time will be necessary to begin to completely evaluate the long-term consequences of exposure to sound sources.

3.8.3.1.4 Thresholds and Criteria for Predicting Acoustic and Explosive Impacts on Marine Mammals

If proposed Navy activities introduce sound or explosive energy into the marine environment, an analysis of potential impacts to marine mammals is conducted. To do this, information about the numerical sound and energy levels that are likely to elicit certain types of physiological and behavioral reactions is needed.

3.8.3.1.4.1 Frequency Weighting

Frequency-weighting functions are used to adjust the received sound level based on the sensitivity of the animal to the frequency of the sound. The weighting functions de-emphasize sound exposures at frequencies to which marine mammals are not particularly sensitive. This effectively makes the acoustic thresholds frequency-dependent, which means they are applicable over a wide range of frequencies and therefore applicable for a wide range of sound sources. Frequency-weighting functions, deemed "M-weighting" functions by Southall et al. (2007), were proposed to account for the frequency bandwidth of hearing in marine mammals. These M-weighting functions were derived for each marine mammal hearing group based on an algorithm using the range of frequencies that are within 80 dB of an animal or group's best hearing sensitivity at any frequency (Southall et al. 2007). The Southall et al. (2007) M-weighting functions are nearly flat between the lower and upper cutoff frequencies, and thus were believed to represent a conservative approach to assessing the effects of sound (Figure 3.8-6). For the purposes of this analysis, the Navy will refer to these as Type I auditory weighting functions. Otariid seal thresholds and weighting functions were applied to sea otter as described in Finneran and Jenkins (2012).

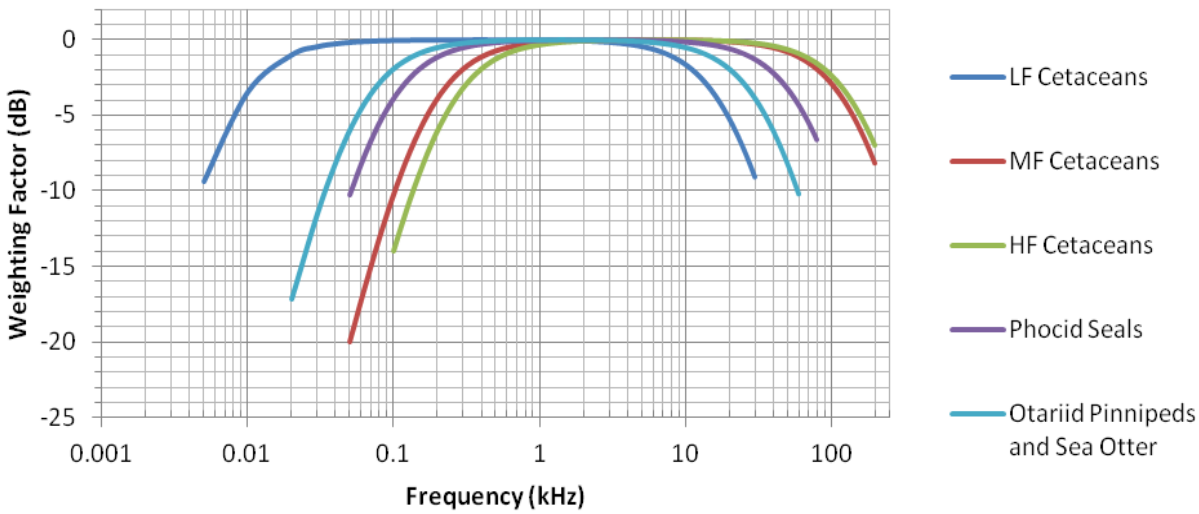

Figure 3.8-6: Type I Auditory Weighting Functions Modified from the Southall et al. (2007) M-Weighting Functions

While all data published since 2007 have been reviewed to determine if any adjustments to the weighting functions were required, only two published experiments suggested that modification of the mid-frequency cetacean auditory weighting function was necessary (see Finneran and Jenkins [2012] for more details on that modification not otherwise provided below). The first experiment measured TTS in a bottlenose dolphin after exposure to pure tones with frequencies from 3

Frequency Weighting Example:

A common dolphin, a mid-frequency cetacean (Section 3.8.2.3.2), receives a 10 kHz ping from a sonar with a sound exposure level of 180 dB re 1 μPa^2-s. To discern if this animal may suffer a TTS, the received level must first be adjusted using the appropriate Type II auditory weighting function for mid-frequency cetaceans (Section 3.8.2.3.2). At 10 kHz, the weighting factor for mid-frequency cetaceans is -3 dB, which is then added to the received level (180 dB re 1 μPa^2-s + (-3 dB) = 177 dB re 1 μPa^2-s) to yield the weighted received level. This is compared to the Non-Impulsive Mid-Frequency Cetacean TTS threshold (178 dB re 1 μPa^2-s; see Table 3.8-3). Since the adjusted received level is less than the threshold, TTS is not likely for this animal from this exposure.

to 28 kHz (Finneran et al. 2010). These data were used to derive onset-TTS values as a function of exposure frequency and demonstrate that the use of a single numeric threshold for onset-TTS, regardless of frequency, is not correct. The second experiment examined how subjects perceived the loudness of sounds at different frequencies to derive equal loudness contours (Finneran and Schlundt 2011). These data are important because human auditory weighting functions are based on equal loudness contours. The dolphin equal loudness contours provide a means to generate auditory weighting functions in a manner directly analogous to the approach used to develop safe exposure guidelines for people working in noisy environments (National Institute for Occupational Safety and Health 1998).

Taken together, the recent higher-frequency TTS data and equal loudness contours provide the underlying data necessary to develop new weighting functions, referred to as Type II auditory weighting functions, to improve accuracy and avoid underestimating the impacts on animals at higher frequencies as shown on Figure 3.8-7. To generate the new Type II weighting functions, Finneran and Schlundt (2011) substituted lower and upper frequency values which differ from the values used by Southall et al. (2007). The new Type II weighting curve predicts appreciably higher susceptibility for frequencies above 3 kHz. Since data below 3 kHz are not available, the original Type I weighting functions from Southall et al. (2007) were substituted below this frequency. Low- and high-frequency cetacean weighting functions were extrapolated from the dolphin data as well because of the suspected similarities of greatest susceptibility at best frequencies of hearing. Similar type II weighting curves were not developed for pinnipeds because their hearing is markedly different from cetaceans and they do not hear as well at higher frequencies; therefore, their weighting curves did not require the same adjustment (see Finneran and Jenkins 2012 for additional details).

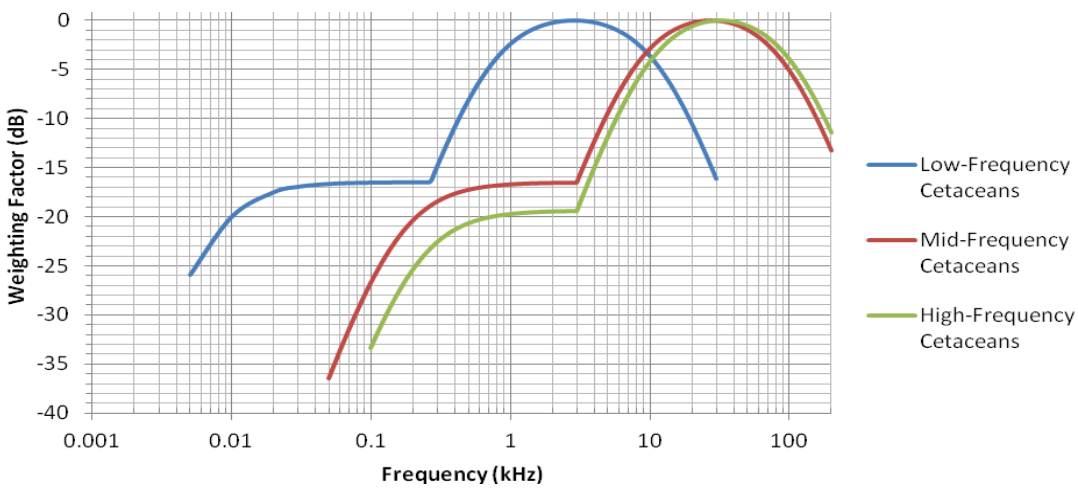

Figure 3.8-7: Type II Weighting Functions for Low-, Mid-, and High-Frequency Cetaceans

The Type II auditory cetacean weighting functions (Figure 3.8-7) are applied to the received sound level before comparing it to the appropriate sound exposure level thresholds for TTS or PTS, or the impulsive behavioral response threshold (note that for pinnipeds and sea otters, the Southall et al. [2007] weighting functions [Figure 3.8-4] would be used in lieu of any new weighting functions). For some criteria, received levels are not weighted before being compared to the thresholds to predict effects. These include the peak pressure criteria for predicting TTS and PTS from underwater explosions, the acoustic impulse metrics used to predict onset-mortality and slight lung injury, and the thresholds used

to predict behavioral responses from harbor porpoises and beaked whales from sonar and other active acoustic sources.

3.8.3.1.4.2 Summation of Energy From Multiple Sources

In most cases, an animal's received level will be the result of exposure to a single sound source. In some scenarios, however, multiple sources will be operating simultaneously, or nearly so, creating the potential for accumulation of energy from multiple sources. Energy is summed for multiple exposures of similar source types. For sonars, including use of multiple systems within any scenario, energy will be summed for all exposures within a frequency band, with the cumulative frequency exposure bands defined as 0–1.0 kHz (low-frequency sources), 1.1–10.0 kHz (mid-frequency sources), 10.1–100.0 kHz (high-frequency sources), and 100.1–200.0 kHz (very high frequency sources). Sources operated at frequencies above 200 kHz are considered to be inaudible to all groups of marine mammals and are not analyzed in the quantitative modeling of exposure levels. After the energy has been summed within each frequency band, the band with the greatest amount of energy is used to evaluate the onset of PTS or TTS. For explosives, including use of multiple explosives in a single scenario, energy is summed across the entire frequency band.

3.8.3.1.4.3 Temporary and Permanent Threshold Shift – Loss of Hearing Sensitivity

Criteria for physiological effects from sonar and other active acoustic sources are based on temporary and permanent threshold shift with thresholds based on cumulative sound exposure levels (Table 3.8-4). The temporary and permanent threshold shift criteria used by the Navy in this analysis parallels the recent NOAA draft, "Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals." This criteria was proposed in December 2013 and is still in review as of June 2014. Details can be found at www.nmfs.noaa.gov/pr/acoustics/guidelines.htm. The onset of temporary or permanent threshold shift from exposure to impulsive sources is predicted using a sound exposure level-based threshold in conjunction with a peak pressure threshold. The horizontal ranges are then compared, with the threshold producing the longest range being the one used to predict effects. For multiple exposures within any 24-hour period, the received sound exposure level for individual events is accumulated for each animal.

Table 3.8-4: Acoustic Criteria and Thresholds for Predicting Physiological Effects to Marine Mammals Underwater from Sonar and Other Active Acoustic Sources

Hearing Group	Species	Onset temporary threshold shift	Onset permanent threshold shift
Low-Frequency Cetaceans	All mysticetes	178 dB re 1 μPa^2-s SEL (Type II weighting)	198 dB re 1 μPa^2-s SEL (Type II weighting)
Mid-Frequency Cetaceans	Dolphins, beaked whales, and medium and large toothed whales	178 dB re 1 μPa^2-s SEL (Type II weighting)	198 dB re 1 μPa^2-s SEL (Type II weighting)
High-Frequency Cetaceans	Porpoises and *Kogia* spp.	152 dB re 1 μPa^2-s SEL (Type II weighting)	172 dB re 1 μPa^2-s SEL (Type II weighting)
Phocid Seals (underwater)	Hawaiian Monk, Northern Elephant and Harbor Seals	183 dB re 1 μPa^2-s SEL (Type I weighting)	197 dB re 1 μPa^2-s SEL (Type I weighting)
Otariidae (underwater)	Sea Lions and Fur Seals	206 dB re 1 μPa^2-s SEL (Type I weighting)	220 dB re 1 μPa^2-s SEL (Type I weighting)
Mustelidae (underwater)	Sea Otters		

Notes: μPa^2-s = micropascal squared second, dB = decibels, re = referenced to, SEL = Sound Exposure Level

As no studies have been designed to intentionally induce PTS in marine mammals due to the moral and ethical issues inherent in such a study, onset-PTS levels have been estimated using empirical TTS data obtained from marine mammals and relationships between TTS and PTS established in terrestrial mammals.

Temporary and permanent threshold shift thresholds are based on TTS onset values for impulsive and non-impulsive sounds obtained from representative species of mid- and high-frequency cetaceans and pinnipeds. This data are then extended to the other marine mammals for which data are not available. The Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis technical report (Finneran and Jenkins 2012) provides a detailed explanation of the selection of criteria and derivation of thresholds for temporary and permanent loss in hearing sensitivity for marine mammals. Section 3.8.3.1.2.3 (Hearing Loss) provided the specific meanings of temporary and permanent threshold shift as used in this Supplemental EIS/OEIS. Table 3.8-3 and Table 3.8-4 provide a summary of acoustic thresholds for TTS and PTS for marine mammals.

3.8.3.1.4.4 Temporary Threshold Shift for Sonar and Other Active Acoustic Sources

TTS involves no tissue damage, is by definition temporary, and therefore is not considered injury. Temporary threshold shift values for mid-frequency cetaceans exposed to non-impulse sound are derived from multiple studies (Finneran and Schlundt 2010; Finneran et al. 2005, 2010; Mooney et al. 2009b; Schlundt et al. 2000) from two species, bottlenose dolphins and beluga whales. Especially notable are data for frequencies above 3 kHz, where bottlenose dolphins have exhibited lower TTS onset thresholds than at 3 kHz (Finneran and Schlundt 2010, 2011). This difference in TTS onset at higher frequencies is incorporated into the weighting functions.

Previously, there were no direct measurements of TTS from non-impulse sound in high frequency cetaceans. Lucke et al. (2009) measured TTS in a harbor porpoise exposed to a small seismic air gun, and those results are reflected in the current impulse sound TTS thresholds described below. The beluga whale, which had been the only species for which both impulsive and non-impulsive TTS data existed, has a non-impulsive TTS onset value about 6 dB above the (weighted) impulsive threshold (Finneran et al. 2002, Schlundt et al. 2000). Therefore, 6 dB was added to the harbor porpoise impulsive temporary thresholds shift threshold demonstrated by Lucke et al. (2009) to derive the non-impulse TTS threshold used in the current Navy modeling for high frequency cetaceans. Report on the first direct measurements of TTS from non-impulse sound has been recently presented by Kastelein et al. (2012b) for harbor porpoise. This new data are consistent with the current harbor porpoise thresholds used in the modeling of effects from non-impulse sources.

There are no direct measurements of TTS or hearing abilities for low-frequency cetaceans. The Navy uses mid-frequency cetacean thresholds to assess PTS and TTS for low-frequency cetaceans, since mid-frequency cetaceans are the most similar to the low-frequency cetacean group (see Finneran and Jenkins [2012] on the development of the thresholds and criteria).

Pinniped TTS criteria are based on data provided by Kastak et al. (2005) for representative species of both of the pinniped hearing groups: harbor seals (Phocidae) and California sea lions (Otariidae). Kastak et al. (2005) used octave band noise centered at 2.5 kHz to extrapolate an onset-TTS threshold. More recently, Kastelein et al. (2012c) used octave band noise centered at 4 kHz to obtain TTS thresholds in the same two species, resulting in similar levels causing onset-TTS as those found in Kastak et al. (2005). For sea otter, the otariid TTS threshold and weighting function are applied due to similarities in taxonomy and auditory performance. Recent research using sound at 4 kHz on harbor seal (Kastelein et

al. 2012a) has findings consistent with the Navy's current criteria and thresholds.

The appropriate frequency weighting function for each species group is applied when using the sound exposure level-based thresholds to predict TTS.

3.8.3.1.4.5 Temporary Threshold Shift for Explosives

The TTS sound exposure level thresholds for cetaceans are consistent with thresholds approved by NMFS for the USS MESA VERDE ship shock trial (73 FR 143: 43130–43138, 24 July 2008) and are more representative of TTS induced from impulses (Finneran et al. 2002) rather than pure tones (Schlundt et al. 2000). In most cases, a total weighted sound exposure level is more conservative than greatest sound exposure level in one-third octave bands, which was used prior to the USS MESA VERDE ship shock trials. There are no data on TTS obtained directly from low-frequency cetaceans, so mid-frequency cetacean impulse threshold criteria from Finneran et al. (2002) have been used. High-frequency cetacean TTS thresholds are based on research by Lucke et al. (2009), who exposed harbor porpoises to pulses from a single air gun.

Pinniped criteria were not included for prior ship shock trials, as pinnipeds were not expected to occur at the shock trial sites, and TTS criteria for previous Navy EISs/OEISs also were not differentiated between cetaceans and pinnipeds (National Marine Fisheries Service 2008b). Temporary threshold shift values for impulse sound criteria have not been obtained for pinnipeds, but there are TTS data for octave band sound from representative species of both major pinniped hearing groups (Kastak et al. 2005). Impulse sound TTS criteria for pinnipeds were estimated by applying the difference between mid-frequency cetacean TTS onset for impulse and non-impulse sounds to the pinniped non-impulse TTS data (Kastak et al. 2005), a methodology originally developed by Southall et al. (2007). Therefore, the TTS criterion for impulsive sounds from explosions for pinnipeds is 6 dB less than the non-impulsive onset-TTS criteria derived from Kastak et al. (2005).

For sea otters, the otariid temporary and permanent threshold shift criteria and weighting function would be applied due to similarities in taxonomy and the likely hearing ability of sea otters when underwater (Finneran and Jenkins 2012).

3.8.3.1.4.6 Permanent Threshold Shift for Sonar and Other Active Acoustic Sources

There are no direct measurements of PTS onset in marine mammals. Well understood relationships between TTS and PTS in terrestrial mammals have been applied to marine mammals. Threshold shifts up to 40–50 dB have been induced in terrestrial mammals without resultant PTS (Miller et al. 1963; Ward et al. 1958, 1959a). These data would suggest that a PTS criteria of 40 dB would be reasonable for conservatively predicting (overestimating) PTS in marine mammals. Data from terrestrial mammal testing (Ward et al. 1958; 1959a, b) show growth of TTS by 1.5–1.6 dB for every 1 dB increase in exposure level (EL). The difference between measureable TTS onset (6 dB) and the selected 40 dB upper safe limit of TTS yields a difference in TTS of 34 dB, which, when divided by a TTS growth function of 1.6 indicates that an increase in exposure of 21 dB would result in 40 dB of TTS. For simplicity and additional conservatism we have rounded that number down to 20 dB (Southall et al. 2007).

Therefore, exposures to sonar and other active acoustic sources with levels 20 dB above those producing TTS are assumed to produce a PTS. For example, an onset-TTS criteria of 195 dB re 1 μPa^2-s would have a corresponding onset-PTS criteria of 215 dB re 1 μPa^2-s. This extrapolation process is identical to that recently proposed by Southall et al. (2007). The method overestimates or predicts greater effects than have actually been observed in tests on a bottlenose dolphin (Finneran et al. 2010, Schlundt et al. 2006).

Kastak et al. (2007) obtained different TTS growth rates for pinnipeds than Finneran and colleagues obtained for mid-frequency cetaceans. NMFS recommended reducing the estimated PTS criteria for both groups of pinnipeds, based on the difference in TTS growth rate reported by Kastak et al. (2007) (14 dB instead of 20 dB).

The appropriate frequency weighting function for each species group is applied when using the sound exposure level-based thresholds to predict PTS.

3.8.3.1.4.7 Permanent Threshold Shift for Explosives

As marine mammal PTS data from impulsive exposures do not exist, onset-PTS levels for these animals are estimated by adding 15 dB to the sound exposure level-based TTS criteria and by adding 6 dB to the peak pressure based thresholds. These relationships were derived by Southall et al. (2007) from impulse noise TTS growth rates in chinchillas. The appropriate frequency weighting function for each species group is applied when using the resulting sound exposure level-based thresholds, as shown in Table 3.8-5, to predict PTS.

3.8.3.1.4.8 Mortality and Injury from Explosives

There is a considerable body of laboratory data on actual injury for impulse sound, usually from explosive pulses, obtained from tests with a variety of lab animals (mice, rats, dogs, pigs, sheep, and other species). Onset Slight Gastrointestinal (GI) Tract Injury, Onset Slight Lung Injury, and Onset Mortality (a 50 percent lung injury with mortality occurring in 1 percent of those having this injury) represent a series of effects with increasing likelihood of serious injury or lethality. Primary impulse injuries from explosive blasts are the result of differential compression and rapid re-expansion of adjacent tissues of different acoustic properties (e.g., between gas-filled and fluid-filled tissues or between bone and soft tissues). These injuries usually manifest themselves in the gas-containing organs (lung and gut) and auditory structures (e.g., rupture of the eardrum across the gas-filled spaces of the outer and inner ear) (Craig and Hearn 1998, Craig Jr. 2001).

Criteria and thresholds for predicting injury and mortality to marine mammals from impulse sources were initially developed for the U.S. Navy ship shock trials of the SEAWOLF submarine (Craig and Hearn 1998) and WINSTON S. CHURCHILL surface ship (Craig Jr. 2001). These criteria and thresholds were also adopted by NMFS in several Final Rules issued under the MMPA (63 FR 230, 66 FR 87, 73 FR 121, 73 FR 199). These criteria and thresholds were revised as necessary based on new science and used for the ship shock trial of the U.S. Navy amphibious transport dock ship MESA VERDE (Finneran and Jenkins 2012), and were subsequently adopted by NMFS in its MMPA Final Rule authorizing the MESA VERDE shock trial (73 FR 143). Upper and lower frequency limits of hearing are not applied for lethal and injurious exposures. These criteria and their origins are explained in greater detail in Finneran and Jenkins (2012), which covered the development of the thresholds and criteria for assessment of impacts.

Onset of Gastrointestinal Tract Injury

Evidence indicates that gas-containing internal organs, such as lungs and intestines, are the principal damage sites from shock waves in submerged terrestrial mammals (Clark and Ward 1943, Greaves et al. 1943, Richmond et al. 1973, Yelverton et al. 1973). Furthermore, slight injury to the gastrointestinal tract may be related to the magnitude of the peak shock wave pressure over the hydrostatic pressure and would be independent of the animal's size and mass (Goertner 1982).

Table 3.8-5: Criteria and Thresholds for Physiological Effects to Marine Mammals Underwater for Explosives

Group	Species	Onset TTS	Onset PTS	Onset Slight GI Tract Injury	Onset Slight Lung Injury[1]	Onset Mortality[1]
Low Frequency Cetaceans	All mysticetes	172 dB re 1 μPa^2-s SEL (Type II weighting) or 224 dB re 1 μPa Peak SPL (unweighted)	187 dB re 1 μPa^2-s SEL (Type II weighting) or 230 dB re 1 μPa Peak SPL (unweighted)	237 dB re 1 μPa (unweighted)	Note 1	Note 2
Mid-Frequency Cetaceans	Most delphinids, medium and large toothed whales	172 dB re 1 μPa^2-s SEL (Type II weighting) or 224 dB re 1 μPa Peak SPL (unweighted)	187 dB re 1 μPa^2-s SEL (Type II weighting) or 230 dB re 1 μPa Peak SPL (unweighted)			
High Frequency Cetaceans	Porpoises and *Kogia* spp.	146 dB re 1 μPa^2-s SEL (Type II weighting) or 195 dB re 1 μPa Peak SPL (unweighted)	161 dB re 1 μPa^2-s SEL (Type II weighting) or 201 dB re 1 μPa Peak SPL (unweighted)			
Phocidae	Hawaiian monk, elephant, and harbor seal	177 dB re 1 μPa^2-s (Type I weighting) or 212 dB re 1 μPa Peak SPL (unweighted)	192 dB re 1 μPa^2-s (Type I weighting) or 218 dB re 1 μPa Peak SPL (unweighted)			
Otariidae	Sea lions and Fur seals	200 dB re 1 μPa^2-s (Type I weighting) or 212 dB re 1 μPa Peak SPL (unweighted)	215 dB re 1 μPa^2-s (Type I weighting) or 218 dB re 1 μPa Peak SPL (unweighted)			
Mustelidae	Sea Otters					

Note 1 $= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$

Note 2 $= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-\sec$

[1] Impulse calculated over a delivery time that is the lesser of the initial positive pressure duration or 20 percent of the natural period of the assumed-spherical lung adjusted for animal size and depth.

Notes: μPa = micropascal, μPa^2-s = micropascal squared second, dB = decibels, D_{Rm} = depth of receiver (animal) in meters, GI = gastrointestinal, M = mass of animals in kilograms, PTS = Permanent Threshold Shift, re = referenced to, SEL = Sound Exposure Level, SPL = Sound Pressure Level (re 1 μPa), TTS = Temporary Threshold Shift

There are instances where injury to the gastrointestinal tract could occur at a greater distance from the source than slight lung injury, especially for animals near the surface. Gastrointestinal tract injury from small test charges (described as “slight contusions”) was observed at peak pressure levels as low as 104 pounds per square inch, equivalent to a sound pressure level of 237 dB re 1 μPa (Richmond et al. 1973). This criterion was previously used by the Navy and NMFS for ship shock trials (63 FR 230, 66 FR 87, 73 FR 143, U.S. Department of the Navy 2008).

Slight Lung Injury and Mortality

The most commonly reported internal bodily injury from impulse energy is hemorrhaging in the fine structure of the lungs. Biological damage is governed by the impulse of the underwater blast (pressure integrated over time), not peak pressure or energy (Richmond et al. 1973; Yelverton and Richmond 1981; Yelverton et al. 1973, 1975). Therefore, impulse was used as a metric upon which internal organ injury could be predicted.

Species-specific minimal animal masses are used for determining impulse-based thresholds of slight lung injury and mortality. The Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis technical report (Finneran and Jenkins 2012) provides a nominal conservative body mass for each species based on newborn weights. In some cases body masses were extrapolated from similar species rather than the listed species. The scaling of lung volume to depth is conducted for all species because data are from experiments with terrestrial animals held near the water's surface.

Because the thresholds for onset of mortality and onset of slight lung injury are proportional to the cube root of body mass, the use of all newborn, or calf/pup, weights rather than representative adult weights results in an overestimate of effects to animals near an explosion. The range to onset mortality for a newborn compared to an adult animal of the same species can range from less than twice to over four times as far from an explosion, depending on the differences in calf/pup versus adult sizes for a given species and the size of the explosion. Considering that injurious high pressures due to explosions propagate away from detonations in a roughly spherical manner, the volumes of water in which the threshold for onset mortality may be exceeded are generally less than a fifth for an adult animal versus a calf or pup.

The use of onset mortality and onset slight lung injury is a conservative method to estimate potential mortality and recoverable (non-mortal, non-PTS) injuries. When analyzing impulse-based effects, all animals within the range to these thresholds are assumed to experience the effect. The onset mortality and onset slight lung injury criteria are based on the impulse at which these effects are predicted for 1 percent of animals; the portion of animals affected would increase closer to the explosion. As discussed above, due to these conservative criteria used to predict these effects, it is likely that fewer animals would be affected than predicted under the Navy's acoustic analysis. Therefore, these criteria conservatively overestimate the number of animals that could be killed or injured.

Impulse thresholds for onset mortality and slight injury are indexed to 75 and 93 lb. (34 and 42 kg) for mammals, respectively (Richmond et al. 1973). The regression curves based on these experiments were plotted such that a prediction of mortality to larger animals could be determined as a function of positive impulse and mass (Craig Jr. 2001). After correction for atmospheric and hydrostatic pressures and based on the cube root scaling of body mass, as used in the Goertner injury model (Goertner 1982), the minimum impulse for predicting onset of extensive (50 percent) lung injury for "1 percent Mortality" (defined as most survivors had moderate blast injuries and should survive on their own) and slight lung injury for "zero percent Mortality" (defined as no mortality, slight blast injuries) (Yelverton and Richmond 1981) were derived for each species. As the mortality threshold, the Navy chose to use the minimum impulse level predictive of 50 percent lung injury, even though this injury is likely to result in mortality to only 1 percent of exposed animals. Because the mortality criteria represent a threshold at which 99 percent of exposed animals would be expected to recover, this analysis overestimates the impact on individuals and populations from exposure to impulse sources.

3.8.3.1.5 Behavioral Responses

The behavioral response criteria are used to estimate the number of animals that may exhibit a behavioral response. In this analysis, animals may be behaviorally harassed in each modeled scenario (using the NAEMO) or within each 24-hour period, whichever is shorter. Therefore, the same animal could have a behavioral reaction multiple times over the course of a year.

Sonar and Other Active Acoustic Sources

Potential behavioral effects from in-water sound from sonar and other active acoustic sources were predicted using a behavioral response function for most animals. The received sound level is weighted with Type I auditory weighting functions (Southall et al. 2007; see Figure 3.8-6) before the behavioral response function is applied. Harbor porpoise and beaked whale non-impulsive behavioral criteria are used unweighted (without weighting the received level before comparing it to the threshold; see Finneran and Jenkins 2012).

Behavioral Response Functions

The Navy worked with NMFS to define a mathematical function used to predict potential behavioral effects to mysticetes (Figure 3.8-8) and odontocetes (Figure 3.8-9) from mid-frequency sonar (National Marine Fisheries Service 2008a; National Oceanic and Atmospheric Administration 2013b). This effects analysis assumes that the potential consequences of exposure to sonar and other active acoustic sources on individual animals would be a function of the received sound pressure level (SPL; dB re 1 µPa). The behavioral response function applied to mysticetes differs from that used for odontocetes in having a shallower slope, which results in the inclusion of more behavioral events at lower amplitudes, consistent with observational data from North Atlantic right whales (Nowacek et al. 2007). Although the response functions differ, the intercepts on each figure highlight that each function has a 50 percent probability of harassment at a received level of 165 dB SPL. These analyses assume that sound poses a negligible risk to marine mammals if they are exposed to sound pressure levels below a certain basement value.

The values used in this analysis are based on three sources of data: behavioral observations during TTS experiments conducted at the Navy Marine Mammal Program and documented in Finneran et al. (2001, 2003, 2005) and Finneran and Schlundt (2004), reconstruction of sound fields produced by the USS SHOUP associated with the behavioral responses of killer whales observed in Haro Strait (Fromm 2004a, b; National Marine Fisheries Service 2005b; U.S. Department of the Navy 2004), and observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components documented in Nowacek et al. (2004). In some circumstances, some individuals will continue normal behavioral activities in the presence of high levels of human-made noise. In other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson et al. 1995, Southall et al. 2007, Wartzok et al. 2003). These differences within and between individuals appear to result from a complex interaction of experience, motivation, and learning that are difficult to quantify and predict. Therefore, the behavioral response functions represent a relationship that is deemed to be generally accurate, but may not be true in specific circumstances.

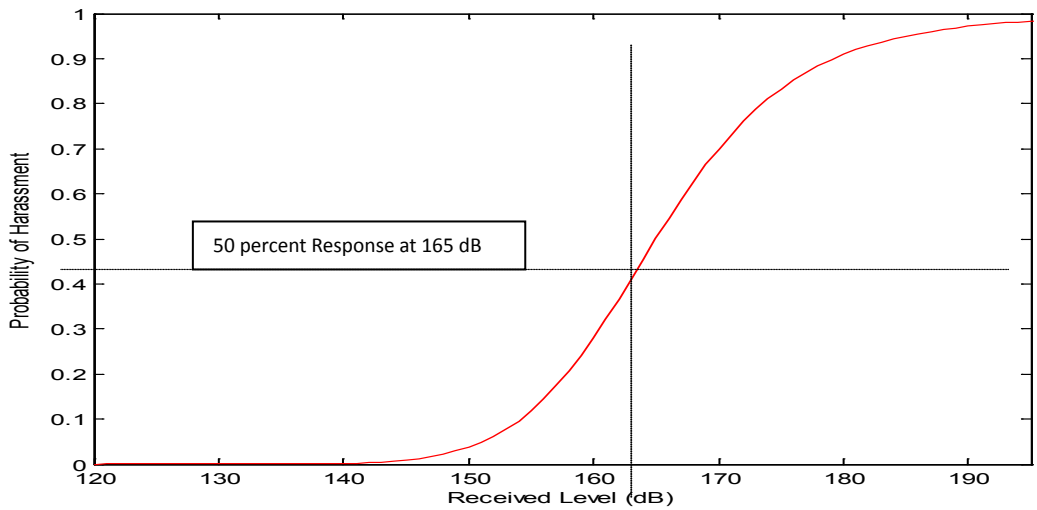

Figure 3.8-8: Behavioral Response Function Applied to Mysticetes

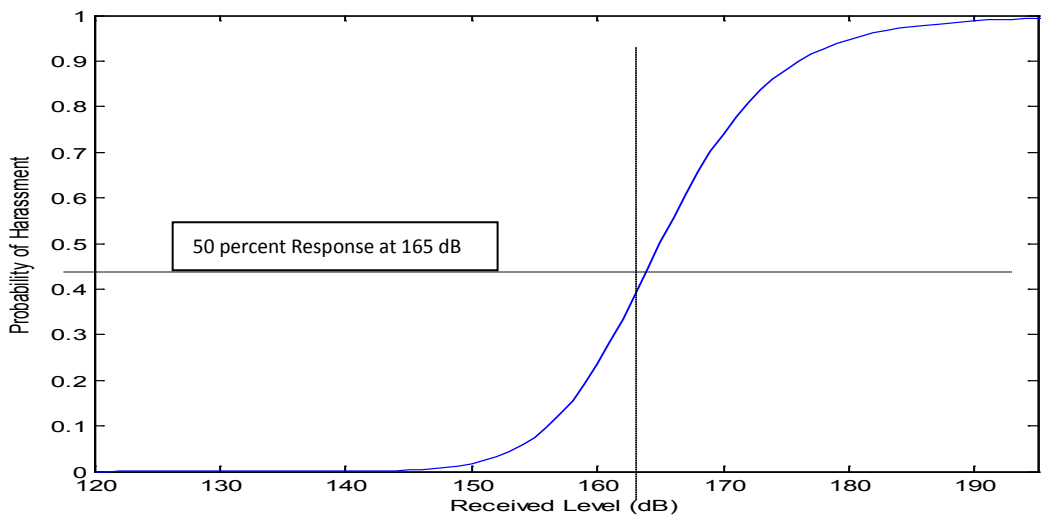

Figure 3.8-9: Behavioral Response Function Applied to Odontocetes, Pinnipeds, and Sea Otters

Specifically, the behavioral response function treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, many other variables, such as the marine mammal's gender, age, and prior experience; the activity it is engaged in during a sound exposure; its distance from a sound source; the number of sound sources; and whether the sound sources are approaching or moving away from the animal can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall et al. 2007). Currently available data do not allow for incorporation of these other variables in the current behavioral response functions; however, the response function represents the best use of the data that are available. Furthermore, the behavioral response functions do not differentiate between different types of behavioral reactions (i.e., area avoidance, diving avoidance, or alteration of natural behavior) or provide information regarding the predicted consequences of the reaction.

The behavioral response function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA

applicable to military readiness activities, such as the Navy's testing and training with MFA sonar) at a given received level of sound (Table 3.8-6). For example, at 165 dB SPL (dB re 1 µPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent. This means that 50 percent of the individuals exposed at that received level would be predicted to exhibit a significant behavioral response.

Harbor Porpoises

The information currently available regarding this species suggests a very low threshold level of response for both captive and wild animals. Threshold levels at which both captive (Kastelein et al. 2000, 2005b) and wild harbor porpoises (Johnston 2002) responded to sound (e.g., acoustic harassment devices, acoustic deterrent devices, or other non-impulsive sound sources) are very low (e.g., approximately 120 dB re 1 µPa). Therefore, a sound pressure level of 120 dB re 1 µPa is used in this analysis as a threshold for predicting behavioral responses in harbor porpoises.

Table 3.8-6: Summary of Behavioral Thresholds for Marine Mammals

Group	Behavioral Thresholds for Sonar and Other Active Acoustic Sources	Behavioral Thresholds for Explosives
Low-Frequency Cetaceans	SPL: BRF (Type I Weighting)	167 dB re 1 µPa^2-s SEL (Type II Weighting)
Mid-Frequency Cetaceans	SPL: BRF (Type I Weighting)	167 dB re 1 µPa^2-s SEL (Type II Weighting)
High-Frequency Cetaceans	SPL: BRF (Type I Weighting)	141 dB re 1 µPa^2-s SEL (Type II Weighting)
Phocid Seals (underwater)	SPL: BRF (Type I Weighting)	172 dB re 1 µPa^2-s SEL (Type I Weighting)
Otariid and Mustelid (underwater)	SPL: BRF (Type I Weighting)	172 dB re 1 µPa^2-s SEL (Type I Weighting)
Beaked Whales	(Unweighted) SPL 140 dB re 1 µPa	167 dB re 1 µPa^2-s SEL (Type II Weighting)
Harbor Porpoises	(Unweighted) SPL 120 dB re 1 µPa	141 dB re 1 µPa^2-s SEL (Type II Weighting)

Notes: BRF = Behavioral Response Function, dB re 1 µPa^2-s = decibels referenced to 1 micropascal squared second, SPL = Sound Pressure Level, SEL = Sound Exposure Level

Beaked Whales

The inclusion of a special behavioral response criterion for beaked whales of the family Ziphiidae is new to these Phase II criteria. It has been speculated for some time that beaked whales might have unusual sensitivities to sound due to strandings which occurred in conjunction with mid-frequency sonar use, even in areas where other species were more abundant (D'Amico et al. 2009), but there were not sufficient data to support a separate treatment for beaked whales until recently. With the recent publication of results from beaked whale monitoring and experimental exposure studies on the Navy's instrumented range in the Bahamas (McCarthy et al. 2011, Tyack et al. 2011), there are now statistically strong data demonstrating that beaked whales tend to avoid both actual naval mid-frequency sonar in real anti-submarine training scenarios as well as playbacks of killer whale vocalizations, and other anthropogenic sounds. Tyack et al. (2011) report that, in reaction to sonar playbacks, most beaked whales stopped echolocation, made long slow ascents, and moved away from the sound. During an exercise using mid-frequency sonar, beaked whales avoided the area at a distance from the sonar where the received level was "around 140 dB" (SPL) and once the exercise ended, beaked whales re-inhabited the center of exercise area within 2–3 days (Tyack et al. 2011). The Navy has therefore adopted a 140 dB re 1 µPa sound pressure level threshold for behavioral effects for all beaked whales (Table 3.8-6).

Since the development of the criterion, analysis of the data from the 2010 and 2011 field seasons of the SOCAL Behavioral Responses Study have been published. The study (De Ruiter et al. 2013a) provides similar evidence of Cuvier's beaked whale sensitivities to sound based on two controlled exposures. Two whales, one in each season, were tagged and exposed to simulated MFA sonar at distances of 3.4–9.5 km. The 2011 whale was also incidentally exposed to MFA sonar from a distant naval exercise (~ 118 km away). Received levels from the MFA sonar signals during the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa rms, respectively. Both whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure from distant naval sonar exercises at comparable received levels, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor. Because the sample size was limited (controlled exposures during a single dive in both 2010 and 2011), baseline behavioral data was obtained from different stocks and geographic areas (i.e., Hawaii and Mediterranean Sea). The Navy relied on the studies at the AUTEC that analyzed beaked whale responses to actual naval exercises using MFA sonar to evaluate potential behavioral responses by beaked whales to training and testing activities using sonar and other active acoustic sources.

Explosives

If more than one explosive event occurs within any given 24-hour period within a training activity, criteria are applied to predict the number of animals that may have a behavioral reaction. For events with multiple explosions, the behavioral threshold used in this analysis is 5 dB less than the TTS onset threshold (in sound exposure level) (Table 3.8-6). This value is derived from observed onsets of behavioral response by test subjects (bottlenose dolphins) during non-impulse TTS testing (Schlundt et al. 2000).

Some multiple explosion events, such as certain gunnery exercises, may be treated as a single impulsive event because a few explosions occur closely spaced within a very short time (a few seconds). For single explosions at received sound levels below hearing loss thresholds, the most likely behavioral response is a brief alerting or orienting response. Since no further sounds follow the initial brief impulses, significant behavioral reactions would not be expected to occur. This reasoning was applied to previous ship shock trials (63 FR 230, 66 FR 87, 73 FR 143) and is extended to the criteria used in this analysis.

Since impulse events can be quite short, it may be possible to accumulate multiple received impulses at sound pressure levels considerably above the energy-based criterion and still not be considered a behavioral take. The Navy treats all individual received impulses as if they were 1 second long for the purposes of calculating cumulative sound exposure level for multiple impulse events. For example, five air gun impulses, each 0.1 second long, received at 178 dB sound pressure level would equal a 175 dB sound exposure level and would not be predicted as leading to a significant behavioral response. However, if the five 0.1-second pulses are treated as a 5-second exposure, it would yield an adjusted value of approximately 180 dB, exceeding the threshold. For impulses associated with explosions that have durations of a few microseconds, this assumption greatly overestimates effects based on sound exposure level metrics such as TTS and PTS and behavioral responses.

Appropriate weighting values will be applied to the received impulse in one-third octave bands and the energy summed to produce a total weighted sound exposure level value. For impulsive behavioral criteria, the new weighting functions (Figure 3.8-10) are applied to the received sound level before being compared to the threshold.

3.8.3.1.6 Quantitative Analysis

The Navy performed a quantitative analysis to estimate the number of marine mammals that could be affected by acoustic sources or explosives used during training activities. Inputs to the quantitative analysis include marine mammal density estimates; marine mammal depth occurrence distributions; oceanographic and environmental data; marine mammal hearing data; and criteria and thresholds for levels of potential effects. The quantitative analysis consists of computer modeled estimates and a post-model analysis to determine the number of potential mortalities and harassments. The model calculates sound energy propagation from sonar, other active acoustic sources, and explosives during naval activities; the sound or impulse received by animat dosimeters representing marine mammals distributed in the area around the modeled activity; and whether the sound or impulse received by a marine mammal exceeds the thresholds for effects. The model estimates are then further analyzed to consider animal avoidance and implementation of mitigation measures, resulting in final estimates of potential effects due to the proposed training activities.

Various computer models and mathematical equations can be used to predict how energy spreads from a sound source (e.g., sonar or underwater detonation) to a receiver (e.g., dolphin or sea turtle). See Appendix D (Acoustics Primer) for background information about how sound travels through the water. Basic underwater sound models calculate the overlap of energy and marine life using assumptions that account for the many, variable, and often unknown factors that can influence the result. Assumptions in previous and current Navy models have intentionally erred on the side of overestimation when there are unknowns or when the addition of other variables was not likely to substantively change the final analysis. For example, because the ocean environment is extremely dynamic and information is often limited to a synthesis of data gathered over wide areas and requiring many years of research, known information tends to be an average of a seasonal or annual variation. El Niño Southern Oscillation events of the ocean-atmosphere system are an example of dynamic change where unusually warm or cold ocean temperatures are likely to redistribute marine life and alter the propagation of underwater sound energy. Previous Navy modeling therefore made some assumptions indicative of a maximum theoretical propagation for sound energy (such as a perfectly reflective ocean surface and a flat seafloor). More complex computer models build upon basic modeling by factoring in additional variables in an effort to be more accurate by accounting for such things as variable bathymetry and an animal's likely presence at various depths.

- NAEMO accounts for the variability of the sound propagation data in both distance and depth when computing the received sound level on the animals. Previous models captured the variability in sound propagation over range and used a conservative approach to account for only the maximum received sound level within the water column.
- NAEMO bases the distribution of animats (virtual representation of an animal) over the operational area on density maps, which provides a more natural distribution of animals. Previous models assumed a uniform distribution of animals over the operational area.
- NAEMO distributes animats throughout the three-dimensional water space proportional to the known time that animals of that species spend at varying depths. Previous models assumed animals were placed at the depth where the maximum sound received level occurred for each distance from a source.
- NAEMO conducts a statistical analysis to compute the estimated effects on animals. Previous models assumed all animals within a defined distance would be affected by the sound.

The Navy has developed a set of data and new software tools for quantification of estimated marine mammal acoustic effects from Navy activities. This new approach is the resulting evolution of the basic

model previously used by Navy (e.g., U.S. Department of the Navy 2011a) and reflects a more complex modeling approach as described below. Although this more complex computer modeling approach accounts for various environmental factors affecting acoustic propagation, the current software tools do not consider the likelihood that a marine mammal would attempt to avoid repeated exposures to a sound or avoid an area of intense activity where a training or testing event may be focused. Additionally, the software tools do not consider the implementation of mitigation (e.g., stopping sonar transmissions when a marine mammal is within a certain distance of a ship or mitigation zone clearance prior to detonations). In both of these situations, naval activities are modeled as though an activity would occur regardless of proximity to marine mammals and without any horizontal movement by the animal away from the sound source or human activities. Therefore, the final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures. This final step in the modeling process is meant to better quantify the predicted effects by accounting for likely animal avoidance behavior and implementation of standard Navy mitigations (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring, for details). In short, naval activities are modeled as though an activity would occur regardless of proximity to detected marine mammals and without any horizontal movement by the animal away from the sound source or human activities (e.g., without accounting for likely animal avoidance) because the science necessary to support that level of modeling complexity is beyond what is currently available. Therefore, the final step of the quantitative analysis of acoustic effects is to consider the implementation of mitigation and the possibility that marine mammals would avoid continued or repeated sound exposures.

Additional details regarding the NAEMO (see Marine Species Modeling Team 2014) and the incorporation of avoidance and mitigation into the analysis of acoustic stressors are presented below.

3.8.3.1.6.1 Marine Species Density Data

A quantitative analysis of impacts on a species requires data on the abundance and distribution of the species population in the potentially impacted area. The most appropriate unit of metric for this type of analysis is density, which is described as the number of animals present per unit area.

There is no single source of density data for every area, species, and season because of the fiscal costs, resources, and effort involved in NMFS providing enough survey coverage to sufficiently estimate density. Therefore, to characterize the marine species density for areas such as the TMAA, the Navy needed to compile data from multiple sources. To develop a database of marine species density estimates, the Navy, in consultation with NMFS experts at the three science centers (Alaska Fisheries Science Center, Southwest Fisheries Science Center, and Pacific Islands Fisheries Science Center) having species ranges overlapping the TMAA, adopted a protocol to select the best available data sources based on species, area, and season (see Navy's Pacific Marine Species Density Database Technical Report; U.S. Department of the Navy et al. 2014a). The resulting Geographic Information System (GIS) database includes one single spatial and seasonal density value for every marine mammal present within the Study Area.

The Navy Marine Species Density Database includes a compilation of the best available density data from several primary sources and published works including survey data from NMFS within the U.S. EEZ. NMFS is the primary agency responsible for estimating marine mammal and sea turtle density within the U.S. EEZ. NMFS publishes annual SARs or various regions of U.S. waters and covers all stocks of marine mammals within those waters. The majority of species that occur in the TMAA are covered by the Alaska Region Stock Assessment Report (Allen and Angliss 2014) and Pacific Region Stock Assessment Report

(Carretta et al. 2014). Other independent researchers often publish density data or research covering a particular marine mammal species, which is integrated into the NMFS SARs.

For most cetacean species, abundance is estimated using line-transect methods that employ a standard equation to derive densities based on sighting data collected from systematic ship or aerial surveys. More recently, habitat-based density models have been used effectively to model cetacean density as a function of environmental variables (e.g., Barlow et al. 2009). Where the data supports habitat-based density modeling, the Navy's database uses those density predictions. Habitat-based density models allow predictions of cetacean densities on a finer spatial scale than traditional line-transect analyses because cetacean densities are estimated as a continuous function of habitat variables (e.g., sea surface temperature, water depth). However, within most of the world's oceans, there have not been enough systematic surveys to allow for line-transect density estimation or the development of habitat models. To get an approximation of the cetacean species distribution and abundance for unsurveyed areas, in some cases it is appropriate to extrapolate data from areas with similar oceanic conditions where extensive survey data exist. Habitat Suitability Index or Relative Environmental Suitability have also been used in data-limited areas to estimate occurrence based on existing observations about a given species' presence and relationships between basic environmental conditions (Kaschner et al. 2006).

Methods used to estimate pinniped at-sea density are generally quite different than those described above for cetaceans. Pinniped abundance is generally estimated via shore counts of animals at known rookeries and haulout sites. For example, for species such as Steller sea lion, population estimates are based on counts of pups at the breeding sites (Allen and Angliss 2014). However, this method is not appropriate for other species such as harbor seals, whose pups enter the water shortly after birth. Population estimates for these species are typically made by counting the number of seals ashore and applying correction factors based on the proportion of animals estimated to be in the water (Allen and Angliss 2014). Population estimates for pinniped species that occur in the TMAA are provided in the Alaska Region Stock Assessment Report (Allen and Angliss 2014). Translating these population estimates to in-water densities presents challenges because the percentage of seals or sea lions at sea compared to those on shore is species-specific and depends on gender, age class, time of year (molt and breeding/pupping seasons), and for species such as harbor seal, time of day and tide level. Species specific foraging ranges from tracking data were also used when available (see Benoit-Bird et al. 2013, Boveng et al. 2008, Robinson et al. 2012, Womble and Gende 2013). These parameters identified from the literature were used to establish correction factors, which were then applied to estimate the proportion of pinnipeds that would be at sea within the Study Area for the time period of the Proposed Action.

Ribbon Seals

There is insufficient information available for the accurate derivation of a density or abundance representing the likely presence of ribbon seals in the Study Area. As presented in Section 3.8.2.25 (Ribbon Seals), satellite telemetry data presented by Boveng et al. (2008) suggests ribbon seals could be present in the Gulf of Alaska in summer although they would likely be very small in number. Given this, any derived density for the Study Area would be too low to be informative in acoustic modeling; predicting estimated effects much less than one (1.0) based on the low number of predicted effects for species that are much more numerous (e.g., gray whale), the Navy has determined possible effects to ribbon seals from Navy training in the Study Area are discountable and a density for the ribbon seal is therefore not required for the impact analyses which follow.

Northern Sea Otters

As presented in detail in Section 3.8.2.27 (Northern Sea Otter [*Enhydra lutris kenyoni*]), sea otters prefer rocky shorelines, relatively shallow water with kelp, and seldom range more than 1.2 mi. (2 km) from shore. Although some juvenile males may travel farther offshore, they would be the minority of the population. Because the nearest shoreline (Kenai Peninsula) is located approximately 24 nm north of the TMAA's northern boundary, it is unlikely that sea otters would be present in the Study Area. Even if exposed to sound from Navy activities, research indicates sea otters often remained undisturbed, quickly become tolerant of various sounds, and even when purposefully harassed they generally moved only a short distance (100–200 m) before resuming normal activity (Davis et al. 1988). Off California at San Nicolas within the Navy's Point Mugu Sea Range, southern sea otters have been subjected to Navy activities for decades. The average growth rate for the population of sea otters at this Navy range has consistently been higher than that for the rest of the California population (U.S. Fish and Wildlife Service 2014). Therefore, the Navy has determined that possible effects to Northern sea otter from Navy training in the Study Area are discountable, and a density for the sea otter was therefore not required for the impact analyses which follow.

Modeling Effects Prorated by Stock

There are a number species of marine mammals having more than one overlapping stock in the Study Area (Table 3.8-1). Individual marine mammal densities cannot be derived for these stocks given the current inability during marine mammal surveys to visually distinguish which stocks animals belong to, in an area having overlapping stocks of the same species. For species having overlapping stocks in the Study Area, modeling for acoustic effects at the species level was therefore prorated to each stock based on the relative abundance of each stock as shown in Table 3.8-7.

Table 3.8-7: Ratios Used to Prorate Modeling Results on Species to Individual Stocks of Marine Mammals in the Study Area

Species Common Name	Stock	Number of Animals in Stock	Total for Species	Ratio of Total Modeled Effects for Species	Rounded Ratio for Prorating Modeled Effects
Humpback whale	Central North Pacific	10,103	11,041	0.915	0.92
	Western North Pacific	938		0.085	0.08
Blue whale	Eastern North Pacific	2,497	2497	Estimate	0.99
	Central North Pacific	Not available		Estimate	0.01
Gray whale	Eastern North Pacific	19,126	19,281	0.992	0.99
	Western North Pacific	155		0.008	0.01
Killer whale	Alaska Resident	2,084	2,854	0.730	0.73
	Offshore	211		0.073	0.08
	AT1 Transient	7		0.002	0.00
	Gulf of Alaska, Aleutian Island, and Bering Sea Transient	552		0.193	0.19
Harbor porpoise	Gulf of Alaska	31,046	42,192	0.736	0.74
	Southeast Alaska	11,146		0.264	0.26
Steller sea lion	Eastern U.S.	52,847	98,763	0.535	0.54
	Western U.S.	45,916		0.465	0.46

Table 3.8-7: Ratios Used to Prorate Modeling Results on Species to Individual Stocks of Marine Mammals in the Study Area (continued)

Species Common Name	Stock	Number of Animals in Stock	Total for Species	Ratio of Total Modeled Effects for Species	Rounded Ratio for Prorating Modeled Effects
Harbor seal	N. Kodiak	4,509	75,145	0.060	0.06
	S. Kodiak	11,117		0.148	0.15
	Prince William Sound	31,503		0.419	0.42
	Glacier Bay/Icy Strait	5,042		0.067	0.07
	Sitka/Chatham	8,586		0.114	0.11
	Dixon/Cape Decision	14,388		0.191	0.19

Note: U.S. = United States

3.8.3.1.6.2 Upper and Lower Frequency Limits

The Navy adopted a single frequency cutoff at each end of a functional hearing group's frequency range, based on the most liberal interpretations of their composite hearing abilities (see Finneran and Jenkins [2012] for details involving derivation of these values). These are not the same as the values used to calculate weighting curves, but instead exceed the demonstrated or anatomy-based hypothetical upper and lower limits of hearing within each group. Table 3.8-8 provides the lower and upper frequency limits for each species group. Sounds with frequencies below the lower frequency limit, or above the upper frequency limit, are not analyzed with respect to auditory effects for a particular group.

Table 3.8-8: Lower and Upper Cutoff Frequencies for Marine Mammal Functional Hearing Groups Used in this Acoustic Analysis

Functional Hearing Group	Limit (Hz)	
	Lower	Upper
Low-Frequency Cetaceans	5	30,000
Mid-Frequency Cetaceans	50	200,000
High-Frequency Cetaceans	100	200,000
Phocid seals (underwater)	50	80,000
Otariid pinniped and sea otter (underwater)	50	60,000

Note: Hz = Hertz

3.8.3.1.6.3 Navy Acoustic Effects Model

For this analysis of training activities at sea, the Navy developed a set of software tools and compiled data for the quantification of predicted acoustic impacts to marine mammals. These databases and tools collectively form the NAEMO. Details of this model's processes and the description and derivation of the inputs are presented in the Navy's Determination of Acoustic Effects Technical Report (Marine Species Modeling Team 2014).

The NAEMO improves upon previous modeling efforts (e.g., U.S. Department of the Navy 2008, 2011a) in several ways. First, unlike earlier methods that modeled sources individually, the NAEMO has the capability to run all sources within a scenario simultaneously, providing a more realistic depiction of the potential effects of an activity. Second, previous models calculated sound received levels within set volumes of water and spread animals uniformly across the volumes; in the NAEMO, animats (virtual

animals) are distributed nonuniformly based on higher resolution species-specific density, depth distribution, and group size information, and animats serve as dosimeters, recording energy received at their location in the water column. Third, a fully three-dimensional environment is used for calculating sound propagation and animat exposure in the NAEMO, rather than a two-dimensional environment where the worst case sound pressure level across the water column is always encountered. Finally, current efforts incorporate site-specific bathymetry, sound speed profiles, wind speed, and bottom properties into the propagation modeling process rather than the flat-bottomed provinces used during earlier modeling (Marine Species Modeling Team 2014). The following paragraphs provide an overview of the NAEMO process and its more critical data inputs.

Using the best available information on the predicted density of marine mammals in the area being modeled, the NAEMO derives an abundance (total number of individuals) and distributes the resulting number of animats into an area bounded by the maximum distance that energy propagates out to a criterion threshold value (energy footprint). For example, for non-impulsive sources, all animats that are predicted to occur within a range that could receive sound pressure levels greater than or equal to 120 dB re 1 µPa are distributed within the modeling predicted sound energy footprint. These animats are distributed based on density differences across the area, the group (pod) size, and known depth distributions (dive profiles; see Marine Species Modeling Team 2014). Animats change depths every 4 minutes but do not otherwise mimic actual animal behaviors, such as avoidance or attraction to a stimulus (horizontal movement), or foraging, social, or traveling behaviors.

Schecklman et al. (2011) argue that static distributions underestimate acoustic exposure compared to a model with fully three-dimensionally moving animals. However, their static method is different from the NAEMO in several ways. First, they distribute the entire population at depth with respect to the species-typical depth distribution histogram, and those animats remain static at that position throughout the entire simulation. In the NAEMO, animats are placed horizontally dependent on nonuniform density information, and then move up and down over time within the water column by integrating species-typical depth distribution information. Second, for the static method, they calculate acoustic received level for designated volumes of the ocean and then sum the animats that occur within that volume, rather than using the animats themselves as dosimeters, as in the NAEMO. Third, Schecklman et al. (2011) ran 50 iterations of the moving distribution to arrive at an average number of exposures, but because they rely on uniform horizontal density (and static depth density), only a single iteration of the static distribution is realized. In addition to moving the animats vertically, the NAEMO overpopulates the animats over a nonuniform density and then resamples the population a number of times to arrive at an average number of exposures as well. Tests comparing fully moving distributions and static distributions with vertical position changes at varying rates were carried out during development of the NAEMO. For position updates occurring more frequently than every 5 minutes, the number of estimated exposures was similar between the NAEMO and the fully moving distribution; however, computational time was much longer for the fully moving distribution.

The NAEMO calculates the likely propagation for various levels of energy (sound or pressure) resulting from each non-impulse or impulse source in use during the Carrier Strike Group exercise. This is done by taking into account the actual bathymetric relief and bottom types (e.g., reflective), and estimated sound speeds and sea surface roughness at an event's location. Platforms (such as a ship using one or more sound sources) are modeled as moving across in a manner consistent with the modeled activity. The model uses typical platform speeds and event durations. Moving source platforms either travel along a predefined track or move along straight-line tracks from a random initial course, reflecting at the

edges of a predefined boundary. Static sound sources are stationary in a fixed location for the duration of a scenario.

All activities[4] involving sonar and other active acoustic sources in use during the Carrier Strike Group exercise are modeled as occurring at the same 21-day period of the exercise in an integrated manner. As a result, the total acoustic energy from all sonar and other active acoustic sources is summed within each 24-hour period so the cumulative sound energy has been accounted for. Events involving use of explosives would not occur in the same location within the TMAA where anti-submarine warfare training using sonar and other active acoustic sources are being used. Events involving the use of explosives[5] are therefore modeled as individual independent events even though they would be taking place within the TMAA. Given the level of activity within the TMAA over the period of the Carrier Strike Group exercise and the likely avoidance of the general area by some species (e.g., beaked whales) as a result of that activity, it is likely modeling overestimates the predicted effects from use of explosives.

Modeling locations were chosen based on regulatory restrictions (such as where a Sinking Exercise can occur), where training events are likely to occur so as not to interfere with commercial aircraft routes and other non-participatory vessels, and in an effort to be representative of the entire TMAA by including all the environmental variation within the Study Area.

The NAEMO then records the energy received by each animat within the sound energy footprint of the event and calculates the number of animats having received levels of energy exposures that fall within defined impact thresholds. Predicted effects to the animats are then converted using actual marine mammal densities, and the highest order effect predicted for a given animal is assumed. Each 24-hour day for events involving sonar and other active acoustic sources and each activity for events involving explosives are modeled as independent of all others, and therefore, the same individual marine mammal animat could be modeled as impacted multiple times during the 21-day Carrier Strike Group exercise. Although the activities themselves all occur within the Study Area, sound may propagate beyond the boundary of the Study Area. Any exposures occurring outside the boundary of the Study Area are included in the model-estimated impacts presented for the Proposed Action. The NAEMO provides the initial predicted impacts to marine species (based on application of multiple conservative assumptions which are assumed to overestimate impacts), which are then further analyzed to produce final estimates used in the Navy's MMPA application for Letter of Authorization (LOA) and ESA risk analyses (Section 3.8.3.3.1.2, Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources, provides further information on additional analyses).

Model Assumptions and Limitations

There are limitations to the data used in the NAEMO, and the results must be interpreted with consideration for these known limitations. Output from the NAEMO relies heavily on the quality of both the input parameters and impact thresholds and criteria. When there was a lack of definitive data to support an aspect of the modeling (such as lack of well-described diving behavior for all marine species), modeling assumptions believed to overestimate the number of exposures were chosen:

- Marine mammals (animats) are modeled as being underwater and facing the source and therefore always predicted to receive the maximum sound level (e.g., the model does not account for conditions such as body shading, porpoising out of the water, or an animal raising its

[4] These include the four Anti-Submarine Warfare Tracking Exercises: (1) Helicopter, (2) Marine Patrol Aircraft, (3) Surface Ship, (4) Submarine, and (5) involving active torpedo sonar during a Sinking Exercise.
[5] Bombing, Surface-to-Surface Gunnery, Sinking Exercise, and Tracking Exercise using Extended Echo Ranging sonobouys

head above water). Some odontocetes have been shown to have directional hearing, with best hearing sensitivity facing a sound source and higher hearing thresholds for sounds propagating toward the rear or side of an animal (Au and Moore 1984, Kastelein et al. 2005c, Mooney et al. 2008, Popov and Supin 2009).

- Animats do not move horizontally (but change their position vertically within the water column), which may overestimate physiological effects such as hearing loss, especially for slow moving or stationary sound sources in the model.
- Animats are stationary horizontally and therefore are not modeled as moving away from any sound source, unlike in the wild where animals would most often avoid exposures at higher sound levels close to the source, especially those exposures that may result in PTS.
- Animats are assumed to receive the full impulse of the initial positive pressure wave due to an explosion, although the impulse-based thresholds (onset mortality and onset slight lung injury) assume an impulse delivery time adjusted for animal size and depth. Therefore, these impacts are overestimated at farther distances and increased depths.
- Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the temporary or permanent hearing loss, because there are not sufficient data to estimate a hearing recovery function for the time between exposures.
- Mitigation measures which are implemented during many training activities were not factored into the initial model output (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring). In reality, sound-producing activities would be reduced, stopped, or delayed if marine mammals are detected within the mitigation zones around sound sources.

Because of these inherent model limitations and simplifications, initial model-estimated results must be further analyzed, considering such factors as the range to specific effects, animal avoidance, and the likelihood of successfully implementing mitigation measures. This analysis uses a number of factors in addition to the acoustic model results to predict acoustic effects to marine mammals, as presented in the following section.

3.8.3.1.7 Marine Mammal Avoidance of Sound Exposures

Marine mammals may avoid sound exposures by either avoiding areas with high levels of anthropogenic activity or moving away from a sound source. Because the NAEMO does not consider horizontal movement of animats, including avoidance of human activity or sounds, it overestimates the number of marine mammals that would be exposed to sound sources that could cause injury. Therefore, the potential for avoidance is considered in the post-model analysis. The consideration of avoidance during use of sonar and other active acoustic sources and during use of explosives is described below and discussed in more detail in Section 3.8.3.1.2 (Analysis Background and Framework).

3.8.3.1.7.1 Avoidance of Human Activity

Cues preceding the commencement of an event (e.g., multiple vessel presence and movement, aircraft overflight) may result in some animals departing the immediate area, even before active sound sources begin transmitting. Harbor porpoises and beaked whales have been observed to be especially sensitive to human activity, which is accounted for by using a low threshold for behavioral disturbance due to exposure to sonars and other active acoustic sources. Both finless porpoises (Li et al. 2008) and harbor porpoises (Barlow 1988, Evans et al. 1994, Palka and Hammond 2001, Polacheck and Thorpe 1990) routinely avoid and swim away from large motorized vessels. The vaquita, which is closely related to the harbor porpoise, appears to avoid large vessels at about 2,995 ft. (913 m) (Jaramillo-Legorreta et al. 1999). The assumption is that the harbor porpoise would respond similarly to large Navy vessels. Beaked

whales have been observed to be especially sensitive to human activity (Tyack et al. 2011; Pirotta et al. 2012), which is accounted for by using a low threshold for behavioral disturbance due to exposure to sonar and other active acoustic sources (Section 3.8.3.1.2, Analysis Background and Framework).

Therefore, for certain naval activities preceded by high levels of vessel activity (multiple vessels) or hovering aircraft, harbor porpoise and beaked whales are assumed to avoid the activity area prior to the start of a sound-producing activity. Model-estimated effects during these types of activities are adjusted so that high-level sound impacts to harbor porpoise and beaked whales (those causing PTS during use of sonar and other active acoustic sources and those causing mortality due to explosives) are considered to be TTS and recoverable injury, respectively, due to animals moving away from the activity and into a lower effect range.

3.8.3.1.7.2 Avoidance of Repeated Exposures

Marine mammals would likely avoid repeated high level exposures to a sound source that could result in injuries (i.e., PTS). Therefore, the model-estimated effects are adjusted to account for marine mammals swimming away from a sonar or other active sources and away from multiple explosions to avoid repeated high level sound exposures.

3.8.3.1.8 Implementing Mitigation to Reduce Sound Exposures

The Navy implements mitigation measures (described in Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) during sound-producing activities, including halting or delaying use of a sound source or explosives when marine mammals are observed in the mitigation zone. These measures and procedures have been previously and recently analyzed, reviewed, and subject to public comment (U.S Department of the Navy 2013d) and authorized by NMFS pursuant to the MMPA (National Oceanic and Atmospheric Administration 2013b) for other identical Navy training activities in the Pacific. The NAEMO estimates acoustic effects without taking into account any shutdown or delay of the activity when marine mammals are detected; therefore, the model overestimates impacts to marine mammals within mitigation zones. The post-model analysis considers the potential for mitigation to reduce the likelihood or risk of PTS due to exposure to sonar and other active acoustic sources and injuries and mortalities due to explosives. A detailed explanation of this analysis is provided in the technical report *Post-Model Quantitative Analysis of Animal Avoidance Behavior and Mitigation Effectiveness for Gulf of Alaska Training* (U.S. Department of the Navy 2014b). Two factors are considered when quantifying the effectiveness of mitigation: (1) the sightability of each species that may be present in the mitigation zone, which is affected by species-specific characteristics; and (2) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity. The mitigation zones proposed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) encompass the estimated ranges to injury (including the range to mortality for explosives) for a given source.

Mitigation is considered in the acoustic effects analysis when the mitigation zone can be fully or mostly observed up to and during a sound-producing activity. Mitigation for each activity is considered in its entirety, taking into account the different scenarios that may take place as part of that activity (some scenarios involve different mitigation zones, platforms, or number of Lookouts). The ability to observe the range to mortality (for explosive activities only) and the range to potential injury (for all sound-producing activities) was estimated for each training event. Mitigation was considered in the acoustic analysis as follows:

- If the entire mitigation zone can be continuously visually observed based on the surveillance platform(s), number of Lookouts, and size of the range to effects zone, the mitigation is considered fully effective (Effectiveness = 1).
- If over half of the mitigation zone can be continuously visually observed or if there is one or more of the scenarios within the activity for which the mitigation zone cannot be continuously visually observed (but the range to effects zone can be visually observed for the majority of the scenarios), the mitigation is considered mostly effective (Effectiveness = 0.5).
- If less than half of the mitigation zone can be continuously visually observed or if the mitigation zone cannot be continuously visually observed during most of the scenarios within the activity due to the type of surveillance platform(s), number of Lookouts, and size of the mitigation zone, the mitigation is not considered in the acoustic effects analysis.

In the case of Navy Carrier Strike Group training in the Gulf of Alaska, the events using sonar and other active acoustic sources are all modeled as occurring during 21 consecutive days and involving multiple surface ships, a submarine, planes, and helicopters operating in proximity to each other or otherwise involving the same general event area. Because there will be multiple watch personnel on board vessels and aircraft observing a mitigation zone and given there will be multiple platforms having opportunities at detecting any marine mammals that may be in the area, it is therefore assumed that the entire PTS mitigation zone for events involving sonar and other active acoustic sources can be continuously observed. For the events involving use of explosives, the assessment of the mitigation effectiveness in observation of the serious injury and mortality zones are variable (for details, see Table 3.8-19).

The ability of Lookouts to detect marine mammals in or approaching the mitigation zone is determined by the animal's presence at the surface and the characteristics of the animal that influence its sightability. The Navy considered what applicable data were available to numerically approximate the sightability of marine mammals and determined that the standard "detection probability" referred to as g(0) was most appropriate. The abundance of marine mammals is typically estimated using line-transect analyses (Buckland et al. 2001), in which g(0) is the probability of detecting an animal or group of animals on the transect line (the straight-line course of the survey ship or aircraft). This detection probability is derived from systematic line-transect marine mammal surveys based on species-specific estimates for vessel and aerial platforms. Estimates of g(0) are available from peer-reviewed marine mammal line-transect survey reports, generally provided through research conducted by the National Marine Fisheries Service Science Centers.

There are two separate components of g(0): perception bias and availability bias (Marsh and Sinclair 1989). Perception bias accounts for marine mammals that are on the transect line and detectable, but were simply missed by the observer. Various factors influence the perception bias component of g(0), including species-specific characteristics (e.g., behavior and appearance, group size, and blow characteristics), viewing conditions during the survey (e.g., sea state, wind speed, wind direction, wave height, and glare), observer characteristics (e.g., experience, fatigue, and concentration), and platform characteristics (e.g., pitch, roll, speed, and height above water).

To derive estimates of perception bias, typically an independent observer is present who looks for marine mammals missed by the primary observers. Mark-recapture methods are then used to estimate the probability that animals are missed by the primary observers. Availability bias accounts for animals that are missed because they are not at the surface at the time the survey platform passes by, which generally occurs more often with deep diving whales (e.g., sperm whales and beaked whales). The availability bias portion of g(0) is independent of prior marine mammal detection experience since it

only reflects the probability of an animal being at the surface within the survey track and therefore available for detection.

Some g(0) values are estimates of perception bias only, some are estimates of availability bias only, and some reflect both, depending on the species and data that are currently available. The Navy used g(0) values with both perception and availability bias components if that data was available. If both components were not available for a particular species, the Navy determined that g(0) values reflecting perception bias or availability bias, but not both, still represent the best statistically-derived factor for assessing the likelihood of marine mammal detection by Navy Lookouts.

As noted above, line-transect surveys and subsequent analyses are typically used to estimate cetacean abundance. To systematically sample portions of an ocean area (such as the coastal waters off California or the east coast), marine mammal surveys are designed to uniformly cover the survey area and are conducted at a constant speed (generally 10 knots for ships and 100 knots for aircraft). Survey transect lines typically follow a pattern of straight lines or grids. Generally there are two primary observers searching for marine mammals. Each primary observer looks for marine mammals in the forward 90-degree quadrant on their side of the survey platform. Based on data collected during the survey, scientists determine the factors that affected the detection of an animal or group of animals directly along the transect line.

Visual marine mammal surveys (used to derive g(0)) are conducted during daylight.[6] Marine mammal surveys are typically scheduled for a season when weather at sea is more likely to be good, however, observers on marine mammal surveys will generally collect data in sea state conditions up to Beaufort 6 and do encounter rain and fog at sea which may also reduce marine mammal detections (see Barlow 2006). For most species, g(0) values are based on the detection probability in conditions from Beaufort 0 to Beaufort 5, which reflects the fact that marine mammal surveys are often conducted in less than ideal conditions (see Barlow 2003, Barlow and Forney 2007). The ability to detect some species (e.g., small beaked whales and Dall's porpoise) decreases dramatically with increasing sea states, so g(0) estimates for these species are usually restricted to observations in sea state conditions of Beaufort 0 to 2 (Barlow 2003).

Navy training events differ from systematic line-transect marine mammal surveys in several respects. These differences suggest the use of g(0), as a sightability factor to quantitatively adjust model-predicted effects based on mitigation is likely to result in an underestimate of the protection afforded by the implementation of mitigation as follows:

- Mitigation zones for training events are significantly smaller (typically less than 1,000 yd. radius) than the area typically searched during line-transect surveys, which includes the maximum viewable distance out to the horizon.
- The case of Navy Carrier Strike Group training in the Gulf of Alaska, events involve more than one vessel or aircraft (or both) operating in proximity to each other or otherwise covering the same general area. Additional vessels and aircraft can result in additional watch personnel observing the mitigation zone (e.g., a Sinking Exercise). This would result in more observation platforms and observers looking at the mitigation zone than the two primary observers used in marine mammal surveys upon which g(0) is based.

[6] At night, passive acoustic data may still be collected during a marine mammal survey.

- A systematic marine mammal line-transect survey is designed to sample broad areas of the ocean, and generally does not retrace the same area during a given survey. Therefore, in terms of g(0), the two primary observers have only a limited opportunity to detect marine mammals that may be present during a single pass along the trackline (i.e., deep diving species may not be present at the surface as the survey transits the area). In contrast, many training activities involve area-focused events (e.g., anti-submarine warfare tracking exercise), where participants are likely to remain in the same general area during an event. In other cases training activities are stationary (e.g., use of dipping sonar), which allows Lookouts to focus on the same area throughout the activity. Both of these circumstances result in a longer observation period of a focused area with more opportunities for detecting marine mammals than are offered by a systematic marine mammal line-transect survey that only passes through an area once.

Although Navy Lookouts on ships have hand-held binoculars and, on some ships, pedestal mounted binoculars very similar to those used in marine mammal surveys, there are differences between the scope and purpose of marine mammal detections during research surveys along a trackline and Navy Lookouts observing the water proximate to a Navy training activity to facilitate implementation of mitigation. The distinctions required careful consideration when comparing the Navy Lookouts to marine mammal surveys.[7]

- A marine mammal observer is responsible for detecting marine mammals in their quadrant of the trackline out to the limit of the available optics. Although Navy Lookouts are responsible for observing the water for safety of ships and aircraft, during specific training activities, they need only detect marine mammals in the relatively small area that surrounds the mitigation zone (in most cases less than 1,000 yd. from the ship) for mitigation to be implemented.
- Navy Lookouts, personnel aboard aircraft and on watch onboard vessels at the surface will have less experience detecting marine mammals than marine mammal observers used for line-transit survey. However, Navy personnel responsible for observing the water for safety of ships and aircraft do have significant experience looking for objects (including marine mammals) on the

[7] Barlow and Gisiner (2006) provide a description of typical marine mammal survey methods from ship and aircraft and then provide "a crude estimate" of the difference in detection of beaked whales between trained marine mammal observers and seismic survey mitigation, which is not informative with regard to Navy mitigation procedures for the following reasons. The authors note that seismic survey differs from marine mammal surveys in that "(1) seismic surveys are also conducted at night; (2) seismic surveys are not limited to calm sea conditions; (3) mitigation observers are primarily searching with unaided eyes and 7x binoculars; and (4) typically only one or possibly two observers are searching." When the Navy implements mitigation for which adjustments to modeling output were made, the four conditions Barlow and Gisiner (2006) note are not representative of Navy procedures nor necessarily a difference in marine mammal line-transect survey procedures. The Navy accounts for reduced visibility (i.e., activities which occur at night, etc.) by assigning a lower value to the mitigation effectiveness factor. Additionally, in the TMAA during the proposed mid-summer training there should be 18–19 hours of daylight. On Navy ships, hand-held binoculars are always available and pedestal mounted binoculars, very similar to those used in marine mammal surveys, are generally available to Navy Lookouts on board vessels over 60 ft. Also, like marine mammal observers, Navy Lookouts are trained to use a methodical combination of unaided eye and optics as they search the surface around a vessel. The implication that marine mammal surveys only occur in "calm sea conditions" is not accurate since the vast majority of marine mammal surveys occur and data are collected in conditions up to sea states of Beaufort 5. The specific g(0) values analyzed by Barlow and Gisiner (2006) were derived from survey data for Cuvier's and *Mesoplodon* beaked whale that were detected in sea states of Beaufort 0–2 during daylight hours. However, marine mammal surveys are not restricted to sea states of Beaufort 0–2, many species g(0) values are based on conditions up to and including Beaufort 5 and, therefore, the conclusions reached by Barlow and Gisiner (2006) regarding the effect of sea state conditions on sightability do not apply to other species. Finally, when Lookouts are present, there are always more than the "one or two personnel" described by Barlow and Gisiner (2006) observing the area ahead of a Navy vessel (additional bridge watch personnel are also observing the water around the vessel).

water's surface and Lookouts are trained using the NMFS-approved Marine Species Awareness Training.

Although there are distinct differences between marine mammal surveys and the proposed training activities, the use of g(0) as an approximate sightability factor for quantitatively adjusting model-predicted impacts due to mitigation (mitigation effectiveness x g(0)) is an appropriate use of the best available science based on the way it has been applied. Consistent with the Navy's impact assessment processes, the Navy applied g(0) in a conservative manner (erring on the side of overestimating the number of impacts) to quantitatively adjust model-predicted effects to marine mammals within the applicable mitigation zones during training activities. Conservative application of g(0) include:

- In addition to a sightability factor (based on g(0)), the Navy also applied a mitigation effectiveness factor to acknowledge the uncertainty associated with applying the g(0) values derived from marine mammal surveys to specific Navy training and testing activities where the ability to observe the whole mitigation zone is less than optimal (generally due to the size of the mitigation zone).
- For activities that can be conducted at night, the Navy assigned a lower value to the mitigation effectiveness factor. For example, if an activity can take place at night half the time, then the mitigation effectiveness factor was only given a value of 0.5 (note this will occur less often in the TMAA during the mid-summer training when there should be 18–19 hours of daylight).
- The Navy did not quantitatively adjust model-predicted effects for activities that were given a mitigation effectiveness factor of zero. A mitigation effectiveness factor of zero was given to activities where less than half of the mitigation zone can be continuously visually observed or if the mitigation zone cannot be continuously visually observed during most of the scenarios within the activity due to the type of surveillance platform(s), number of Lookouts, and size of the mitigation zone. However, some protection from applied mitigation measures would be afforded during these activities, even though they are not accounted for in the quantitative reduction of model-predicted impacts.
- The Navy did not quantitatively adjust model-predicted effects based on detections made by other personnel that may be involved with an event (such as support personnel aboard a boat towing a target or onboard support aircraft), even though information about marine mammal sightings are shared among units participating in the training or activity. In other words, the Navy only quantitatively adjusted the model-predicted effects based on the required number of Lookouts as specified in established mitigation measures.
- The Navy only quantitatively adjusted model-predicted effects within the range to mortality (explosives only) and injury (all sound-producing activities) (see Chapter 11 for a comparison of the range to effects for PTS, TTS, and the recommended mitigation zone). Despite employing the required mitigation measures during an activity that will also reduce some TTS exposures, the Navy did not quantitatively adjust the model-predicted TTS effects or other predicted behavioral effects as a result of implemented mitigation.
- The total model-predicted number of animals affected is not reduced by the post-model mitigation analysis, since all reductions in mortality and injury effects are then added to and counted as TTS effects.
- Mitigation involving a power-down or cessation of sonar, or delay in use of explosives, as a result of a marine mammal detection, protects the observed animal and all unobserved (below the surface) animals in the vicinity. The quantitative adjustments of model-predicted impacts, however, assumes that only animals on the water surface, approximated by considering the species-specific g(0) and activity-specific mitigation effectiveness factor, would be protected by

the applied mitigation (i.e., a power down or cessation of sonar or delaying the event). The quantitative post-model mitigation analysis, therefore, does not capture the protection afforded to all marine mammals that may be near or within the mitigation zone.

The Navy recognizes that g(0) values are estimated specifically for line-transect analyses; however, g(0) is still the best statistically-derived factor for assessing the likely marine mammal detection abilities of Navy Lookouts. This sightability factor is then used in post-modeling adjustments to account for the reduced potential for mortality and injury to occur as a result of implemented mitigation. Based on the points summarized above, as a factor used in accounting for the implementation of mitigation, g(0) is therefore considered to be the best available scientific basis for Navy's representation of the sightability of a marine mammal as used in this analysis.

The g(0) value used in the mitigation analysis is based on the platform(s) with Lookouts utilized in the activity. In the case of multiple platforms, the higher g(0) value for either the aerial or vessel platform is selected. For species for which there is only a single published value for each platform, that individual value is used. For species for which there is a range of published g(0) values, an average of the values, calculated separately for each platform, is used. A g(0) of zero is assigned to species for which there is no data available, unless a g(0) estimate can be extrapolated from similar species/guilds based on the published g(0) values. The g(0) values used in this analysis are provided in Table 3.8-9. The post-model acoustic effects quantification process is summarized in Table 3.8-10.

The post-model acoustic effect analysis quantification process is summarized in Table 3.8-10 and presented in detail in the technical report Post-Model Quantitative Analysis of Animal Avoidance Behavior and Mitigation Effectiveness for the Gulf of Alaska Training Activities (U.S. Department of the Navy 2014b). In brief, the mitigation effectiveness score for an event is multiplied by the estimated sightability of each species to quantify the number of animals that were originally modeled as a mortality (explosives only) or injury (all sound-producing activities) exposure but would, in reality, be observed by Lookouts or shore-based observers prior to or during a sound-producing activity. Observation of marine mammals prior to or during a sound-producing event would be followed by stop or delay of the sound-producing activity, which would reduce actual marine mammal sound exposures. The final quantified results of the acoustic effects analysis for non-impulse sources are presented in Section 3.8.3.3.2 (Model Predicted Effects from use of Sonar and Other Active Acoustic Sources) and for explosive sources in Section 3.8.3.3.7 (Model Predicted Effects from use of Explosives) for the three alternatives.

Table 3.8-9: Sightability Based on g(0) Values for Marine Mammal Species in Temporary Maritime Activities Area

Species/Stocks	Family	Vessel Sightability	Aircraft Sightability
Baird's Beaked Whale	Ziphiidae	0.96	0.18
Blue Whale, Fin Whale; Sei Whale	Balaenopteridae	0.921	0.407
California Sea Lion, Northern Fur Seal, Steller Sea Lion	Zalophus, Callorhinus, Eumetopias	0.299	0.299
Cuvier's Beaked Whale	Ziphiidae	0.23	0.074
Dall's Porpoise	Phocoenidae	0.822	0.221
Gray Whale	Eschrichtiidae	0.921	0.482
Harbor Porpoise	Phocoenidae	0.769	0.292
Harbor Seal, Ribbon Seal	Phoca vitulina, Histriophoca	0.281	0.281
Humpback Whale	Balaenopteridae	0.921	0.495
Killer Whale	Delphinidae	0.921	0.95

Table 3.8-9: Sightability Based on g(0) Values for Marine Mammal Species in Temporary Maritime Activities Area (continued)

Species/Stocks	Family	Vessel Sightability	Aircraft Sightability
Minke Whale	Balaenopteridae	0.856	0.386
North Pacific Right Whale	Eubalaena	0.645	0.41
Northern Elephant Seal	Mirounga	0.105	0.105
Pacific White-Sided Dolphin	Delphinidae	0.856	0.96
Sperm Whale	Physeteridae	0.87	0.32
Stejneger's Beaked Whale	Mesoplodon	0.23	0.074

Notes: When there was no value available for vessels, the g(0) for aircraft was used as a conservative underestimate of sightability following the assumption that the availability bias from a slower moving vessel should result in a higher g(0). The g(0) for Cuvier's beaked whale was used for Stejneger's beaked whale given there is no data available for Stejneger's. The published California Sea Lion aircraft g(0) is used for Steller Sea Lion and Northern Fur Seal since all are in the otariidae family and there is no g(0) data for these other species. The published Harbor Seal aircraft g(0) is used for Ribbon Seal since they are in the phocid family and there is no g(0) data for ribbon seal. North Atlantic right whale data (Palka 2005) has been used for North Pacific right whale.
Sources: Barlow 2006, Barlow and Forney 2007, Barlow et al. 2006, Carretta et al. 2000, Forney and Barlow 1998, Laake et al. 1997, Palka 2005

The incorporation of mitigation factors for the reduction of predicted effects used a conservative approach (erring on the side of overestimating the number of effects) since reductions as a result of implemented mitigation were only applied to those events having a very high likelihood of detecting marine mammals. It is important to note that there are additional protections offered by mitigation procedures, which will further reduce effects to marine mammals, but these are not considered in the quantitative adjustment of the model predicted effects.

3.8.3.1.9 Marine Mammal Monitoring During Navy Training

The current behavioral exposure criteria under the response function also assumes there will be a range of reactions from minor or inconsequential to severe. Section 3.8.5.1 (Alaska Specific Monitoring and Research) summarizes the monitoring data that has been collected thus far within the Study Area. There is, in addition, other relevant monitoring and research that has been completed across the Navy since 2006 and that is summarized for the Pacific in Section 3.8.5 (Summary of Observations During Previous Navy Activities). Results of monitoring may provide indications that the severity of reactions has also been overestimated.

3.8.3.2 Application of the Marine Mammal Protection Act to Potential Acoustic Effects

The MMPA prohibits the unauthorized harassment of marine mammals and provides the regulatory processes for authorization for any such incidental harassment that might occur during an otherwise lawful activity. Harassment that may result from training activities described in this Supplemental EIS/OEIS is unintentional and incidental to those activities.

For military readiness activities, MMPA Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild. Injury, as defined in this Supplemental EIS/OEIS, is the destruction or loss of biological tissue from a marine mammal. The destruction or loss of biological tissue will result in an alteration of physiological function that exceeds the normal daily physiological variation of the intact tissue. For example, increased localized histamine production, edema, production of scar tissue, activation of clotting factors, white blood cell response, etc., may be expected following injury. Therefore, this Supplemental EIS/OEIS assumes that all injury is qualified as a physiological effect and, to be consistent with prior actions and rulings (National Marine Fisheries Service 2001b, 2008a, 2008b; National Oceanic and Atmospheric Administration 2013b),

Table 3.8-10: Post-Model Acoustic Effects Quantification Process

Sonar or other active acoustic source	Explosives
S-1. Is the activity preceded by multiple vessel activity or hovering helicopter?	***E-1. Is the activity preceded by multiple vessel activity or hovering helicopter?***
Species sensitive to human activity (i.e., harbor porpoise and beaked whales) are assumed to avoid the activity area, as the participants arrive and prepare for the event and before sonar activities and the use of explosives commence, putting them out of the range to Level A harassment. Model-estimated PTS to these species during these activities are unlikely to actually occur and, therefore, are considered to be TTS (animal is assumed to move into the range of potential TTS). The Carrier Strike Group exercise is modeled as having multiple vessel movements, planes, and hovering helicopters as part of the exercise events.	Species sensitive to human activity (i.e., harbor porpoise and beaked whales) are assumed to avoid the activity area, putting them out of the range to mortality. Model-estimated mortalities to these species during these activities are unlikely to actually occur and, therefore, are considered to be injuries (animal is assumed to move into the range of potential injury). For this analysis, the Sinking Exercise (SINKEX) is the only activity modeled as being preceded by multiple vessel movements and hovering helicopters.
S-2. Can Lookouts observe the activity-specific mitigation zone (see Chapter 5) up to and during the sound-producing activity?	***E-2. Can Lookouts observe the activity-specific mitigation zone (see Chapter 5) up to and during the sound-producing activity?***
If Lookouts are able to observe the mitigation zone up to and during a sound-producing activity, the sound-producing activity would be halted or delayed if a marine mammal is observed and would not resume until the animal is thought to be out of the mitigation zone. Therefore, model-estimated PTS are reduced by the portion of animals that are likely to be seen [Mitigation Effectiveness (1, 0.5, or 0) x Sightability, g(0)]. Any animals removed from the model-estimated PTS are instead assumed to be TTS (animal is assumed to move into the range of TTS). The g(0) value is associated with the platform (vessel or aircraft) with the Lookout(s). For activities with Lookouts on both platforms, the higher g(0) is used for analysis. The g(0) values are provided in Table 3.8-9. The Mitigation Effectiveness during the Carrier Strike Group exercise is given a factor of 1, since the activities are modeled as involving multiple vessels, planes, and helicopters operating in a coordinated manner. Marine mammals in the mid-frequency hearing group would have to be close to the most powerful moving source (less than 10 m) to experience PTS. These model-estimated PTS of mid-frequency cetaceans are unlikely to actually occur and, therefore, are considered to be TTS (animal is assumed to move into the range of TTS).	If Lookouts are able to observe the mitigation zone up to and during an explosion, the explosive activity would be halted or delayed if a marine mammal is observed and would not resume until the animal is thought to be out of the mitigation zone. Therefore, model-estimated mortalities and injuries are reduced by the portion of animals that are likely to be seen [Mitigation Effectiveness (1, 0.5, or 0) x Sightability, g(0)]. Any animals removed from the model-estimated mortalities or injuries are instead assumed to be injuries or behavioral disturbances, respectively (animals are assumed to move into the range of a lower effect). The g(0) value is associated with the platform (vessel or aircraft) with the Lookout(s). For activities with Lookouts on both platforms, the higher g(0) is used for analysis. The g(0) values are provided in Table 3.8-9. The Mitigation Effectiveness values for explosive activities are given in Table 3.8-18.
S-3. Does the activity cause repeated sound exposures which an animal would likely avoid?	***E-3. Does the activity cause repeated sound exposures which an animal would likely avoid?***
The Navy Acoustic Effects Model assumes that animals do not move away from a sound source and receive a maximum sound exposure level. In reality, an animal would likely avoid repeated sound exposures that would cause PTS by moving away from the sound source. Therefore, only the initial exposures resulting in model-estimated PTS to high-frequency cetaceans, low frequency cetaceans, and phocids are expected to actually occur (after accounting for mitigation in step S-2). Model estimates of PTS beyond the initial pings are considered to actually be behavioral disturbances, as the animal is assumed to move out of the range to PTS and into the range of TTS. Given that the Carrier Strike Group exercise involves multiple vessels, planes, and helicopters operating in a coordinated manner during the anti-submarine warfare events, the training involves multiple sound sources an animal would likely avoid.	The Navy Acoustic Effects Model assumes that animals do not move away from multiple explosions and receive a maximum sound exposure level. In reality, an animal would likely avoid repeated sound exposures that would cause PTS by moving away from the site of multiple explosions. Therefore, only the initial exposures resulting in model-estimated PTS are expected to actually occur (after accounting for mitigation in step E-2). Model estimates of PTS are reduced to account for animals moving away from an area with multiple explosions, out of the range to PTS, and into the range of TTS. Activities with multiple explosions are listed in Table 3.8-20.

all injuries (except those serious enough to be expected to result in mortality) are considered MMPA Level A harassment.

PTS is non-recoverable and, by definition, results from the irreversible impacts to auditory sensory cells, supporting tissues, or neural structures within the auditory system. PTS therefore qualifies as an injury and is classified as Level A harassment under the wording of the MMPA. The smallest amount of PTS (onset-PTS) is taken to be the indicator for the smallest degree of injury that can be measured. The acoustic exposure associated with onset-PTS is used to define the outer limit of the MMPA Level A exposure zone. Model predicted slight lung injury, gastrointestinal tract injuries, and mortalities are also considered MMPA Level A harassment in this analysis.

Public Law 108–136 (2004) amended the MMPA definitions of, Level B harassment for military readiness activities to be "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behaviors are abandoned or significantly altered." Unlike MMPA Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may cause MMPA Level B harassment.

TTS is recoverable and is considered to result from the temporary, non-injurious fatigue of hearing-related tissues. The smallest measurable amount of TTS (onset-TTS) is taken as the best indicator for slight temporary sensory impairment. Because it is considered non-injurious, the acoustic exposure associated with onset-TTS is used to define the outer limit of the portion of the MMPA Level B exposure zone attributable to physiological effects. Short term reduction in hearing acuity could be considered a temporary decrement, similar in scope to a period of hearing masking or behavioral disturbance. As such, it is considered by the Navy and NMFS as a Level B effect overlapping the range of sounds producing behavioral effects.

As noted previously, the TTS and PTS criteria used by the Navy in the quantification of MMPA effects parallels the recent National Oceanic and Atmospheric Administration's draft "Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals." This criteria was proposed in December 2013 and is still in review as of June 2014. Details can be found at www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

The harassment status of slight behavior disruption has been addressed in workshops, previous actions, and rulings (National Marine Fisheries Service 2001b, 2008a, 2008b; National Oceanic and Atmospheric Administration 2013b; U.S. Department of Defense 2001). The conclusion is that a momentary behavioral reaction of an animal to a brief, time-isolated acoustic event does not qualify as MMPA Level B harassment. This analysis uses behavioral criteria to predict the number of animals likely to experience a significant behavioral reaction, and therefore a MMPA Level B harassment.

NMFS also includes mortality, or serious injury likely to result in mortality, as a possible outcome to consider in addition to MMPA Level A and MMPA Level B harassment. An individual animal predicted to experience simultaneous multiple injuries, multiple disruptions, or both, is typically counted as a single take (National Marine Fisheries Service 2001b, 2006, 2008a; National Oceanic and Atmospheric Administration 2009; 2013b). There are many possible temporal and spatial combinations of activities, stressors, and responses, for which multiple reasonable methods can be used to quantify take by Level B harassment on a case-specific basis. NMFS generally considers it appropriate for applicants to consider multiple modeled exposures of an individual animal to levels above the behavioral harassment threshold

within one 24-hour period as a single MMPA take. Behavioral harassment, under the response function presented in this request, uses received sound pressure level over a 24-hour period as the metric for determining the probability of harassment.

3.8.3.2.1 Application of the Endangered Species Act to Marine Mammals

Generalized information on definitions and the application of the ESA are presented in Chapter 3 (General Approach to Analysis) along with the acoustic conceptual framework used in this analysis. Consistent with NMFS analysis for Section 7 consultation under the ESA (e.g., see National Oceanic and Atmospheric Administration 2013b), the spatial and temporal overlap of activities with the presence of listed species is assessed in this Supplemental EIS/OEIS. The definitions used by the Navy in making the determination of effect under Section 7 of the ESA are based on the USFWS and NMFS *Endangered Species Consultation Handbook* (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998), and recent NMFS Biological Opinions involving many of the same activities and species.

- "No effect" is the appropriate conclusion when a listed species or its designated critical habitat will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species or modify designated critical habitat. "No effect" does not include a small effect or an effect that is unlikely to occur.
- If effects are insignificant (in size) or discountable (extremely unlikely), a "may affect" determination is still appropriate. "May affect" is appropriate when animals are within a range where they could potentially detect or otherwise be affected by the sound (e.g., the sound is above background ambient levels).
    - Insignificant effects relate to the size of the impact and should never reach the scale where take occurs.
    - Discountable effects are those extremely unlikely to occur and based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.
- If a stressor and species presence overlap, and a predicted effect is not insignificant, discountable, or beneficial, a "may affect, likely to adversely affect" determination is appropriate.

There are no harassment or injury criteria established for marine mammals under the ESA because the ESA requires an assessment starting with mere exposure potential (resulting in a "may affect" determination under the ESA). Acoustic modeling is used to predict the number of ESA-listed marine mammals exposed to sound resulting from training activities, without any behavioral or physiological criteria applied. In order to determine if adverse effects may result pursuant to the ESA, the Navy assumed that any exposures that resulted in MMPA harassment equated to "may affect, likely to adversely affect" when the definition of "take" under both statutes were taken into consideration.

3.8.3.3 Analysis of Effects on Marine Mammals

3.8.3.3.1 Impacts from Sonar and Other Active Acoustic Sources

Sonar and other active acoustic sources proposed for use are transient in most locations as active sonar activities move throughout the Study Area. Sonar and other active acoustic sound sources emit sound waves into the water to detect objects, safely navigate, and communicate. General categories of sonar systems are described in Section 2.2.1 (Classification of Non-Impulse and Impulse Sources).

Exposure of marine mammals to non-impulsive sources such as active sonar is not likely to result in primary blast injuries or barotraumas given the power output of the sources and the proximity to the source that would be required. Sonar induced acoustic resonance and bubble formation phenomena are also unlikely to occur under realistic conditions in the ocean environment, as discussed in Section 3.8.3.1.2.1 (Direct Injury). Direct injury from sonar and other active acoustic sources would not occur under conditions present in the natural environment and therefore is not considered further in this analysis.

Research and observations of auditory masking in marine mammals is discussed in Section 3.8.3.1.2.4 (Auditory Masking). Anti-submarine warfare sonar can produce intense underwater sounds in the Study Area associated with the Proposed Action. These sounds are likely within the audible range of most cetaceans but are normally very limited in the temporal, frequency, and spatial domains. The duration of individual sounds is short; sonar pulses can last up to a few seconds each, but most are shorter than 1 second. The duty cycle is low, with most tactical anti-submarine warfare sonar typically transmitting about once per minute. Furthermore, events are geographically and temporally dispersed, and most events are limited to a few hours. Tactical sonar has a narrow frequency band (typically less than one-third octave). These factors reduce the likelihood of sources causing significant auditory masking in marine mammals.

Some sound sources (i.e., submarine navigation sonar) have a high duty cycle producing up to a few pings per second. Such sonar typically employs high frequencies (above 10 kHz) that attenuate rapidly in the water, thus producing only a small area of potential auditory masking. These higher-frequency systems are typically outside the hearing and vocalization ranges of mysticetes (Section 3.8.2.3, Vocalization and Hearing of Marine Mammals); therefore, mysticetes are unlikely to be able to detect the higher frequency systems, and these systems would not interfere with their communication or detection of biologically relevant sounds. Odontocetes may experience some limited masking at closer ranges as the frequency band of many higher frequency systems overlaps the hearing and vocalization abilities of some odontocetes; however, the frequency band of these systems is narrow, limiting the likelihood of auditory masking. With any of the activities using these systems, the limited duration and dispersion of the activities in space and time reduce the potential for auditory masking effects from proposed activities on marine mammals.

The most probable effects from exposure to sonar and other active acoustic sources are PTS, TTS, and behavioral harassment (Section 3.8.3.1.2.3, Hearing Loss, and Section 3.8.3.1.2.6, Behavioral Reactions). The NAEMO is used to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. These are discussed below in the following sections.

Another concern is the number of times an individual marine mammal is exposed and potentially reacts to a sonar or other active acoustic source associated with Navy training within the TMAA. Repeated and chronic noise exposures to marine mammals and their observed reactions are discussed in this analysis where applicable; however, the sound producing activities associated with a Carrier Strike Group exercise are of limited extent and duration and will not constitute a source of long-term chronic noise exposure such as those stressors (whale watching, commercial vessel noise, etc.) discussed in Section 3.8.3.1.2.6 (Behavioral Reactions).

3.8.3.3.1.1 Range to Effects

The following section provides range (distance) over which specific physiological or behavioral effects are expected to occur based on the acoustic criteria (see Finneran and Jenkins 2012) and the acoustic propagation calculations from the NAEMO (Section 3.8.3.1.6.3, Navy Acoustic Effects Model). The range to specific effects are used to assess model results and determine adequate mitigation ranges to avoid higher level effects, especially physiological effects. Additionally, these data can be used to analyze the likelihood of an animal being able to avoid an oncoming sound source by simply moving a short distance (i.e., within a few hundred meters). Figure 3.8-10 shows a representation of effects with distance from a hypothetical sonar source; notice the proportion of animals that are likely to have a behavioral response (yellow block; "response-function") decreases with increasing distance from the source.

Although the Navy uses a number of sonar and other non-impulse sources, the three source class bins provided below (MF1, MF4, and MF5) represent three of the most powerful sources (see Section 2.2.1, Classification of Non-Impulse and Impulse Sources, for a discussion of sonar and other non-impulse source bins included in this analysis). The sources in these three bins are often the dominant source in an activity in which they are included, especially for smaller unit level training activities. Therefore, these ranges provide realistic maximum distances over which the specific effects would be possible.

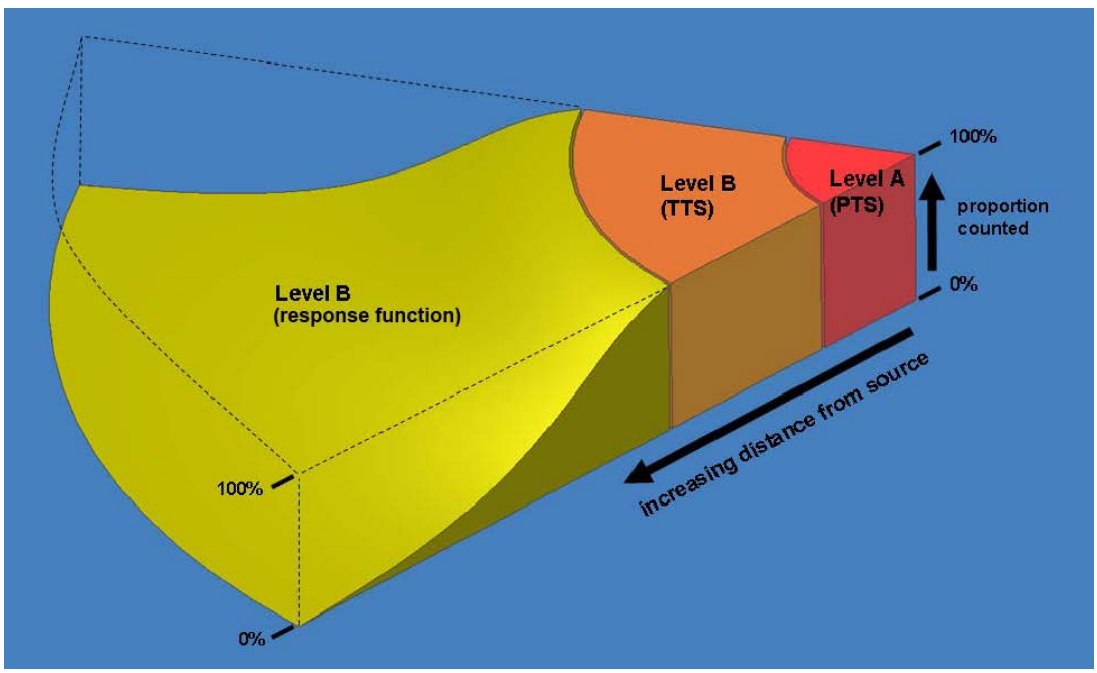

Figure 3.8-10: Hypothetical Range to Specified Effects for a Sonar Source

PTS: The ranges to the PTS threshold are shown in Table 3.8-11 relative to the marine mammal's functional hearing group (Navy's high frequency sources have a lower source level and more energy loss over distance than these mid-frequency examples and therefore have a shorter range to effects). For a SQS-53C sonar transmitting for 1 second at 3 kHz and a source level of 235 dB re 1 μPa^2-s at 1 m, the range to PTS for the most sensitive species (the high-frequency cetaceans) extends from the source to a range of approximately 100 m (109 yd.).

Since any surface vessel using hull-mounted anti-submarine warfare sonar, such as the SQS-53, engaged in anti-submarine warfare training would be moving at between 10 and 15 knots (5.1 and 7.7 m/second)

and nominally pinging every 50 seconds, the vessel will have traveled a minimum distance of approximately 280 yd. (257 m) during the time between those pings (note: 10 knots is the speed used in the NAEMO). As a result of the vessel moving forward, there is little overlap of PTS footprints from successive pings, indicating that in most cases, an animal predicted to receive PTS would do so from a single exposure (i.e., ping). For all other functional hearing groups (low-frequency cetaceans and mid-frequency cetaceans, phocid, otariid, and mustelid) single-ping PTS zones are within 110 yd. (100 m) of the sound source. A scenario could be imagined where an animal does not leave the vicinity of a ship or travels a course parallel to the ship within the PTS zone; however, as indicated in Table 3.8-11, the sustained proximity to the ship required make it unlikely there would be exposures resulting in PTS from any subsequent pings. For a Navy vessel moving at a nominal 10 knots, it is unlikely a marine mammal could maintain the speed to parallel the ship and receive adequate energy over successive pings to result in a PTS exposure. For all sources except hull-mounted sonar (e.g., SQS-53 and BQQ-10) ranges to PTS are well within 55 yd. (50 m), even for multiple pings (up to five pings examined) and the most sensitive functional hearing group (high-frequency cetaceans).

Table 3.8-11: Approximate Ranges to Permanent Threshold Shift Criteria for Each Functional Hearing Group for a Single Ping from Three of the Most Powerful Sonar Systems within Representative Ocean Acoustic Environments

Functional Hearing Group	Ranges to the Onset of PTS for One Ping (meters)[1]		
	Sonar Bin MF1 (e.g., SQS-53; ASW Hull-Mounted Sonar)	Sonar Bin MF4 (e.g., AQS-22; ASW Dipping Sonar)	Sonar Bin MF5 (e.g., SSQ-62; ASW Sonobuoy)
Low-Frequency Cetaceans	70	10	< 2
Mid-Frequency Cetaceans	10	< 2	< 2
High-Frequency Cetaceans	100	20	10
Phocid Seals	80	10	< 2
Otariid Seals & Sea Lions; Mustelid (Sea Otters)	10	< 2	< 2

[1] PTS ranges extend from the sonar or other active acoustic sound source to the indicated approximate distance. These approximate ranges are based on spherical spreading (Transmission Loss = 20 log R, where R = range in meters).
Note: ASW = Anti-Submarine Warfare, PTS = Permanent Threshold Shift

Under average environmental conditions for the most powerful active acoustic sources, hull-mounted anti-submarine warfare sonar (e.g., Bin MF1; SQS-53C), for a single ping the range to the onset of PTS for otariid seals and sea lions and sea otter does not exceed 2 yd. (2 m); for mid-frequency cetaceans (the majority of species present) it does not exceed 11 yd. (10 m); for low-frequency cetaceans does not exceed 77 yd. (70 m); for phocid seals does not exceed and 87 yd. (80 m); and for high-frequency cetaceans does not exceed 109 yd. (100 m). In the Study Area the high-frequency cetaceans include harbor porpoise and Dall's porpoise. Harbor porpoise are known to avoid areas of human activity and underwater noise. Likewise, all other species are assumed to avoid the area immediately around an active sound source, beyond the ranges where PTS would be possible.

TTS: Table 3.8-13 illustrates the ranges to the onset of TTS (i.e., the maximum distances to which TTS would be expected) for one, five, and ten pings from four representative source bins and sonar systems. Due to the lower acoustic thresholds for TTS versus PTS, ranges to TTS are longer; this can also be thought of as a larger volume acoustic footprint for TTS effects. Because the effects threshold is total summed sound energy and because of the longer distances, successive pings can add together, further increasing the range to onset-TTS.

Table 3.8-12: Approximate Maximum Ranges to the Onset of Temporary Threshold Shift for Three Representative Sonar Over a Representative Range of Ocean Environments

Functional Hearing Group	Approximate Range to Onset TTS (meters)								
	Sonar Bin MF1 (e.g., SQS-53; ASW Hull-Mounted Sonar)			Sonar Bin MF4 (e.g., AQS-22; ASW Dipping Sonar)			Sonar Bin MF5 (e.g., SSQ-62; ASW Sonobuoy)		
	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings	One Ping	Five Pings	Ten Pings
Low-frequency cetaceans	560–2,280	1,230–6,250	1,620–8,860	220–240	490–1,910	750–2,700	110–120	240–310	340–1,560
Mid-frequency cetaceans	150–180	340–440	510–1,750	< 50	< 50	< 50	< 50	< 50	< 50
High-frequency cetaceans	2,170–7,570	4,050–15,350	5,430–19,500	90	180–190	260–950	< 50	< 50	< 50
Otariid seals, sea lion, and Mustelid (sea otter)	230–570	1,240–1,300	1,760–1,780	< 50	< 50	< 50	< 50	< 50	< 50
Phocid seals	70–1,720	200–3,570	350–4,850	< 50	100	150	< 50	< 50	< 50

Note: ASW = Anti-Submarine Warfare, TTS = Temporary Threshold Shift

Behavioral: The distances over which the sound pressure level from three representative sonar sources is within the indicated 6 dB bins, and the percentage of animals that may exhibit a significant behavioral response under the mysticete and odontocete behavioral response function, are shown in Table 3.8-13 and Table 3.8-14, respectively. See Section 3.8.3.1.2 (Analysis Background and Framework) for details on the derivation and use of the behavioral response function as well as the step function thresholds for harbor porpoise and beaked whales of 140 dB re 1 µPa.

Range to 120 dB re 1 µPa varies by system, but can reach 97 nm for the most powerful hull-mounted sonar; however, only a very small percentage of animals would be predicted to react at received levels between 120 and 130 dB re 1 µPa, with the exception of harbor porpoises. All harbor porpoises that are predicted to receive 120 dB re 1 µPa or greater would be assumed to exhibit a behavioral response. Likewise, beaked whales would be predicted to have behavioral reactions at distances out to approximately 42 nm.

Table 3.8-13: Range to Received Sound Pressure Level in 6-Decibel Increments and Percentage of Behavioral Harassments for Low-Frequency Cetaceans under the Mysticete Behavioral Response Function for Three Representative Source Bins for the Study Area

Received Level in 6 dB Increments for Low-Frequency Cetaceans	Source Bin MF1 (e.g., SQS-53; Anti-Submarine Warfare Hull-Mounted Sonar)		Source Bin MF4 (e.g., AQS-22; Anti-Submarine Warfare Dipping Sonar)		Source Bin MF5 (e.g., SSQ-62; Anti-Submarine Warfare Sonobuoy)	
	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment
120 <= SPL < 126	185,400–160,325	0%	91,363–70,650	0%	20,463–12,725	0%
126 <= SPL < 132	160,325–138,400	0%	70,650–49,125	0%	12,725–7,575	0%
132 <= SPL < 138	138,400–118,100	0%	49,125–28,950	4%	7,575–3,813	5%
138 <= SPL < 144	118,100–85,400	2%	28,950–10,800	29%	3,813–2,200	15%
144 <= SPL < 150	85,400–61,288	7%	10,800–4,250	29%	2,200–638	51%
150 <= SPL < 156	61,288–42,750	19%	4,250–2,013	19%	638–250	18%
156 <= SPL < 162	42,750–20,813	43%	2,013–638	16%	250–100	9%
162 <= SPL < 168	20,813–4,375	26%	638–200	3%	100–< 50	3%
168 <= SPL < 174	4,375–1,825	1%	200–100	0%	< 50	0%
174 <= SPL < 180	1,825–750	0%	100–< 50	0%	< 50	0%
180 <= SPL < 186	750–375	0%	< 50	0%	< 50	0%
186 <= SPL < 192	375–200	0%	< 50	0%	< 50	0%
192 <= SPL < 198	200–100	0%	< 50	0%	< 50	0%

Notes: dB = decibels, m = meters, SPL = Sound Pressure Level

Table 3.8-14: Range to Received Sound Pressure Level in 6-Decibel Increments and Percentage of Behavioral Harassments under the Odontocete* Response Function for Three Representative Source Bins

Received Level in 6 dB Increments for Odontocetes and Pinnipeds	Source Bin MF1 (e.g., SQS-53; Anti-Submarine Warfare Hull-Mounted Sonar)		Source Bin MF4 (e.g., AQS-22; Anti-Submarine Warfare Dipping Sonar)		Source Bin MF5 (e.g., SSQ-62; Anti-Submarine Warfare Sonobuoy)	
	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment	Approximate Distance (m)	Behavioral Harassment % from SPL Increment
120 <= SPL < 126	185,450–160,475	0%	93,075–71,275	0%	21,288–14,200	0%
126 <= SPL < 132	160,475–138,750	0%	71,275–50938	0%	14,200–8,238	0%
132 <= SPL < 138	138,750–123,113	0%	50,938–29,075	1%	8,238–4,350	1%
138 <= SPL < 144	123,113–85,450	1%	29,075–11,050	14%	4,350–2,425	6%
144 <= SPL < 150	85,450–61,363	4%	11,050–4,250	25%	2,425–1,213	24%
150 <= SPL < 156	61,363–42,763	14%	4,250–2,013	24%	1,213–250	54%
156 <= SPL < 162	42,763–21,025	44%	2,013–638	28%	250–150	7%
162 <= SPL < 168	21,025–4,475	35%	638–200	7%	150–< 50	9%
168 <= SPL < 174	4,475–1,850	2%	200–100	1%	< 50	0%
174 <= SPL < 180	1,850–763	0%	100–< 50	0%	< 50	0%
180 <= SPL < 186	763–400	0%	< 50	0%	< 50	0%
186 <= SPL < 192	400–200	0%	< 50	0%	< 50	0%
192 <= SPL < 198	200–100	0%	< 50	0%	< 50	0%

* Note the Odontocete Behavioral Risk Function is used for mid-frequency and high-frequency cetaceans and pinnipeds; see Finneran and Jenkins (2012) for discussion of this approach.
Notes: dB = decibels, m = meters, SPL = Sound Pressure Level

3.8.3.3.1.2 Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources

As discussed above, within the NAEMO, animats (virtual animals representing individual marine mammals) do not move horizontally or react in any way to avoid sound or any other disturbance. In reality, various researchers have demonstrated that cetaceans can perceive the movement of a sound source (e.g., vessel, seismic source, etc.) relative to their own location and react with responsive movement away from the source, often at distances of a kilometer or more (Au and Perryman 1982, Jansen et al. 2010, Palka and Hammond 2001, Richardson et al. 1995, Tyack 2009, Tyack et al. 2011,

Watkins 1986, Wursig et al. 1998). See Section 3.8.3.1.5 (Behavioral Responses) for a review of research and observations of marine mammals' reactions to sound sources including sonar, ships, and aircraft. The behavioral criteria used as a part of this analysis acknowledge that a behavioral reaction is likely to occur at levels below those required to cause a loss in hearing sensitivity (TTS or PTS) or higher order physiological impacts. At close ranges and high sound levels approaching those that could cause PTS, avoidance of the area immediately around intense activity associated with a sound source (such as a low hovering helicopter) or a sound source or both is assumed in most cases. Additionally, the NAEMO does not account for the implementation of mitigation, which would prevent many of the model-estimated PTS effects. Therefore, the model-estimated PTS effects due to sonar and other active acoustic sources are further analyzed considering avoidance and implementation of mitigation measures described in Section 3.8.3.1.6 (Quantitative Analysis) and using identical procedures to those described in the technical report *Post-Model Quantitative Analysis of Animal Avoidance Behavior and Mitigation Effectiveness for the Gulf of Alaska Training* (U.S. Department of the Navy 2014b).

For example, if sound-producing activities are preceded by multiple vessel traffic or hovering aircraft, harbor porpoise and beaked whales are assumed to move beyond the range to PTS before sound transmission begins, as discussed above in Section 3.8.3.1.7.1 (Avoidance of Human Activity). Table 3.8-11 shows the ranges to PTS for three of the most common and powerful sound sources proposed for use when training in the Study Area. The source class Bin MF1 includes the most powerful anti-submarine warfare system for a surface combatant, the SQS-53. The range to PTS for all systems is generally much less than 50 m (55 yd.), with the exception of high-frequency cetaceans exposed to Bin MF1 with a PTS range of approximately 100 m (110 yd.). Because the NAEMO does not include avoidance behavior, the preliminary model-estimated effects are based on unlikely behavior for these species—that they would tolerate staying in an area of high human activity. The Carrier Strike Group exercise events involving sonar and other active acoustic sources are undertaken in a coordinated manner and therefore involve multiple vessels, aircraft, and hovering helicopters operating together while conducting Anti-Submarine Warfare training. Harbor porpoise and beaked whales that were model-estimated to experience PTS due to sonar and other active acoustic sources are assumed to actually move away from the activity and into the range of TTS prior to the start of the sound production due to the high level of activity associated with the Carrier Strike Group exercise.

The NAEMO does not consider implemented mitigation measures (as presented in detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). To account for the implementation of mitigation measures, the acoustic effects analysis assumes a model-estimated PTS would not occur if an animal at the water surface would likely be observed during those activities with Lookouts up to and during use of the sound source, considering the sightability of a species based on g(0) (see Table 3.8-9 in Section 3.8.3.1.8, Implementing Mitigation to Reduce Sound Exposures), the range to PTS for each hearing group by source (see examples in Table 3.8-11), and mitigation effectiveness. Given that the use of sonar and other active acoustic sources during the Carrier Strike Group exercise would occur in a coordinated manner involving multiple platforms (ships, fixed-wing aircraft, and helicopters), it is likely that there would be multiple opportunities to detect marine mammals in the immediate area of the coordinated activity. The range to PTS is generally less than 50 m (55 yd.), and the largest single ping range to PTS for the most powerful sonar system is approximately 100 m (109 yd.), so Lookouts need only to detect animals before they are within a very close range of a sound source to prevent PTS. For the Carrier Strike Group exercise use of sonar and other active acoustic sources, the mitigation is assumed to be effective (the Mitigation Adjustment Factor is equal to 1). The preliminary model-estimated PTS numbers are reduced by the portion of animals that are likely to be seen (Mitigation Adjustment Factor x Sightability). Model predicted PTS effects are adjusted based on these

factors and added to the model predicted TTS exposures. This is a conservative approach that will still result in an overestimation of PTS effects since the range to PTS is generally much less than 55 yd. (50 m), Lookouts need only detect animals before they are within this very close range to implement mitigation to prevent PTS, and the g(0) detection probabilities used as a sightability factor are based on having to detect animals at much greater distance (many kilometers; as presented previously in Section 3.8.3.1.8, Implementing Mitigation to Reduce Sound Exposures).

Marine mammals that are encountered in groups have a higher potential for being visually detected since there are more sighting opportunities when there are multiple animals present. Additionally, detection of any one animal in a group can result in implementation of mitigation for the entire group including animals that may not have been otherwise detected. Data from the GOALS II survey (Rone et al. 2013) provided observed group sizes for the species encountered in and around the Study Area as presented in Table 3.8-15.

Table 3.8-15: Marine Mammals Sightings from the Gulf of Alaska Line-Transect Survey (GOALS) II (Rone et al. 2013)

Species	Total Sightings	Total Individuals	Average Group Size	Group Size	
				Min	Max
Baird's beaked whale	7	58	8.3	2	16
Blue whale	5	7	1.4	1	2
Cuvier's beaked whale	1	1	1.0	1	1
Dall's porpoise	337	907	2.7	1	25
Elephant seal	16	16	1.0	1	1
Fin whale	200	392	2.0	1	13
Fin/Sei whale	1	1	1.0	1	1
Gray whale	1	25	25.0	25	25
Harbor porpoise	8	11	1.4	1	2
Humpback whale	106	331	3.1	1	15
Killer whale	21	138	6.6	1	45
Minke whale	3	6	2.0	1	3
Northern fur seal	78	83	1.1	1	2
Sperm whale	19	22	1.2	1	2
Unidentified beaked whale	5	8	1.6	1	2
Unidentified dolphin	3	4	1.3	1	2
Unidentified large whale	122	160	1.3	1	5
Unidentified small whale	4	4	1.0	1	1
Unidentified pinniped	6	6	1.0	1	1
Unidentified porpoise	22	87	4.0	1	10
Total	965	2,267			

Note: Numbers presented in the table above were derived from data presented in Rone et al. (2013).

The unpublished group size data from the Study Area and adjacent waters as derived from Rone et al. (2013) have been considered in the analysis of predicted exposures as presented subsequently in Section 3.8.3.3.2 (Model Predicted Exposures from Use of Sonar and Other Active Acoustic Sources) and Section 3.8.3.3.2 (Model Predicted Exposures from Use of Explosives). Note that the new and unpublished group size data in Table 3.8-15 were not used as input to the NAEMO since they only represent data from one survey as opposed to the more rigorous dataset presented in Watwood and Buonantony (2012). The group size numbers presented in Table 3.8-15 above are, however, within the range of values[8] used in the NAEMO (Marine Species Modeling Team 2014).

Animal avoidance of the area immediately around the sonar or other active acoustic system, coupled with mitigation measure designed to avoid exposing animals to high energy levels, would make the majority of model-estimated PTS to mid-frequency cetaceans unlikely. The maximum ranges to onset PTS for mid-frequency cetaceans (Table 3.8-11) do not exceed 10 m (11 yd.) in any environment modeled for the most powerful non-impulsive acoustic sources, hull-mounted sonar (e.g., Bin MF1; SQS-53C). Ranges to PTS for low-frequency cetaceans and high-frequency cetaceans (Table 3.8-11) do not exceed approximately 77 and 110 yd. (70 m and 100 m), respectively. Considering vessel speed during anti-submarine warfare activities normally exceeds 10 knots, and sonar pings occur about every 50 seconds, even for the MF1 an animal would have to maintain a position within a 22 yd. (20 m) radius in front of, or alongside the moving the ship for over 3 minutes (given the time between five pings) to experience PTS. In addition, the animal(s) or pod would have to remain unobserved; otherwise implemented mitigation would result in the sonar transmissions being shut down and thus ending any further exposure. Finally, the majority of marine mammals likely to be present in the Study Area (odontocetes) have been demonstrated to have directional hearing, with best hearing sensitivity when facing a sound source (Kastelein et al. 2005b, Mooney et al. 2008, Popov and Supin 2009). An odontocete avoiding a source would receive sounds along a less sensitive hearing orientation (its tail pointed toward the source), potentially reducing impacts. All model-estimated PTS exposures of mid-frequency cetaceans, therefore, are considered to actually be TTS due to the likelihood that an animal would be observed if it is present within the very short range to PTS effects.

The NAEMO does not account for several factors (see Section 2.2.1, Classification of Non-Impulse and Impulse Sources, and Section 3.8.3.3.1.2, Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources) that must be considered in the overall acoustic analysis. The results in the following tables are the predicted exposures from the NAEMO adjusted by the animal avoidance and mitigation factors discussed in the section above (Section 3.8.3.3.1.2, Avoidance Behavior and Mitigation Measures as Applied to Sonar and Other Active Acoustic Sources). Mitigation measures are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) and provide additional protections that are not considered in the numerical results below.

Marine mammals in other functional hearing groups (i.e., low-frequency cetaceans and high-frequency cetaceans, and pinnipeds) if present but not observed by Lookouts, are assumed to leave the area near the sound source after the first few pings, thereby reducing sound exposure levels and the potential for PTS. Based on nominal marine mammal swim speeds and normal operating parameters for Navy vessels it was determined that an animal can easily avoid PTS zones within the timeframe it takes an active

[8] The Navy's acoustic effects modeling used group size estimates provided in Watwood and Buonantony (2012) to distribute animats within an acoustic impact modeling location. Groups of animats were distributed using the mean group size and standard deviations into species-typical groups for modeling purposes (see Marine Species Modeling Team 2014). Each species specific group size presented in Table 3.8-15 (derived from Rone et al. 2013), is well within one standard deviation of the mean presented in Watwood and Buonantony (2012) and as used in the acoustic modeling's prediction of exposures.

sound source to generate one to two pings. As a conservative measure, and to account for activities where there may be a pause in sound transmission, PTS was accounted for over three to four pings of an activity. Additionally, and as presented above, during the first few pings of an event, or after a pause in sonar operations, if animals are caught unaware and it was not possible to implement mitigation measures (e.g., animals are at depth and not visible at the surface), it is possible that they could receive enough acoustic energy for that to result in a PTS exposure. Only these initial PTS exposures at the beginning of the activity or after a pause in sound transmission are expected to actually occur. The remaining model-estimated PTS are considered to be TTS due to animal avoidance.

3.8.3.3.2 Model Predicted Effects from Use of Sonar and Other Active Acoustic Sources

The predicted effects are the result of the acoustic analysis, including acoustic effects modeling followed by consideration of animal avoidance of multiple exposures, avoidance by sensitive species of areas with a high level of activity, and Navy mitigation measures. Mitigation measures are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). These measures provide additional protections, many of which are not considered in the numerical results below since reductions as a result of implemented mitigation were only applied to those events having a very high likelihood of detecting marine mammals. It is important to note that there are additional protections offered by mitigation procedures which would further reduce effects to marine mammals, but are not considered in the quantitative adjustment of the model predicted effects.

3.8.3.3.3 No Action Alternative

During the annual Carrier Strike Group exercise under the No Action Alternative, there would be no use of the sonar or other active acoustic sources as presented in Table 2.2-1 (as found in Section 2.2.1, Classification of Non-Impulse and Impulse Sources).

3.8.3.3.4 Alternative 1

Activities under Alternative 1 involving use of sonar and other active acoustic sources are described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-1, and Section 3.0.5.2.1.1, (Acoustic Stressors). Activities could occur throughout the TMAA but generally would not occur near the boundaries of the TMAA.

The predicted annual effects to marine mammals for activities involving use of sonar and other active acoustic sources are presented in Table 3.8-16. Annual totals presented in the table are the summation of all annual events occurring in a 12-month period. It is important to note that effect numbers presented in Table 3.8-16 are the total number of effects and not necessarily the number of separate individual marine mammals affected. As discussed in Section 3.8.3.1.5 (Behavioral Responses), an animal could be predicted to receive more than one effect over the course of the 21-day exercise period proposed to occur annually. The acoustic modeling and post-modeling analyses predict 18,195 marine mammal effects[9] to sonar and other active acoustic sources resulting in Level B harassment and 1 exposure[10] resulting in Level A as defined under the MMPA for military training activities.

[9] This is the combined summation of all non-TTS and TTS effects (behavioral effects) for all species and stocks in the TMAA for an annual total (based on a 12-month period).

[10] This is the combined summation of all PTS effects for all species and stocks in the TMAA for an annual total (based on a 12-month period).

Table 3.8-16: Annual Predicted Effects to Marine Mammals from Use of Sonar and Other Active Acoustic Sources under Alternative 1

Species	Stock	Behavioral	TTS	PTS
North Pacific right whale	Eastern North Pacific	2	1	0
Humpback whale	Western North Pacific	49	15	0
	Central North Pacific	4	1	0
Blue whale	Eastern North Pacific	38	9	0
	Central North Pacific	0	0	0
Fin whale	Northeast Pacific	941	350	0
Sei whale	Eastern North Pacific	5	1	0
Minke whale	Alaska	35	8	0
Gray whale	Eastern North Pacific	0	0	0
	Western North Pacific	0	0	0
Sperm whale	North Pacific	98	0	0
Killer whale	Alaskan Resident	269	12	0
	Eastern North Pacific Offshore	25	1	0
	AT1 Transient	0	0	0
	Gulf of Alaska, Aleutian Island, and Bering Sea Transient	69	3	0
Pacific white-sided dolphin	North Pacific	939	42	0
Harbor porpoise	Gulf of Alaska	2,742	0	0
	Southeast Alaska	963	0	0
Dall's porpoise	Alaska	1,099	6,967	1
Cuvier's beaked whale	Alaska	1,269	2	0
Baird's beaked whale	Alaska	200	0	0
Stejneger's beaked whale	Alaska	576	0	0
Steller sea lion	Eastern U.S.	335	0	0
	Western U.S.	286	0	0
California sea lion	U.S.	2	0	0
Northern fur seal	Eastern Pacific-Alaska	713	0	0
Northern elephant seal	California Breeding	100	22	0
Harbor seal	North Kodiak	0	0	0
	South Kodiak	1	0	0
	Prince William Sound	1	0	0
	Glacier Bay/Icy Strait	0	0	0
	Sitka/Chatham	0	0	0
	Dixon/Cape Decision	0	0	0
Ribbon seal	Alaska	0	0	0
Northern sea otter	Southeast Alaska	0	0	0
	Southcentral Alaska	0	0	0
	Southwest Alaska	0	0	0
	Sub-Total	10,761	7,434	1
	MMPA Totals	**Level B**		**Level A**
		18,195		1

Note: U.S. = United States

As described in Section 3.8.3.1.6.1 (Marine Species Density Data), in some cases (humpback whales, blue whale, gray whale, transient killer whale, harbor porpoise, Steller sea lion, and harbor seal) the density of marine mammals can be calculated for use in the NAEMO analysis; however, the number of whales from each stock contributing to that species density is unknown. To provide the number of effects by species and stock, the total modeled effects to the species were apportioned to each stock using derived ratios. These species/stock ratios were based on the relative abundances for each stock as provided in the applicable SARs (Allen and Angliss 2013, Carretta et al. 2013a). This method of apportionment is consistent with the Navy's approach in previous documents (U.S. Department of the Navy 2011a, 2013d) and as developed in consultation with NMFS as a cooperating agency; see Section 3.8.3.1.6.1 (Marine Species Density Data) regarding details on this approach for each applicable species.

Predicted acoustic effects to marine mammals from training activities from sonar and other active sound sources are, with the exception of two effects from torpedo use during a Sinking Exercise, all from anti-submarine warfare events involving multiple platforms and sensors operating in a coordinated manner. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) can be on the order of several kilometers, whereas some behavioral effects could take place at distances exceeding 93 mi. (150 km), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source.

All effects to marine mammals from sonar and other active acoustic sources are associated with the activities conducted during a Carrier Strike Group exercise; see Table 2.3-1). The exercise is a 21-day event composed of multiple, dispersed yet coordinated activities involving multiple platforms (e.g., ships, planes, helicopters, and submarines) that often require movement across or use of large portions of the Study Area. Some animals may be exposed to this activity multiple times over the course of a few days and leave the area, although these activities do not use the same locations day-after-day during multi-day activities. Therefore, displaced animals could return after the exercise moves away, allowing the animal to recover from any energy expenditure or missed resources.

For shorter term exposures or those from distant sources, animals may stop vocalizing, break off feeding dives, or, alternatively, ignore the acoustic stimulus, especially if it is located more than a few kilometers away (see Section 3.8.3.1.2.6, Behavioral Reactions, for discussion of research and observations on the behavioral reactions of marine mammals to sonar and other active acoustic sources). A few behavioral reactions per year, even from a single individual, are unlikely to produce long-term consequences for that individual or the population. Furthermore, mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts since not all mitigations are accounted for in the adjustments to the acoustic effects modeling numbers.

3.8.3.3.4.1 Mysticetes

Predicted acoustic effects to mysticetes during the Carrier Strike Group exercise are from anti-submarine warfare events involving surface ships, aircraft, and submarines. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) can be on the order of several thousand yards (kilometers); see Section 3.8.3.3.1.1 (Range to Effects) and Table 3.8-12 for details. If there was no background noise (such as that from vessel traffic, breaking waves, or other vocalizing marine mammals) masking the active ping occurring approximately every 50 seconds, the ping could reach and possibly be heard underwater at distances exceeding approximately 100 mi. (185 km; see for example Table 3.8-18). Although significant behavioral effects are much more likely at higher received

levels within a few kilometers of the sound source, the low received level (approximately 120 dB SPL) from the sonar at a distance exceeding approximately 100 mi. (185 km) conservatively assumes there is no masking background ambient noise and is modeled as having some behavioral effects.

Research by Risch et al. (2012) found that humpback whale vocalizations were reduced concurrent with pulses at low received levels from a low frequency source located approximately 100 mi. (161 km) away. None of the sources proposed for use in this Supplemental EIS/OEIS are comparable to the low frequency source recorded by Risch et al. (2012). Those findings do, however, validate use of the Behavioral Response Function's low (120 dB SPL received level) threshold as criteria for MMPA Level B harassment for a percent of the population exposed to that level of sound.

As mentioned previously in Section 3.8.3.1.2.6 (Behavioral Reactions), Melcón et al. (2012) documented that blue whales decreased the proportion of time spent producing certain types of calls when mid-frequency simulated sonar was present. Changes in vocal response by marine mammals have been documented elsewhere (Noren et al. 2009, Potter et al. 2007), while blue whale feeding/social calls were found to increase when seismic exploration was underway (Di Iorio and Clark 2010), indicative of a potentially compensatory response to the increased noise level. Although long-term implications of disruption in call production to blue whale foraging and other behaviors are currently not well understood, sonar usage in the Gulf of Alaska (fathometers, fish-finders, research sonar, and Navy mid-frequency sonar during annual training) in narrow bands of the mid-frequency and high frequency spectrums is not likely to have long-term impacts on marine mammals believed to predominately use the low frequency sound.

Additionally, in Section 3.8.3.1.2.6 (Behavioral Reactions), Goldbogen et al. (2013) reported on the results of an ongoing Navy-funded behavioral response study in the waters of Southern California.[11] Goldbogen et al. (2013) suggested that "frequent exposure to mid-frequency anthropogenic sounds may pose significant risks to the recovery rates of endangered blue whale populations." However, research along the U.S. west coast and Baja California reported by Calambokidis et al. (2009b) based on mark-recapture estimates "indicated a significant upward trend in abundance of blue whales" at a rate of increase just under 3 percent per year for the portion of the blue whale population in the Pacific that includes Southern California as part of its range. Data provided by Monnahan et al. (2014) indicate that the Eastern North Pacific blue whales may have recovered near to the estimated pre-whaling population size. The Eastern North Pacific stock (population), which is occasionally present in Southern California, is known to migrate from the northern Gulf of Alaska to the eastern tropical Pacific at least as far south as the Costa Rica Dome and has been increasingly found feeding to the north and south of the U.S. west coast during summer and fall (Carretta et al. 2014). Given this population's vast range and absent discussion of any other documented impacts, such as commercial ship strikes (Berman-Kowalewski et al. 2010), the suggestion by Goldbogen et al. (2013) that, since the end of commercial whaling, sonar use (in the fraction of time and area represented by Navy's training and testing in the SOCAL Range Complex) may be of significant risk to the blue whale's recovery in the Pacific is speculative at this stage given there is no clear populations trend where sonar use has been occurring for decades (for discussion of the trend in abundance in SOCAL, see Berman-Kowalewski et al. 2010, Calambokidis et al. 2009b, Calambokidis and Barlow 2013, Carretta et al. 2014).

[11] Navy-funded Behavioral Response Study (BRS) investigations have been ongoing since 2007. The Navy is continuing funding the BRS research which for the first time in Southern California in fall 2013, experimentally exposed marine mammals to actual U.S. Navy mid-frequency sonar. The results from that most recent fieldwork are pending.

To summarize, research and observations show that if mysticetes are exposed to sonar or other active acoustic sources they may react in a number of ways depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal grounds (i.e., breeding or feeding). Reactions may include changes in vocalization, alerting, breaking off feeding dives and surfacing, diving or swimming away, or no response at all.

Animals that do experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers and is therefore as a condition potentially affecting an animal's behavior. Recovery from a threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. For exposures resulting in TTS, long-term consequences for individuals or populations of mysticetes would not be expected. This assessment of long-term consequences is based on findings from ocean areas where the Navy has been intensively training and testing with sonar and other active acoustic sources for decades. While there are many factors such as the end of large-scale commercial whaling complicating any analysis, there are no data suggesting any long-term consequences to mysticetes from exposure to sonar and other active acoustic sources. On the contrary, there are findings suggesting mysticete populations are increasing in the two primary locations (Southern California and Hawaii) where Navy's most intensively used range complexes are located. These findings include: (1) Calambokidis et al. (2009b) indicating a significant upward trend in abundance of for blue whales in SOCAL; (2) the recovery of gray whales that migrate through the Navy's SOCAL Range Complex twice a year; (3) work by Moore and Barlow (2011) indicating evidence of increasing fin whale abundance in the California Current area, which includes the SOCAL Range Complex; (4) the range expansion and increasing presence of Bryde's whales south of Point Conception in Southern California (Kerosky et al. 2012); and (5) the ocean area contained within the Hawaii Range Complex continuing to function as a critical breeding, calving, and nursing area to the point at which the overall humpback whale population in the North Pacific is now greater than some prior estimates of pre-whaling abundance (Barlow et al. 2011).

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales may be exposed to sonar or other active acoustic stressors that may result in one TTS and two behavioral reactions per year. These three predicted behavioral effects could be to the same animal on subsequent days, or be the result of exposures to two or three animals. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species. There is no designated right whale critical habitat in the Study Area.

Blue Whales (Endangered Species Act-Listed)

Blue whales were visually detected five times during the GOALS II survey (Rone et al. 2013) both as single individuals and in pairs. Blue whales should be readily detectable; however, there was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Blue whales may be exposed to sonar or other active acoustic stressors that may result in 9 TTS and 38 behavioral reactions per year. For both stocks and as presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Humpback Whales (Endangered Species Act-Listed)

Humpback whales were visually detected during the GOALS II survey (Rone et al. 2013) and were typically in groups of two or more animals. Group sizes ranged from 1 to 15 individuals and the average group size was 3.12. Humpback whales should be readily detectable; however, there was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Humpback whales may be exposed to sonar or other active acoustic stressors that may result in 16 TTS and 53 behavioral reactions per year. For both stocks and as presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Sei Whales (Endangered Species Act-Listed)

Sei whales may be exposed to sonar or other active acoustic stressors that may result in 1 TTS and 5 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Fin Whales (Endangered Species Act-Listed)

Fin whales were visually detected during the GOALS II survey (Rone et al. 2013) approximately 54 percent of the time as single individuals and 46 percent in groups of two or more. Group sizes ranged from 1 to 13 individuals (the average group size was 1.96). Goldbogen et al. (2006) found that fin whales engaged in lunge feeding at depth had dive durations that averaged approximately 7 minutes so they should be available at the surface for detection by vessels, helicopters, and aircraft participating in training. Although fin whales should be readily detectable, however, there was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Fin whales may be exposed to sonar or other active acoustic stressors that may result in 350 TTS and 941 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Gray Whales, Eastern North Pacific Stock and Endangered Species Act-Listed Western North Pacific Stock

No gray whales were detected in the TMAA Study Area during the GOALS II survey (Rone et al. 2013). Acoustic modeling indicates that gray whales would not be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds. Gray whales of the Western North Pacific stock may migrate through the Study Area although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur. Since gray whales of the Western North Pacific stock could potentially be present in the Study Area, they may be exposed to low levels of sound or energy. Pursuant to the ESA, training activity in the Study Area may affect and is not likely to adversely affect this species.

Minke Whales

Minke whales were visually detected during the GOALS II survey (Rone et al. 2013) on three occasions in groups of one, two, and three individuals. There was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Minke whales may be exposed to sonar or other active acoustic stressors that may result in 8 TTS and 35 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected.

3.8.3.3.4.2 Odontocetes

Predicted impacts to odontocetes from training activities under Alternative 1 from sonar and other active acoustic sources are all from anti-submarine warfare events during the Carrier Strike Group exercise involving surface ships and hull-mounted sonar. As discussed in Section 3.8.3.3.1.1 (Range to Effects), for mid-frequency odontocetes (cetaceans constituting the majority of marine mammals present), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) is within a maximum of approximately 200 yd. (200 m) for a single ping. For high-frequency cetaceans (i.e., Dall's porpoise and harbor porpoise), ranges to TTS for multiple pings can stretch to distances of over 5 mi. (8 km). If there was no background noise (such as that from vessel traffic, breaking waves, or other vocalizing marine mammals) masking the active ping occurring approximately every 50 seconds, the most powerful surface ship hull-mounted sonar could, under rather optimal conditions, reach and possibly be heard underwater at distances exceeding approximately 107 mi. (172 km). The low received level (approximately 120 dB SPL) at that distance is modeled as having some behavioral effects possible, although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. Modeling predicts behavioral effects at long distance and low received levels but does not take into account background ambient noise levels or other competing biological sounds, which may mask sound from distant Navy sources. D'Spain and Batchelor (2006) measured a source spectral density of 105–120 dB re 1 $\mu Pa^2/Hz$ at 1 m (in the mid-frequency range) and calculated an estimated source level of 135–150 dB re 1 µPa at 1 m from various biologics (fish and marine mammals) contributing to those underwater ambient sound levels recorded to the southeast of San Clemente Island off San Diego, California.

Although involving species that are not present in the GOA Study Area, controlled exposure experiments in 2007 and 2008 in the Bahamas recorded responses of false killer whales, short-finned pilot whales, and melon-headed whales to simulated MFA sonar (De Ruiter et al. 2013b). The responses to exposures between species were variable. After hearing each MFA signal, false killer whales were found to "increase their whistle production rate and made more-MFA-like whistles" (De Ruiter et al. 2013b). In contrast, melon-headed whales had "minor transient silencing" after each MFA signal, while pilot whales had no apparent response.

Pilot whales or false killer whales in the Bahamas showed an avoidance response to controlled exposure playbacks (Southall et al. 2009b). Consistent with the findings of other previous research (see, for example Southall et al. 2007), De Ruiter et al. (2013b) found the responses were variable by species and with the context of the sound exposure. The assumption is that odontocete species in general, including those in the GOA Study Area, would have similar variable responses.

Activities involving anti-submarine warfare training in a Carrier Strike Group exercise involve multiple participants and activities associated with the event. More sensitive species of odontocetes such as beaked whales, Dall's porpoises, and harbor porpoise may avoid the area for the duration of the event (see Section 3.8.3.1.2.6, Behavioral Reactions, for a discussion of these species observed reactions sonar and other active acoustic sources). After the event ends, displaced animals would likely return to the area within a few days as seen in the Bahamas study with Blainville's beaked whales (Tyack et al. 2011). This would allow the animal to recover from any energy expenditure or missed resources, reducing the likelihood of long-term consequences for the individual or population.

Animals that do experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers. Recovery from a threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the

severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. For exposures resulting in TTS, long-term consequences for individuals or populations would not be expected.

There is one PTS effect predicted annually for a Dall's porpoise. For PTS, it is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual, given that natural hearing loss occurs in marine mammals as a result of disease, parasitic infestations, and age-related impairment (Ketten 2012). Furthermore, likely avoidance of intense activity and sound coupled with mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the potential for PTS exposures to occur. Considering these factors, long-term consequences for individuals or populations would not be expected.

Sperm Whales (Endangered Species Act-Listed)

Sperm whales were visually detected during the GOALS II survey (Rone et al. 2013) as single individuals or approximately 10 percent of the time in pairs. There was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Sperm whales (classified as mid-frequency cetaceans [Section 3.8.2.3.2, Mid-Frequency Cetaceans]) may be exposed to sonar or other active acoustic stressors associated with training activities that may result in 98 behavioral reactions per year.

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if sperm whales are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior. Straley et al. (2014) reported on findings from satellite tags attached to 10 sperm whales in the Gulf of Alaska. The tags demonstrated that at least three of these animals went as far south as waters off Mexico. This suggests that potential behavioral disturbances resulting in avoidance of Navy events or acoustic sources is unlikely to have any meaningful consequences for animals that cover such distances. As presented above for odontocetes in general, long-term consequences for sperm whale individuals or populations would not be expected. Pursuant to the ESA, training activities involving the use of sonar and other active acoustic sources in the Study Area may affect and are likely to adversely affect this species.

Harbor Porpoises

Harbor porpoises were visually detected 8 times during the GOALS II survey (Rone et al. 2013) as single individuals or in pairs (approximately 38 percent of the time). Harbor porpoises may be exposed to sonar or other active acoustic stressors associated with training activities that may result in 2,742 behavioral reactions involving the Gulf of Alaska stock and 963 behavioral reactions involving the Southeast Alaska stock.

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) of harbor porpoises show that this small species is very wary of human activity and will avoid anthropogenic sound sources in many situations at levels down to 120 dB re 1 µPa. This level was determined by observing harbor porpoise reactions to acoustic deterrent and harassment devices used to drive away animals from around fishing nets and aquaculture facilities. Avoidance distances typically were about 1 km or more, but it is

unknown if animals would react similarly if the sound source were at a distance of tens or hundreds of kilometers. The behavioral response function is not used to estimate behavioral responses by harbor porpoises; rather, a single threshold is used. Because of this very low behavioral threshold (120 dB re 1 µPa) for harbor porpoises, animals at distances exceeding approximately 100 nm in some cases are predicted to have a behavioral reaction in this acoustic analysis. It is not known whether animals would actually react to sound sources at these ranges, regardless of the received sound level. Harbor porpoises may startle and leave the immediate area of the anti-submarine warfare training exercise but return within a few days after the cessation of the event. Significant behavioral reactions seem more likely than with most other odontocetes. Since these species are typically found in nearshore and inshore habitats, they should generally not be present in the TMAA. Animals that do exhibit a significant behavioral reaction would likely recover from any incurred costs, reducing the likelihood of long-term consequences for the individual or population.

There are no PTS or TTS exposures predicted for harbor porpoises.

Beaked Whales

Beaked whales (Baird's, Cuvier's, and Stejneger's beaked whales) may be exposed to sonar or other active acoustic stressors that may result in 2 TTS and 2,045 behavioral reactions annually (see Table 3.8-16 for details regarding predicted exposures for each species). Baird's beaked whales were visually detected during the GOALS II survey (Rone et al. 2013) in groups of 2 or more individuals (the average group size was 8.29), with group sizes ranging from 2 to 16 individuals. Only a single Cuvier's beaked whale was visually detected during the GOALS II survey; Stejneger's beaked whales were not observed (Rone et al. 2013).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives (see Defence Science and Technology Laboratory 2007), and avoid the area of the sound source to levels of 157 dB re 1 µPa or below (McCarthy et al. 2011). In research done at the Navy's instrumented tracking range in the Bahamas, animals leave the immediate area of the anti-submarine warfare training exercise, but return within a few days after the event ends (Claridge and Durban 2009, McCarthy et al. 2011, Moretti et al. 2009, Tyack et al. 2011). Passive acoustic monitoring of a training event at the Navy's instrumented range in Hawaii was undertaken during a Submarine Commander Course involving three surface ships and a submarine using mid-frequency sonar over the span of the multiple-day event. Manzano-Roth et al. (2013) determined that beaked whales (tentatively identified as Blainville's beaked whales) continued to make foraging dives at estimated distances of 13 to 52 km from active mid-frequency sonar, but that the animals shifted to the southern edge of the range with differences in the dive vocal period duration and dive rate. De Ruiter et al. (2013a) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated MFA sonar during the 2010 and 2011 field seasons of the Southern California behavioral response study (note that preliminary results from a similar behavioral response study in Southern California waters have been presented for the 2010–2011 field season [Southall 2011]). The 2011 tagged whales were also incidentally exposed to MFA sonar from a distant naval exercise. Received levels from the MFA sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa rms, respectively. Both whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure from distant naval sonar exercises at comparable received levels, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor. Cuvier's beaked whale responses suggested particular sensitivity to sound

exposure as consistent with results for Blainville's beaked whale. Based on these findings, significant behavioral reactions seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers (Section 3.8.3.3.1, Impacts from Sonar and Other Active Acoustic Sources), especially for prolonged periods (a few hours or more) since research indicates beaked whales have been shown to will leave an area where anthropogenic sound is present (Tyack et al. 2011; De Ruiter et al. 2013a; Manzano-Roth et al. 2013).

The concern with beaked whales and an avoidance response is whether that displacement is likely to have long-term consequences for an animal or populations. Research involving tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) has documented movements in excess of hundreds of kilometers by some those animals. Schorr et al. (2014) reported the results for eight tagged Cuvier's beaked whales from the same area. Five of these eight whales made journeys of approximately 250 km from their tag deployment location and one of these five made an extra-regional excursion over 450 km south to Mexico and back again. Given that some beaked whales may routinely move hundreds of kilometers as part of their normal pattern, temporarily leaving an area to avoid sonar or other anthropogenic activity may have little if any cost to such an animal. Photo identification studies in the SOCAL Range Complex have identified approximately 100 individual Cuvier's beaked whales with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart (Falcone and Schorr 2014). These results indicate long-term residency by beaked whales in an intensively used Navy training and testing area where sonar use is common and has been occurring for decades. These results suggest inconsequential effects or a lack of long-term consequences resulting from exposure to Navy training activities.

Moore and Barlow (2013) noted a decline in beaked whales in a broad area of the Pacific Ocean area out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico, which is extremely more area than the Navy uses during training and testing. Interestingly, however, in the small portion of that area overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and higher densities suggest that the proposed decline noted elsewhere is not apparent where the Navy has been intensively training and testing with sonar and other systems for decades. Navy sonar training and testing is not conducted along a large part of the U.S. West Coast from which Moore and Barlow (2013) drew their survey data. In Southern California, based on a series of surveys from 2006 to 2008 and a high number encounter rate, Falcone et al. (2009) suggested the ocean basin west of San Clemente Island may be an important region for Cuvier's beaked whales given the number of animals encountered there. Follow-up research (Falcone and Schorr 2012, 2014) in this same location suggests that Cuvier's beaked whales may have population sub-units with higher than expected residency, particularly in Navy's instrumented SOCAL Anti-Submarine Warfare Range. Encounters with multiple groups of Cuvier's and Baird's beaked whales indicated not only that they were prevalent on the range where Navy routinely trains and tests, but also that they were potentially present in much higher densities than had been reported for anywhere along the U.S. west coast (Falcone et al. 2009, Falcone and Schorr 2012). This finding is also consistent with concurrent results from passive acoustic monitoring that estimated regional Cuvier's beaked whale densities were higher than indicated by NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald 2009).

Moore and Barlow (2013) suggest that one reason for the decline in beaked whales from Canada to Mexico may be as a result of anthropogenic sound, including the use of sonar by the U.S. Navy in the fraction of the U.S. Pacific coast overlapped by the SOCAL Range Complex. Moore and Barlow (2013) recognized the inconsistency between their hypothesis and the abundance trends in the region of

SOCAL Range Complex, stating, "High densities are not obviously consistent with a hypothesis that declines are due to military sonar, but they do not refute the possibility that declines have occurred in these areas (i.e., that densities were previously even higher)." While it is possible that the high densities of beaked whale currently inhabiting the Navy's range were even higher before the Navy began training with sonar, there is no data available to test that hypothesis. Although Moore and Barlow (2013) have noted a decline in the overall beaked whale population along the Pacific coast, in the small fraction of that area where the Navy has been training and testing with sonar and other systems for decades (the Navy's SOCAL Range Complex), higher densities and long-term residency by individual Cuvier's beaked whales suggest that the decline noted elsewhere is not apparent where Navy sonar use is most intense. Navy sonar training and testing is not conducted along a large part of the U.S. West Coast from which Moore and Barlow (2013) drew their survey data. In Southern California, based on a series of surveys from 2006 to 2008 and a high number encounter rate, Falcone et al. (2009) suggested the ocean basin west of San Clemente Island may be an important region for Cuvier's beaked whales given the number of animals encountered there.

Claridge (2013) used photo-recapture methods to estimate population abundance and demographics of Blainville's beaked whale (*Mesoplodon densirostris*) at two study sites in the Bahamas, one of which is regularly used for MFA sonar exercises. Claridge hypothesized that the reason a lower abundance was found at the site located within the bounds of the Navy's Atlantic Undersea Test and Evaluation Center (AUTEC) range than at the site off Abaco Island is due either to reduced prey availability at AUTEC or due to population-level effects from the exposure to MFA sonar at AUTEC. However, Claridge sampled half as frequently at AUTEC as at Abaco over the 5-year study period (102 versus 235 surveys), with only 20 encounter days at AUTEC from March to October versus 34 at Abaco. The estimated annual abundances at each location (31 [22–42] at AUTEC, 49 [38–62] at Abaco) was almost identical to the number of distinct (and therefore identifiable by photographic identification) individuals observed annually at each site (30 including 1 calf at AUTEC, 48 including 4 calves at Abaco). In fact, in the full 15-year study at Abaco (1997–2011), the estimated annual density was 42, and this population was considered to be part of a larger "parent" population in the area of approximately 135 whales.

All of the resighted whales at both sites were female. This leads to heterogeneity in the capture probability due to an age/sex bias, which can compromise the model fit and lead to negative bias in the estimation of abundances (Claridge 2013). The two study sites were each 300 km^2, an area that is small for known Blainville's beaked whale home ranges, based on tag data (e.g., Schorr et al. 2009). In addition, the population models for both sites were best described as an open population with re-immigration. At Abaco, over the 15-year study, many of the resighted females had sighting gaps of 5–10 years, but most of the animals were only observed in one year. This gap in resights is equal to or longer than the duration of the study at AUTEC.

These results indicate that there is both temporary and permanent emigration from the population at both sites, and that even over 15 years of research, the entire population (either the "parent" population or the smaller one at Abaco) was not entirely sampled (as indicated by the lack of an asymptote in the discovery curve of individuals from Abaco). In addition, beaked whales at AUTEC are known to leave the area for a few days following sonar activity (McCarthy et al. 2011, Tyack et al. 2011) so, depending on the timing of the photo-identification surveys, many animals may not have even been present to be sampled. Therefore, while Claridge did find a lower abundance at AUTEC than at Abaco, the results are biased by reduced effort and a shorter overall study period that was not long enough to capture some of the emigration/immigration trends discovered at Abaco. In addition, while Claridge makes no mention of the "parent" population in Chapter 1 while comparing the study sites, she easily

attributes the low site fidelity and small population size at Abaco to the larger movement patterns of these whales throughout the area, which could just as easily be done for the population at AUTEC.

Finally, when comparing only the 5-year study period between AUTEC and Abaco, the estimated abundance at Abaco appears to be almost double that of the AUTEC population; however, when the full 15-year dataset at Abaco is presented, the estimated annual abundance is approximately 7 animals fewer (42 compared to 49), which is then only about 11 animals greater than the estimated annual abundance at AUTEC (31). Therefore the presentation of these population abundances as markedly different is questionable, and to attribute the difference largely to the presence of Navy sonar without considering ecological factors is poorly supported.

In an effort to understand beaked whale responses to stressors, New et al. (2013) developed a mathematical model simulating a functional link between foraging energetics and requirements for survival and reproductions for 21 species of beaked whale. New et al. (2013) report "reasonable confidence" in their model although approximately 29 percent (6 of 21 beaked whale species modeled) failed to survive or reproduce, which the authors attribute to possible inaccuracies in the underlying parameter values. The simulations suggested that adults will survive but not reproduce if anthropogenic disturbances resulted in them being displaced to areas of "impaired foraging."

Ecological modeling provides an important tool for exploring the properties of an animal's use of the environment and the factors that drive or contribute to survivorship and reproduction. The ability of any model to accurately predict real ecological processes is partly dictated by the ability of the modeler to correctly parameterize the model and incorporate assumptions that do not violate real-world conditions. Assumptions and parameters identified by New et al. (2013) that likely have a large effect on the model output include the period of reproduction (i.e.,inter-calf interval) and prey selection (i.e., energy acquisition). Although New et al. (2013) concluded that anthropogenic disturbances might impair foraging through animal displacement and ultimately impact reproduction, the parameter values need to be revisited, as do assumptions that habitat capable of sustaining a beaked whale is limited in proximity to where any disturbance has occurred (i.e., beaked whales are likely not always in the most optimal foraging location).

While the New et al. (2013) model provides a test case for future research, the model has little of the critical data necessary to form conclusions applicable to current management decisions. There remains significant scientific uncertainty from which to infer modeled impacts to any marine species, especially reclusive beaked whales. For each population and sub-population, critical demographic data gaps still exist (adult survival, calf survival, juvenile survival, annual probability of calving, age at first calving, longevity, and an indication of likely levels of variation between years). The authors note the need for more data on prey species and reproductive parameters including gestation and lactation duration, as the model results are particularly affected by these assumptions. Therefore, any suggestion of biological sensitivity to the simulation's input parameters is uncertain. Given this level of uncertainty, the Navy will continue to follow developments in the mathematical modeling of energetics to estimate specific sensitivity to disturbance. The Navy continues to fund the behavioral response studies in the Bahamas and Southern California specifically to better understand, via direct field observations, the potential for anthropogenic activities to disturb marine mammals. In cooperation with NMFS, the Navy will continue to develop the most effective management and conservation actions to needed to protect marine mammals while accomplishing the Navy's mission to train and test safely and effectively.

For over three decades, the ocean west of San Clemente Island has been the location of the Navy's instrumented training range and is one of the most intensively used training and testing areas in the Pacific. Research has documented the presence and long-term residence of Cuvier's beaked whales for the ocean basin west of San Clemente Island (Falcone et al. 2009, Falcone and Schorr 2012, 2014) and results from passive acoustic monitoring estimated regional Cuvier's beaked whale densities were higher than indicated by the NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald 2009). Based on these findings, it is clear that the Navy's long-term ongoing use of sonar and other active acoustic sources has not precluded beaked whales from also continuing to inhabit those areas. In summary, based on the best available science, the Navy believes that beaked whales that exhibit a significant behavioral reaction due to sonar and other active acoustic training activities would generally not have long-term consequences for individuals or populations. Neither NMFS nor the Navy anticipates that marine mammal strandings or mortality will result from the operation of sonar or other acoustic sources during Navy exercises within the TMAA. Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding involving beaked whale or other marine mammal species.

There are two TTS exposures from sonar and other active acoustic sources predicted for Cuvier's beaked whales (no TTS are predicted for the other two beaked whale species (Baird's and Stejneger's) in the Study Area. For the most powerful surface ship sonar (MF1) proposed for use in the Study Area, the predicted TTS exposures for beaked whales (a MF cetacean) would have to occur within approximately 100 yd. (100 m) of a ship's bow or well within the established mitigation zone (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring, for discussion of the mitigation zones). It was not, however, assumed that Cuvier's beaked whales would be detected and model predicted TTS exposures were not reduced even though implemented mitigation may be effective in reducing model predicted TTS exposures. Given that beaked whales have been documented to leave the area where sonar use or other anthropogenic disturbance is occurring (Claridge and Durban 2009; De Ruiter et al. 2013a; McCarthy et al. 2011; Moretti et al. 2009; Tyack et al. 2011; Manzano-Roth et al. 2013), it is likely that Cuvier's beaked whale would avoid the area before coming within range of a TTS exposure. As noted above, research from the intensively used the SOCAL Range Complex indicates year-round prolonged use of the Navy's training and testing area by Cuvier's and Baird's beaked whales (Falcone et al. 2009; Falcone and Schorr 2012, 2014; Hildebrand and McDonald 2009). Research efforts involving tagging of Cuvier's beaked whales (Falcone and Schorr 2014; Schorr et al. 2014) have documented movements in excess of hundreds of kilometers as part of their normal pattern of movement, suggesting that a temporary movement to avoid the vicinity of sonar use or other anthropogenic disturbance may have little if any cost to such an animal. Costs and long-term consequences to the individual and population as a result of a beaked whale behaviorally reacting to sonar and other active acoustic sources are not expected. Costs and long-term consequences to the individual and population as a result of a beaked whale receiving a TTS is the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.4.3 Dall's Porpoise

Dall's porpoise are classified as high-frequency cetaceans (Section 3.8.2.3.1, High-Frequency Cetaceans) and are part of the Alaska stock. Dall's porpoises were most often visually detected during the GOALS II survey (Rone et al. 2013) in pods of 2 or more individuals, with group sizes ranging from 1 to 25 individuals (the average group size was 2.69). Survey observations by Rone et al. (2009) recorded 10 sightings of 59 Dall's porpoise with an average group size of 5.90 and thus illustrating the variability possible in group sizes between the two survey efforts. Acoustic modeling predicts that Dall's porpoise

could be exposed to sonar and other active acoustic sources that may result in 1 PTS, 6,967 TTS, and 1,099 behavioral reactions. Costs and long-term consequences to the individual and population as a result of a Dall's porpoise receiving a PTS or TTS is the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.4.4 Killer Whale

Killer whales are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Killer whales were visually detected during the GOALS II survey (Rone et al. 2013) approximately 90 percent of the time in pods of 2 or more individuals, with group sizes ranging from 1 to 45 individuals (the average group size was 6.57). Acoustic modeling predicts that killer whales (see Table 3.8-16 for the details of exposure to the four stocks of killer whales in the Study Area) could be exposed to sound that may result in 16 TTS and 363 behavioral reactions annually. The acoustic modeling and post-modeling analyses predict there would be no exposures to killer whale from sonar and other active acoustic sources resulting in PTS, due to the short range from the source required for PTS to occur (see discussion in Section 3.8.3.3.1.1, Range to Effects).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if killer whales are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Killer whales may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Killer whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source. Research has demonstrated that Alaska Resident killer whales may routinely move over long large distances (Andrews and Matkin 2014, Fearnbach et al. 2013). In a similar documented long-distance movement, an Eastern North Pacific Offshore stock killer whale tagged off San Clemente Island, California, moved (over a period of 147 days) to waters off northern Mexico, then north to Cook Inlet, Alaska, and finally (when the tag ceased transmitting) to coastal waters off Southeast Alaska (Falcone and Schorr 2014). Given these findings, temporary displacement due to avoidance of training activities are therefore unlikely to have biological significance to individual animals. Long-term consequences to individual killer whales or populations are not likely due to exposure to sonar or other active acoustic sources.

Costs and long-term consequences to the individual and population as a result of killer whale receiving an exposure resulting in TTS are the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.4.5 Pacific White-Sided Dolphin

Pacific white-sided dolphin are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Pacific white-sided dolphins were not detected during the Rone et al. (2013) survey in the Study Area. Acoustic impact modeling predicts that Pacific white-sided dolphin (Table 3.8-16) could be exposed to sound that may result in 42 TTS and 939 behavioral reactions. The acoustic modeling and post-modeling analyses predict there would be no exposure to Pacific white-sided dolphin from sonar and other active acoustic sources resulting in PTS, due to the short range from the source required for PTS to occur (see discussion in Section 3.8.3.3.1.1, Range to Effects).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if delphinids such as the Pacific white-sided dolphin are exposed to sonar or other active acoustic sources they may react in a

number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Delphinids may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Delphinids that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source. Long-term consequences to individual delphinids or populations are not likely due to exposure to sonar or other active acoustic sources.

Costs and long-term consequences to the individual and population as a result of Pacific white-sided dolphin receiving an exposure resulting in TTS are the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.4.6 Pinniped

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that pinnipeds in the water are tolerant of anthropogenic noise and activity. Evidence from areas where the Navy extensively trains and tests provides some indication of the possible consequences resulting from those proposed activities. In the confined waters of Washington State's Hood Canal where the Navy has been training and intensively testing for decades and harbor seals are present year-round, the population level has remained stable suggesting the area's carrying capacity may have been reached (Jeffries et al. 2003). In a similar manner, the beaches and shallow water areas within the PMRF at Kauai (in the main Hawaiian Islands) continue to be an important haulout and nursing area for endangered Hawaiian Monk Seals. While there has been a decline in the population of Hawaiian monk seals in the northwestern Hawaiian Islands, in the main Hawaiian Islands the numbers have continued to increase (Littnan 2011). If seals are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Seals may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Significant behavioral reactions would not be expected in most cases and long-term consequences for individuals or pinniped populations are unlikely.

Recovery from a hearing threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the severity of the initial shift. More severe shifts may not fully recover and thus would be considered PTS. Threshold shifts do not necessarily affect all hearing frequencies equally, so threshold shifts may not necessarily interfere with an animal's ability to hear biologically relevant sounds. As discussed previously in this section, it is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual given that natural hearing loss occurs in marine mammals as a result of disease, parasitic infestations, and age-related impairment (Ketten 2012).

Phocids (Harbor Seal, Northern Elephant Seal, and Ribbon Seal)

Harbor seal, northern elephant seal, and ribbon seal are the species of phocid pinnipeds that may be present within the Study Area. Elephant seals were visually identified 16 times at-sea during the GOALS II survey (Rone et al. 2013) as single individuals and no other phocids were encountered.

There are six stocks of Harbor seal that may be present in the general Gulf of Alaska area although migrating harbor seals generally use of only nearshore pelagic areas based on an analysis of the findings in Alaska from Womble and Gende (2013). Modeled effects for harbor seal were apportioned based on

the ratio of abundance for each stock as provided in the Alaska Stock Assessment Report (Allen and Angliss 2013). Northern elephant seal are the California breeding stock and Ribbon seal are the Alaska Stock.

Predicted effects to phocids are from anti-submarine warfare events involving surface ships, submarines, and aircraft during the Carrier Strike Group exercise. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources) ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53) can be on the order of a several kilometers for phocid seals (see discussion in Section 3.8.3.3.1.1, Range to Effects). Some behavioral effects could hypothetically take place at distances exceeding 54 mi. (87 km), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. For behavioral exposures, long-term consequences would not be expected. Costs and long-term consequences to the individual and population as a result of a phocid receiving a TTS is the same as presented above under the general discussion for pinniped. Population-level consequences are not expected.

Acoustic modeling predicts phocids could be exposed to sound that may result in 22 TTS and 102 behavioral reactions (see Table 3.8-16 for details regarding the species and six harbor seal stocks). The majority of all exposures (approximately 98 percent) are attributed to northern elephant seal. Exposures to harbor seals (two total) are predicted based on animals being at sea in deep water such as is present in the TMAA. Individual ribbon seal may be present in the Study Area but they are expected to be rare in occurrence. Based on that rare occurrence, ribbon seal are unlikely to be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds.

Otariids (Sea Lion and Fur Seal)

Northern fur seal, California sea lion, and Steller sea lion comprise the otariid species of pinniped in the Study Area. Otariids may be exposed to sonar or other active acoustic stressors associated with anti-submarine warfare events involving surface ships, submarines, and aircraft during the Carrier Strike Group exercise, which generally take place in deep ocean areas away from the shelf and coastal margins. Olesiuk reported that evidence from various sources indicates that juvenile and non-breeding northern fur seal are virtually ubiquitous throughout the Northeastern Pacific Ocean, albeit in densities lower than at the coastal margins (Olesiuk 2012). It is likely that Steller sea lion and the rare California sea lion, which share haulout locations with them in the Gulf of Alaska, are generally foraging in the vicinity to their haulouts and will therefore be concentrated outside the Study Area. Northern fur seals were visually detected at-sea during the GOALS II survey (Rone et al. 2013) on 78 occasions, and on 5 of those occasions in pairs. California sea lion and Steller sea lion were not identified during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts otariids could be exposed to sound that may result in 1,336 behavioral reactions (see Table 3.8-16 for details). As presented above under the general discussion for pinnipeds, behavioral exposures otariid are not expected to result in long-term consequences to individuals or populations.

Steller Sea Lion (Endangered Species Act-Listed Threatened Western Distinct Population Segment and the Recovered Eastern Distinct Population Segment)

Acoustic modeling predicts that the Western stock of Steller sea lion (also considered the Western DPS under the ESA) could be exposed to sound from sonar and other active acoustic sources that may result in 286 behavioral reactions. Acoustic modeling predicts that the Eastern stock of Steller sea lion could be exposed to sound from sonar and other active acoustic sources that may result in 335 behavioral reactions. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources),

ranges to some behavioral impacts could take place at distances exceeding 100 km (62 mi.), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. Significant behavioral reactions would not be expected and long-term consequences for individuals or populations are unlikely. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect the ESA-listed Western stock of Steller sea lion. In the Alaska region, critical habitat has been designated for Steller sea lions in the Aleutian Islands and Western Alaska. Steller sea lion critical habitat is not present within the Study Area.

3.8.3.3.4.7 Mustelid (Northern Sea Otter)

Because sea otter are rare in waters where depths exceed 35 m (115 ft.), it is extremely unlikely that sea otters would be present in proximity to most training taking place in the TMAA where the water depth greatly exceeds a sea otter's preferred habitat. Sea otters seldom range more than approximately 1 nm from shore, although some individuals, particularly juvenile males, may travel farther offshore (Riedman and Estes 1990; Ralls et al. 1995, 1996; U.S. Fish and Wildlife Service 2003). As a result, sea otter may on rare occasions be present in the Study Area. Acoustic modeling for sea otter was not undertaken given almost all sea otter should be far from where activities involving sonar and other active acoustic sources are proposed to occur, they inhabit complex shallow water environments where acoustic modeling is very imprecise and therefore not representative of actual likely impacts, and sea otter spend little time underwater thus very much limiting the potential for exposure to underwater sound in any case. The unlikely potential for sea otter to hear underwater sound would especially be the case for wandering sea otter in the TMAA since the average depth within the Study Area greatly exceeds the foraging depth for sea otter, therefore, they would generally not be exposed to the sound field from distant sources. Ghoul and Reichmuth (2013) have shown that sea otters are not especially well adapted for hearing underwater, which suggests that the function of this sense has been less important in their survival and evolution than in comparison to pinniped. Finally, USFWS has stated that they had no evidence that defense-related activities have had any adverse effects on the well-monitored experimental population of southern sea otters at San Nicolas Island (California) or in the SOCAL Range Complex (U.S. Fish and Wildlife Service 2011). Given these factors, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are not likely to adversely affect the ESA-listed Southwest Alaska stock of Northern sea otter. In the Alaska region, critical habitat has been designated for Northern sea otters, but those nearshore areas are not present within the Study Area.

3.8.3.3.4.8 Conclusion

Training activities under Alternative 1 include the use of sonar and other active acoustic sources as described in Table 2.3-1. These activities may result in inadvertent exposure of marine mammals in the Study Area to underwater sound.

Pursuant to the MMPA, the use of sonar and other acoustic sources during training activities under Alternative 1:

- *May expose marine mammals up to 18,195 times annually to sound levels that would be considered Level B harassment, as defined by the MMPA*
- *May expose a Dall's porpoise 1 time annually to sound levels that would be considered Level A harassment, as defined by the MMPA*

Pursuant to the ESA, the use of sonar and other acoustic sources during training activities as described under Alternative 1:

- *May affect, and is likely to adversely affect, the North Pacific right whale, humpback whale, blue whale, fin whale, sei whale, sperm whale, and the Western Distinct Population Segment of Steller sea lion*
- *May affect, and is not likely to adversely affect Western North Pacific gray whale, and the Southwest Alaska stock of Northern sea otter*
- *Would have no effect on North Pacific right whale, Steller sea lion, or Northern sea otter critical habitat*

3.8.3.3.5 Alternative 2

Activities Involving Sonar and Other Active Acoustic Sources are described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-1, and Section 3.0.5.2.1.1 (Acoustic Stressors). Activities could occur throughout the TMAA but generally would not occur near the boundaries of the TMAA.

The predicted annual effects to marine mammals for activities involving use of sonar and other active acoustic sources are presented in Table 3.8-17. Annual totals presented in the table are the summation of all annual events occurring in a 12-month period. It is important to note that exposure numbers presented in Table 3.8-17 are the total number of exposures and not necessarily the number of separate individual marine mammals exposed. As discussed in Section 3.8.3.1.5 (Behavioral Responses), an animal could be predicted to receive more than one exposure over the course of the two 21-day exercise periods proposed to occur annually. The acoustic modeling and post-modeling analyses predict 36,411 marine mammal exposures[12] to sonar and other active acoustic sources resulting in Level B harassment and 3 exposures[13] resulting in Level A as defined under the MMPA for military training activities.

As described in Section 3.8.3.1.6.1 (Marine Species Density Data), in some cases (humpback whales, blue whale, gray whale, transient killer whale, harbor porpoise, Steller sea lion, and harbor seal) the density of marine mammals can be calculated for use in the NAEMO analysis; however, the number of whales from each stock contributing to that species density is unknown. To provide the number of effects by species and stock, the total modeled effects to the species were apportioned to each stock using derived ratios. These species/stock ratios were based on the relative abundances for each stock as provided in the applicable SARs (Allen and Angliss 2013, Carretta et al. 2013a). This method of apportionment is consistent with the Navy's approach in previous documents (U.S. Department of the Navy 2011a, 2013d) and as developed in consultation with NMFS as a cooperating agency; see Section 3.8.3.1.6.1 (Marine Species Density Data) regarding details on this approach for each applicable species.

[12] This is the combined summation of all non-TTS and TTS exposures (behavioral effects) for all species and stocks in the TMAA for an annual total (based on a 12-month period).
[13] This is the combined summation of all PTS exposures for all species and stocks in the TMAA for an annual total (based on a 12-month period).

Table 3.8-17: Annual Predicted Effects to Marine Mammals from Use of Sonar and Other Active Acoustic Sources under Alternative 2

Species	Stock	Behavioral	TTS	PTS
North Pacific right whale	Eastern North Pacific	5	2	0
Humpback whale	Western North Pacific	99	30	0
	Central North Pacific	8	2	0
Blue whale	Eastern North Pacific	76	19	0
	Central North Pacific	0	0	0
Fin whale	Northeast Pacific	1,882	700	0
Sei whale	Eastern North Pacific	10	3	0
Minke whale	Alaska	70	17	0
Gray whale	Eastern North Pacific	0	0	0
	Western North Pacific	0	0	0
Sperm whale	North Pacific	196	1	0
Killer whale	Alaskan Resident	539	25	0
	Eastern North Pacific Offshore	51	2	0
	AT1 Transient	1	0	0
	GOA, Aleutian Island, and Bering Sea Transient	138	6	0
Pacific white-sided dolphin	North Pacific	1,878	85	0
Harbor porpoise	Gulf of Alaska	5,484	0	0
	Southeast Alaska	1,926	0	0
Dall's porpoise	Alaska	2,198	13,935	3
Cuvier's beaked whale	Alaska	2,539	5	0
Baird's beaked whale	Alaska	401	0	0
Stejneger's beaked whale	Alaska	1,153	0	0
Steller sea lion	Eastern U.S.	671	0	0
	Western U.S.	572	0	0
California sea lion	U.S.	5	0	0
Northern fur seal	Eastern Pacific-Alaska	1,427	1	0
Northern elephant seal	California Breeding	201	44	0
Harbor seal	North Kodiak	1	0	0
	South Kodiak	1	0	0
	Prince William Sound	1	1	0
	Glacier Bay/Icy Strait	0	0	0
	Sitka/Chatham	0	0	0
	Dixon/Cape Decision	0	0	0
Ribbon seal	Alaska	0	0	0
Northern sea otter	Southeast Alaska	0	0	0
	Southcentral Alaska	0	0	0
	Southwest Alaska	0	0	0
	Sub-Total	21,533	14,878	3
	MMPA Totals	**Level B**		**Level A**
		36,411		3

Predicted acoustic effects to marine mammals from training activities from sonar and other active sound sources are, with the exception of two exposures from torpedo use during a Sinking Exercise, all from anti-submarine warfare events involving multiple platforms and sensors operating in a coordinated manner. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) can be on the order of several kilometers, whereas some behavioral effects could take place at distances exceeding 93 mi. (150 km), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source.

All effects to marine mammals from sonar and other active acoustic sources are associated with the activities conducted during a Carrier Strike Group exercise; see Table 2.3-1). The exercise is a 21-day event composed of multiple, dispersed yet coordinated activities involving multiple platforms (e.g., ships, planes, helicopters, and submarines) that often require movement across or use of large portions of the Study Area. Some animals may be exposed to this activity multiple times over the course of a few days and leave the area although these activities do not use the same locations day-after-day during multi-day activities. Therefore, displaced animals could return after the exercise moves away, allowing the animal to recover from any energy expenditure or missed resources.

For shorter term exposures or those from distant sources, animals may stop vocalizing, break off feeding dives, or, alternatively, ignore the acoustic stimulus, especially if it is located more than a few kilometers away (see Section 3.8.3.1.2.6, Behavioral Reactions, for discussion of research and observations on the behavioral reactions of marine mammals to sonar and other active acoustic sources). A few behavioral reactions per year, even from a single individual, are unlikely to produce long-term consequences for that individual or the population. Furthermore, mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts since not all mitigations are accounted for in the adjustments to the acoustic effects modeling numbers.

3.8.3.3.5.1 Mysticetes

Predicted acoustic effects to mysticetes during the Carrier Strike Group exercise are from anti-submarine warfare events involving surface ships, aircraft, and submarines. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) can be on the order of several thousand yards (kilometers); see Section 3.8.3.3.1.1 (Range to Effects) and Table 3.8-11 for details. If there was no background noise (such as that from vessel traffic, breaking waves, or other vocalizing marine mammals) masking the active ping occurring approximately every 50 seconds, the ping could reach and possibly be heard underwater at distances exceeding approximately 54 mi. (87 km), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. The low received level (approximately 120 dB SPL) from the sonar at a distance exceeding approximately 54 mi. (87 km) is modeled as having some behavioral effects.

Research by Risch et al. (2012) found that humpback whale vocalizations were reduced concurrent with pulses at low received levels from a low frequency source located approximately 100 mi. (161 km) away. None of the sources proposed for use in this Supplemental EIS/OEIS are comparable to the low frequency source recorded by Risch et al. (2012). Those findings do, however, validate use of the Behavioral Response Function's low (120 dB SPL received level) threshold as criteria for MMPA Level B harassment for a percent of the population exposed to that level of sound.

As mentioned previously in Section 3.8.3.1.2.6 (Behavioral Reactions), Melcón et al. (2012) documented that blue whales decreased the proportion of time spent producing certain types of calls when mid-frequency simulated sonar was present. Changes in vocal response by marine mammals have been documented elsewhere (Noren et al. 2009, Potter et al. 2007), while blue whale feeding/social calls were found to increase when seismic exploration was underway (Di Iorio and Clark 2010), indicative of a potentially compensatory response to the increased noise level. Although long-term implications of disruption in call production to blue whale foraging and other behaviors are currently not well understood, sonar usage in the Gulf of Alaska (fathometers, fish-finders, research sonar, and Navy mid-frequency sonar during annual training) in narrow bands of the mid-frequency and high frequency spectrums is not likely to have long-term impacts on marine mammals believed to predominately use the low frequency sound.

Additionally in Section 3.8.3.1.2.6 (Behavioral Reactions), Goldbogen et al. (2013) reported on the results of an ongoing Navy-funded behavioral response study in the waters of Southern California.[14] Goldbogen et al. (2013) suggested that "frequent exposure to mid-frequency anthropogenic sounds may pose significant risks to the recovery rates of endangered blue whale populations." However, research along the U.S. west coast and Baja California reported by Calambokidis et al. (2009b) based on mark-recapture estimates "indicated a significant upward trend in abundance of blue whales" at a rate of increase just under 3 percent per year for the portion of the blue whale population in the Pacific that includes Southern California as part of its range. The Eastern North Pacific stock (population), which is occasionally present in Southern California, is known to migrate from the northern Gulf of Alaska to the eastern tropical Pacific at least as far south as the Costa Rica Dome and has been increasingly found feeding to the north and south of the U.S. west coast during summer and fall (Carretta et al. 2014). Given this population's vast range and absent discussion of any other documented impacts, such as commercial ship strikes (Berman-Kowalewski et al. 2010), the suggestion by Goldbogen et al. (2013) that since the end of commercial whaling, sonar use (in the fraction of time and area represented by Navy's training and testing in the SOCAL Range Complex) may be of significant risk to the blue whale's recovery in the Pacific is speculative at this stage. Furthermore, the suggestion is contradicted by the upward trend in abundance and counts of blue whales (Berman-Kowalewski et al. 2010, Calambokidis et al. 2009b) in the location discussed by Goldbogen et al. (2013) and where sonar use has been occurring for decades. Additionally, while there has not been evidence to suggest an increase in the Eastern North Pacific blue whale population, data provided by Monnahan et al. (2014) indicate that population may have recovered near to its estimated pre-whaling size.

Given the documented environmental variability along the U.S. west coast and lack of data needed to make a complete assessment of the blue whale population, there can be no definitive statements regarding the recovery of the blue whale population in the Pacific or inferences then drawn based on a trend in the species recovery in the Pacific from sightings along the U.S. west coast. It is, however, important to note that for the blue whale population along the U.S. west coast (which includes Southern California, where the Navy has been training and testing for decades) there has been a significant upward trend in abundance (Calambokidis et al. 2009b) despite an increasingly found likely redistribution beyond that area (Carretta et al. 2014).

To summarize, research and observations show that if mysticetes are exposed to sonar or other active acoustic sources they may react in a number of ways depending on the characteristics of the sound

[14] Navy-funded Behavioral Response Study (BRS) investigations have been ongoing since 2007. The Navy is continuing funding the BRS research which has, for the first time in Southern California in fall 2013, exposed marine mammals to actual U.S. Navy mid-frequency sonar. The results from that most recent fieldwork are pending.

source, their experience with the sound source, and whether they are migrating or on seasonal grounds (i.e., breeding or feeding). Reactions may include changes in vocalization, alerting; breaking off feeding dives and surfacing, diving or swimming away, or no response at all.

Animals that do experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers and is therefore as a condition potentially affecting an animal's behavior. Recovery from a threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. For exposures resulting in TTS, long-term consequences for individuals or populations of mysticetes would not be expected. This assessment of long-term consequences is based on findings from ocean areas where the Navy has been intensively training and testing with sonar and other active acoustic sources for decades. While there are many factors such as the end of large-scale commercial whaling complicating any analysis, there is no data suggesting any long-term consequences to mysticetes from exposure to sonar and other active acoustic sources. On the contrary, there are findings suggesting mysticete populations are increasing in the two primary locations (Southern California and Hawaii) where the Navy's most intensively used range complexes are located. These findings include: (1) Calambokidis et al. (2009b) indicating a significant upward trend in abundance of for blue whales in Southern California; (2) the recovery of gray whales that migrate through the Navy's SOCAL Range Complex twice a year; (3) work by Moore and Barlow (2011) indicating evidence of increasing fin whale abundance in the California Current area, which includes the SOCAL Range Complex; (4) the range expansion and increasing presence of Bryde's whales south of Point Conception in Southern California (Kerosky et al. 2012); and (5) the ocean area contained within the Hawaii Range Complex continuing to function as a critical breeding, calving, and nursing area to the point at which the overall humpback whale population in the North Pacific is now greater than some prior estimates of pre-whaling abundance (Barlow et al. 2011).

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales may be exposed to sonar or other active acoustic stressors that may result in two TTS and five behavioral reactions per year. These seven predicted behavioral effects could be to the same animal on subsequent days, or be the result of exposures to two or more animals. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species. There is no designated right whale critical habitat in the Study Area.

Blue Whales (Endangered Species Act-Listed)

Blue whales were visually detected five times during the GOALS II survey (Rone et al. 2013), both as single individuals and in pairs. Blue whales should be readily detectable; however, there was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Blue whales may be exposed to sonar or other active acoustic stressors that may result in 19 TTS and 76 behavioral reactions per year. For both stocks and as presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Humpback Whales (Endangered Species Act-Listed)

Humpback whales were visually detected during the GOALS II survey (Rone et al. 2013) and were typically in groups of two or more animals. Group sizes ranged from 1 to 15 individuals, and the average group size was 3.12. Humpback whales should be readily detectable; however, there was no adjustment

to the model predicted impacts due to implemented mitigation or animal avoidance. Humpback whales may be exposed to sonar or other active acoustic stressors that may result in 34 TTS and 108 behavioral reactions per year. For both stocks and as presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Sei Whales (Endangered Species Act-Listed)

Sei whales may be exposed to sonar or other active acoustic stressors that may result in 3 TTS and 11 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Fin Whales (Endangered Species Act-Listed)

Fin whales were visually detected during the GOALS II survey (Rone et al. 2013) approximately 54 percent of the time as single individuals and 46 percent in groups of two or more. Group sizes ranged from 1 to 13 individuals (the average group size was 1.96). Goldbogen et al. (2006) found that fin whales engaged in lunge feeding at depth had dive durations that averaged approximately 7 minutes; therefore, they should be available at the surface for detection by vessels, helicopters, and aircraft participating in training. Although fin whales should be readily detectable, however, there was no adjustment to the model-predicted impacts due to implemented mitigation or animal avoidance. Fin whales may be exposed to sonar or other active acoustic stressors that may result in 700 TTS and 1,882 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect this species.

Gray Whales, Eastern North Pacific Stock and Endangered Species Act-Listed Western North Pacific Stock

No gray whales were detected in the TMAA Study Area during the GOALS II survey (Rone et al. 2013). Acoustic modeling indicates that gray whales would not be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds. Gray whales of the Western North Pacific stock may migrate through the Study Area although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur. Since gray whales of the Western North Pacific stock could potentially be present in the Study Area, they may be exposed to low levels of sound or energy. Pursuant to the ESA, training activity in the Study Area may affect and is not likely to adversely affect this species.

Minke Whales

Minke whales were visually detected during the GOALS II survey (Rone et al. 2013) on three occasions in groups of one, two, and three individuals. There was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Minke whales may be exposed to sonar or other active acoustic stressors that may result in 18 TTS and 70 behavioral reactions per year. As presented above for mysticetes in general, long-term consequences for individuals or the population would not be expected.

3.8.3.3.5.2 Odontocetes

Predicted impacts to odontocetes from training activities under Alternative 2 from sonar and other active acoustic sources during the Carrier Strike Group exercise are, with the exception of two exposures from torpedo use during a Sinking Exercise, all from anti-submarine warfare events involving surface ships and hull-mounted sonar. As discussed in Section 3.8.3.3.1.1 (Range to Effects), for mid-frequency

odontocetes (cetaceans constituting the majority of marine mammals present), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53 anti-submarine warfare hull-mounted sonar) is within a maximum of approximately 200 yd. (200 m) for a single ping. For high-frequency cetaceans (i.e., Dall's porpoise and harbor porpoise), ranges to TTS for multiple pings can stretch to distances of over 5 mi. (8 km). If there was no background noise (such as that from vessel traffic, breaking waves, or other vocalizing marine mammals) masking the active ping occurring approximately every 50 seconds, the most powerful surface ship hull-mounted sonar could, under rather optimal conditions, reach and possibly be heard underwater at distances exceeding approximately 107 mi. (172 km). The low received level (approximately 120 dB SPL) at that distance is modeled as having some behavioral effects possible, although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. Modeling predicts behavioral effects at long distance and low received levels but does not take into account background ambient noise levels or other competing biological sounds, which may mask sound from distant Navy sources. D'Spain and Batchelor (2006) measured a source spectral density of 105–120 dB re 1 $\mu Pa^2/Hz$ at 1 m (in the mid-frequency range) and calculated an estimated source level of 135–150 dB re 1 µPa at 1 m from various biologics (fish and marine mammals) contributing to those underwater ambient sound levels recorded to the southeast of San Clemente Island off San Diego, California.

Although involving species that are not present in the GOA Study Area, controlled exposure experiments in 2007 and 2008 in the Bahamas recorded responses of false killer whales, short-finned pilot whales, and melon-headed whales to simulated MFA sonar (De Ruiter et al. 2013b). The responses to exposures between species were variable. After hearing each MFA signal, false killer whales were found to "increase their whistle production rate and made more-MFA-like whistles" (De Ruiter et al. 2013b). In contrast, melon-headed whales had "minor transient silencing" after each MFA signal, while pilot whales had no apparent response.

Pilot whales or false killer whales in the Bahamas showed an avoidance response to controlled exposure playbacks (Southall et al. 2009a). Consistent with the findings of other previous research (see, for example, Southall et al. 2007; De Ruiter et al. 2013b) found the responses were variable by species and with the context of the sound exposure. The assumption is that odontocete species in general, including those in the GOA Study Area, would have similar variable responses.

Activities involving anti-submarine warfare training in a Carrier Strike Group exercise involve multiple participants and activities associated with the event. More sensitive species of odontocetes such as beaked whales, Dall's porpoises, and harbor porpoise may avoid the area for the duration of the event (see Section 3.8.3.1.2.6, Behavioral Reactions, for a discussion of these species observed reactions sonar and other active acoustic sources). After the event ends, displaced animals would likely return to the area within a few days as seen in the Bahamas study with Blainville's beaked whales (Tyack et al. 2011). This would allow the animal to recover from any energy expenditure or missed resources, reducing the likelihood of long-term consequences for the individual or population.

Animals that do experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers. Recovery from a threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. For exposures resulting in TTS, long-term consequences for individuals or populations would not be expected.

There are three PTS exposures predicted annually for Dall's porpoises. For PTS, it is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual, given that natural hearing loss occurs in marine mammals as a result of disease, parasitic infestations, and age-related impairment (Ketten 2012). Furthermore, likely avoidance of intense activity and sound coupled with mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the potential for PTS exposures to occur. Considering these factors, long-term consequences for individuals or populations would not be expected.

Sperm Whales (Endangered Species Act-Listed)

Sperm whales were visually detected during the GOALS II survey (Rone et al. 2013) as single individuals or approximately 10 percent of the time in pairs. There was no adjustment to the model predicted impacts due to implemented mitigation or animal avoidance. Sperm whales (classified as mid-frequency cetaceans [Section 3.8.2.3.2, Mid-Frequency Cetaceans]) may be exposed to sonar or other active acoustic stressors associated with training activities that may result in 1 TTS and 196 behavioral reactions per year.

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if sperm whales are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Sperm whales have shown resilience to acoustic and human disturbance, although they may react to sound sources and activities within a few kilometers. Sperm whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior. Straley et al. (2014) reported on findings from satellite tags attached to 10 sperm whales in the Gulf of Alaska. The tags demonstrated that at least three of these animals went as far south as waters off Mexico. This suggests that potential behavioral disturbances resulting in avoidance of Navy events or acoustic sources is unlikely to have any meaningful consequences for animals that cover such distances. As presented above for odontocetes in general, long-term consequences for sperm whale individuals or populations would not be expected. Pursuant to the ESA, training activities involving the use of sonar and other active acoustic sources in the Study Area may affect and are likely to adversely affect this species.

Harbor Porpoises

Harbor porpoises were visually detected eight times during the GOALS II survey (Rone et al. 2013) as single individuals or in pairs (approximately 38 percent of the time). Harbor porpoises may be exposed to sonar or other active acoustic stressors associated with training activities that may result in 5,484 behavioral reactions involving the Gulf of Alaska stock and 1,926 behavioral reactions involving the Southeast Alaska stock.

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) of harbor porpoises show that this small species is very wary of human activity and will avoid anthropogenic sound sources in many situations at levels down to 120 dB re 1 µPa. This level was determined by observing harbor porpoise reactions to acoustic deterrent and harassment devices used to drive away animals from around fishing nets and aquaculture facilities. Avoidance distances typically were about 1 km or more, but it is unknown if animals would react similarly if the sound source were at a distance of tens or hundreds of kilometers. The behavioral response function is not used to estimate behavioral responses by harbor porpoises; rather, a single threshold is used. Because of this very low behavioral threshold (120 dB re 1 µPa), harbor porpoises at distances exceeding approximately 100 nm would in some cases be

predicted to have a behavioral reaction in this acoustic analysis. It is not known whether animals would actually react to sound sources at these ranges, regardless of the received sound level. Harbor porpoises may startle and leave the immediate area of the anti-submarine warfare training exercise but return within a few days after the cessation of the event. Significant behavioral reactions seem more likely than with most other odontocetes. Since these species are typically found in nearshore and inshore habitats, they should generally not be present in the TMAA. Animals that do exhibit a significant behavioral reaction would likely recover from any incurred costs, reducing the likelihood of long-term consequences for the individual or population.

There are no PTS or TTS exposures predicted for harbor porpoises.

Beaked Whales

Beaked whales (Baird's, Cuvier's, and Stejneger's beaked whales) may be exposed to sonar or other active acoustic stressors that may result in 5 TTS and 4,093 behavioral reactions annually (see Table 3.8-16 for details regarding predicted exposures for each species). Baird's beaked whales were visually detected during the GOALS II survey (Rone et al. 2013) in groups of 2 or more individuals (the average group size was 8.29), with group sizes ranging from 2 to 16 individuals. Only a single Cuvier's beaked whale was visually detected during the GOALS II survey; Stejneger's beaked whales were not observed (Rone et al. 2013).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if beaked whales are exposed to sonar or other active acoustic sources they may startle, break off feeding dives (see Defence Science and Technology Laboratory 2007), and avoid the area of the sound source to levels of 157 dB re 1 µPa or below (McCarthy et al. 2011). In research done at the Navy's instrumented tracking range in the Bahamas, animals leave the immediate area of the anti-submarine warfare training exercise, but return within a few days after the event ends (Claridge and Durban 2009, McCarthy et al. 2011, Moretti et al. 2009, Tyack et al. 2011). Passive acoustic monitoring of a training event at the Navy's instrumented range in Hawaii was undertaken during a Submarine Commander Course involving three surface ships and a submarine using mid-frequency sonar over the span of the multiple-day event. Manzano-Roth et al. (2013) determined that beaked whales (tentatively identified as Blainville's beaked whales) continued to make foraging dives at estimated distances of 13 to 52 km from active mid-frequency sonar, but that the animals shifted to the southern edge of the range with differences in the dive vocal period duration and dive rate. De Ruiter et al. (2013a) presented results from two Cuvier's beaked whales that were tagged and exposed to simulated MFA sonar during the 2010 and 2011 field seasons of the Southern California behavioral response study (note that preliminary results from the same behavioral response study in Southern California waters have been presented for the 2010–2011 field season [Southall 2011]). One of the 2011 tagged whales was also incidentally exposed to MFA sonar from a distant naval exercise. Received levels from the MFA sonar signals from the controlled and incidental exposures were calculated as 84–144 and 78–106 dB re 1 µPa rms, respectively. Both tagged whales showed responses to the controlled exposures, ranging from initial orientation changes to avoidance responses characterized by energetic fluking and swimming away from the source. However, the authors did not detect similar responses to incidental exposure from distant naval sonar exercises at comparable received levels, indicating that context of the exposures (e.g., source proximity, controlled source ramp-up) may have been a significant factor. Cuvier's beaked whale responses suggested particular sensitivity to sound exposure as consistent with results for Blainville's beaked whale. Based on these findings, significant behavioral reactions seem likely in most cases if beaked whales are exposed to anti-submarine sonar within a few tens of kilometers (Section 3.8.3.3.1, Impacts from Sonar and Other Active Acoustic Sources), especially for prolonged periods (a few hours or more) since research indicates

beaked whales have been shown to leave an area where anthropogenic sound is present (Tyack et al. 2011; Manzano-Roth et al. 2013).

The concern with beaked whales and an avoidance response is whether that displacement is likely to have long-term consequences for an animal or populations. Research involving three tagged Cuvier's beaked whales in the SOCAL Range Complex reported on by Falcone and Schorr (2012, 2014) has documented movements in excess of hundreds of kilometers by some those animals. Schorr et al. (2014) reported the results for an additional eight tagged Cuvier's beaked whale in the same area. Five of these eight whales made journeys of approximately 250 km from their tag deployment location and one of these five made an extra-regional excursion over 450 km south to Mexico and back again. Given that some beaked whales may routinely move hundreds of kilometers as part of their normal pattern, temporarily leaving an area to avoid sonar or other anthropogenic activity may have little if any cost to such an animal. Photo identification studies in the SOCAL Range Complex have identified approximately 100 individual Cuvier's beaked whales, with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart (Falcone and Schorr 2014). These results indicate long-term residency by beaked whales in an intensively used Navy training and testing area where sonar use is common and has been occurring for decades. These results suggest inconsequential effects or a lack of long-term consequences resulting from exposure to Navy training activities.

Moore and Barlow (2013) noted a decline in beaked whales in a broad area of the Pacific Ocean area out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico, which is extremely more area than the Navy uses during training and testing. Interestingly, however, in the small portion of that area overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and higher densities provide indications that the proposed decline noted elsewhere is not apparent where the Navy has been intensively training and testing with sonar and other systems for decades. In Southern California, based on a series of surveys from 2006 to 2008 and a high number encounter rate, Falcone et al. (2009) proposed that their observations suggested the ocean basin west of San Clemente Island may be an important region for Cuvier's beaked whales given the number of animals encountered there (see also Hildebrand and McDonald 2009). Follow-up research (Falcone and Schorr 2012; 2014) in this same location suggests that Cuvier's beaked whales may have population sub-units with higher than expected residency in Navy's instrumented SOCAL Anti-Submarine Warfare Range in particular. Encounters with multiple groups of Cuvier's and Baird's beaked whales indicated not only that they were prevalent on the range where Navy routinely trains and tests, but also that they were potentially present in much higher densities than had been reported for anywhere along the U.S. west coast (Falcone et al. 2009, Falcone and Schorr 2012, 2014). This finding is also consistent with concurrent results from passive acoustic monitoring that estimated regional Cuvier's beaked whale densities were higher than indicated by NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald 2009).

Moore and Barlow (2013) suggest that one reason for the decline in beaked whales from Canada to Mexico may be as a result of anthropogenic sound, including the use of sonar by the U.S. Navy in the fraction of the U.S. Pacific coast overlapped by the SOCAL Range Complex. Moore and Barlow (2013) recognized the inconsistency between their hypothesis and the abundance trends in the region of SOCAL Range Complex stating, "High densities are not obviously consistent with a hypothesis that declines are due to military sonar, but they do not refute the possibility that declines have occurred in these areas (i.e., that densities were previously even higher)." While it is possible that the high densities of beaked whale currently inhabiting the Navy's range were even higher before the Navy began training with sonar, there is no data available to test that hypothesis. Although Moore and Barlow (2013) have

noted a decline in the overall beaked whale population along the Pacific coast, in the small fraction of that area where the Navy has been training and testing with sonar and other systems for decades (the Navy's SOCAL Range Complex), higher densities and long-term residency by individual Cuvier's beaked whales suggest that the decline noted elsewhere is not apparent where Navy sonar use is most intense. Navy sonar training and testing is not conducted along a large part of the U.S. West Coast from which Moore and Barlow (2013) drew their survey data. In Southern California, based on a series of surveys from 2006 to 2008 and a high number encounter rate, Falcone et al. (2009) suggested the ocean basin west of San Clemente Island may be an important region for Cuvier's beaked whales given the number of animals encountered there.

Claridge (2013) used photo-recapture methods to estimate population abundance and demographics of Blainville's beaked whale (*Mesoplodon densirostris*) at two study sites in the Bahamas, one of which is regularly used for MFA sonar exercises. Claridge hypothesized that the reason a lower abundance was found at the site located within the bounds of the AUTEC than at the site off Abaco Island is due either to reduced prey availability at AUTEC or due to population-level effects from the exposure to MFA sonar at AUTEC. However, Claridge sampled half as frequently at AUTEC as at Abaco over the 5-year study period (102 versus 235 surveys), with only 20 encounter days at AUTEC from March to October versus 34 at Abaco. The estimated annual abundances at each location (31 [22–42] at AUTEC, 49 [38–62] at Abaco) was almost identical to the number of distinct (and therefore identifiable by photographic identification) individuals observed annually at each site (30 including 1 calf at AUTEC, 48 including 4 calves at Abaco). In fact, in the full 15-year study at Abaco (1997–2011) the estimated annual density was 42, and this population was considered to be part of a larger "parent" population in the area of approximately 135 whales.

All of the resighted whales at both sites were female. This leads to heterogeneity in the capture probability due to an age/sex bias, which can compromise the model fit and lead to negative bias in the estimation of abundances (Claridge 2013). The two study sites were each 300 km^2, an area which is small for known Blainville's beaked whale home ranges, based on tag data (e.g., Schorr et al. 2009). In addition, the population models for both sites were best described as an open population with re-immigration. At Abaco, over the 15-year study, many of the resighted females had sighting gaps of 5–10 years, but most of the animals were only observed in one year. This gap in resights is equal to or longer than the duration of the study at AUTEC. These results indicate that there is both temporary and permanent emigration from the population at both sites and, that even over 15 years of research, the entire population (either the "parent" population or the smaller one at Abaco) was not entirely sampled (as indicated by the lack of an asymptote in the discovery curve of individuals from Abaco). In addition, beaked whales at AUTEC are known to leave the area for a few days following sonar activity (McCarthy et al. 2011, Tyack et al. 2011), so depending on the timing of the photo-identification surveys many animals may not have even been present to be sampled. Therefore, while Claridge did find a lower abundance at AUTEC than at Abaco, the results are biased by reduced effort and a shorter overall study period that was not long enough to capture some of the emigration/immigration trends discovered at Abaco. In addition, while Claridge makes no mention of the "parent" population in Chapter 1 while comparing the study sites, she easily attributes the low site fidelity and small population size at Abaco to the larger movement patterns of these whales throughout the area, which could just as easily be done for the population at AUTEC.

Finally, when comparing only the 5-year study period between AUTEC and Abaco, the estimated abundance at Abaco appears to be almost double that of the AUTEC population; however, when the full 15-year dataset at Abaco is presented, the estimated annual abundance is approximately 7 animals

fewer (42 compared to 49), which is then only about 11 animals greater than the estimated annual abundance at AUTEC (31). Therefore the presentation of these population abundances as markedly different is questionable, and to attribute the difference largely to the presence of Navy sonar without considering other ecological factors is poorly supported.

In another study to understand beaked whale responses to stressors, New et al. (2013) developed a mathematical model simulating a functional link between foraging energetics and requirements for survival and reproductions for 21 species of beaked whale. New et al. (2013) report "reasonable confidence" in their model although approximately 29 percent (6 of 21 beaked whale species modeled) failed to survive or reproduce, which the authors attribute to possible inaccuracies in the underlying parameter values. Based on the model simulation, New et al. (2013) determined that if habitat quality and "accessible energy" (derived from the availability of either plentiful prey or prey with high energy content) are both high, then survival rates are high as well. If these variables are low, then adults may survive but calves will not. The simulations suggested that adults will survive but not reproduce if anthropogenic disturbances resulted in them being displaced to areas of "impaired foraging."

Ecological modeling provides an important tool for exploring the properties of an animal's use of the environment and the factors that drive or contribute to survivorship and reproduction. The ability of any model to accurately predict real ecological processes is partly dictated by the ability of the modeler to correctly parameterize the model and incorporate assumptions that do not violate real-world conditions. Assumptions and parameters identified by New et al. (2013) that likely have a large effect on the model output include the period of reproduction (i.e. inter-calf interval) and prey selection (i.e. energy acquisition). Although New et al. (2013) concluded that anthropogenic disturbances might impair foraging through animal displacement and ultimately impact reproduction, the parameter values need to be revisited, as do assumptions that habitat capable of sustaining a beaked whale is limited in proximity to where any disturbance has occurred (i.e., beaked whales are likely not always in the most optimal foraging location).

While the New et al. (2013) model provides an test case for future research, the model has little of the critical data necessary to form conclusions applicable to current management decisions. There remains significant scientific uncertainty from which to infer modeled impacts to any marine species, especially reclusive beaked whales. For each population and sub-population, critical demographic data gaps still exist (adult survival, calf survival, juvenile survival, annual probability of calving, age at first calving, longevity, and an indication of likely levels of variation between years). The authors note the need for more data on prey species and reproductive parameters including gestation and lactation duration, as the model results are particularly affected by these assumptions. Therefore, any suggestion of biological sensitivity to the simulation's input parameters is uncertain. Given this level of uncertainty, the Navy will continue to follow developments in the mathematical modeling of energetics to estimate specific sensitivity to disturbance. The Navy continues to fund the behavioral response studies in the Bahamas, Southern California, and Hawaii specifically to better understand, via direct field observations, the potential for anthropogenic activities to disturb marine mammals. In cooperation with NMFS, the Navy will continue to develop the most effective management and conservation actions needed to protect marine mammals while accomplishing the Navy's mission to train and test safely and effectively.

In summary, based on the best available science, the Navy believes that beaked whales that exhibit a significant behavioral reaction due to sonar and other active acoustic training activities would generally not have long-term consequences for individuals or populations. Neither NMFS nor the Navy anticipates that marine mammal strandings or mortality will result from the operation of sonar or other acoustic

sources during Navy exercises within the TMAA. Additionally, through the MMPA process (which allows for adaptive management), NMFS and the Navy will determine the appropriate way to proceed in the event that a causal relationship were to be found between Navy activities and a future stranding involving beaked whale or other marine mammal species.

There are 5 TTS exposures from sonar and other active acoustic sources predicted for Cuvier's beaked whales (no TTS are predicted for the other two beaked whale species [Baird's and Stejneger's] in the Study Area. For the most powerful surface ship sonar (MF1) proposed for use in the Study Area, the predicted TTS exposures for beaked whales (a MF cetacean) would have to occur within approximately 100 yd. (100 m) of a ship's bow or well within the established mitigation zone (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring, for discussion of the mitigation zones). It was not, however, assumed that Cuvier's beaked whales would be detected and model predicted TTS exposures were not reduced even though implemented mitigation may be effective in reducing model predicted TTS exposures. Given that beaked whales have been documented to leave the area where sonar use or other anthropogenic disturbance is occurring (Claridge and Durban 2009; De Ruiter et al. 2013a; McCarthy et al. 2011; Moretti et al. 2009; Tyack et al. 2011; Manzano-Roth et al. 2013), it is likely that Cuvier's beaked whale would avoid the area before coming within range of a TTS exposure. As noted above, research from the intensively used SOCAL Range Complex indicates year-round prolonged use of the Navy's training and testing area by Cuvier's and Baird's beaked whales (Falcone et al. 2009, Falcone and Schorr 2012, 2014; Hildebrand and McDonald 2009). Research efforts involving tagging of Cuvier's beaked whales (Falcone and Schorr 2014) has documented movements in excess of hundreds of kilometers as part of their normal pattern of movement, suggesting that a temporary movement to avoid the vicinity of sonar use or other anthropogenic disturbance may have little if any cost to such an animal. Costs and long-term consequences to the individual and population as a result of a beaked whale behaviorally reacting to sonar and other active acoustic sources are not expected. Costs and long-term consequences to the individual and population as a result of a beaked whale receiving a TTS is the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.5.3 Dall's Porpoise

Dall's porpoise are classified as high-frequency cetaceans (Section 3.8.2.3.1, High-Frequency Cetaceans) and are part of the Alaska stock. Dall's porpoises were most often visually detected during the GOALS II survey (Rone et al. 2013) in pods of 2 or more individuals, with group sizes ranging from 1 to 25 individuals (the average group size was 2.69). Survey observations by Rone et al. (2009) recorded 10 sightings of 59 Dall's porpoise with an average group size of 5.90 and thus illustrated the variability possible in group sizes between the two survey efforts. Acoustic modeling predicts that Dall's porpoise could be exposed to sonar and other active acoustic sources that may result in 3 PTS, 13,935 TTS, and 2,198 behavioral reactions. Costs and long-term consequences to the individual and population as a result of a Dall's porpoise receiving a PTS or TTS is the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.5.4 Killer Whale

Killer whales are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Killer whales were visually detected during the GOALS II survey (Rone et al. 2013) approximately 90 percent of the time in pods of 2 or more individuals, with group sizes ranging from 1 to 45 individuals (the average group size was 6.57). Acoustic modeling predicts that killer whales (see Table 3.8-16 for the details of exposure to the four stocks of killer whales in the Study Area) could be exposed to sound that may result in 33 TTS and 729 behavioral reactions annually. The acoustic modeling and post-modeling

analyses predict there would be no exposures to killer whale from sonar and other active acoustic sources resulting in PTS, due to the short range from the source required for PTS to occur (see discussion in Section 3.8.3.3.1.1, Range to Effects).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if killer whales are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Killer whales may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Killer whales that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source. Research has demonstrated that Alaska Resident killer whales may routinely move over long large distances (Andrews and Matkin 2014, Fearnbach et al. 2013). In a similar documented long distance movement, an Eastern North Pacific Offshore stock killer whale tagged off San Clemente Island, California moved (over a period of 147 days) to waters off northern Mexico, then north to Cook Inlet, Alaska, and finally (when the tag ceased transmitting) to coastal waters off Southeast Alaska (Falcone and Schorr 2014). Given these findings, temporary displacement due to avoidance of training activities are therefore unlikely to have biological significance to individual animals. Long-term consequences to individual killer whales or populations are not likely due to exposure to sonar or other active acoustic sources.

Costs and long-term consequences to the individual and population as a result of a killer whale receiving an exposure resulting in TTS are the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.5.5 Pacific White-Sided Dolphin

Pacific white-sided dolphin are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Pacific white-sided dolphins were not detected during the Rone et al. (2013) survey in the Study Area. Acoustic impact modeling predicts that Pacific white-sided dolphin (Table 3.8-16) could be exposed to sound that may result in 65 TTS and 1,878 behavioral reactions. The acoustic modeling and post-modeling analyses predict there would be no exposure to Pacific white-sided dolphin from sonar and other active acoustic sources resulting in PTS, due to the short range from the source required for PTS to occur (see discussion in Section 3.8.3.3.1.1, Range to Effects).

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if delphinids such as the Pacific white-sided dolphin are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Delphinids may not react at all until the sound source is approaching within a few hundred meters to within a few kilometers depending on the environmental conditions and species. Delphinids that are exposed to activities that involve the use of sonar and other active acoustic sources may alert, ignore the stimulus, change their behaviors or vocalizations, avoid the sound source by swimming away or diving, or be attracted to the sound source. Long-term consequences to individual delphinids or populations are not likely due to exposure to sonar or other active acoustic sources.

Costs and long-term consequences to the individual and population as a result of Pacific white-sided dolphin receiving an exposure resulting in TTS are the same as presented above in the general discussion for odontocetes. Population-level consequences are not expected.

3.8.3.3.5.6 Pinniped

Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that pinnipeds in the water are tolerant of anthropogenic noise and activity. Evidence from areas where Navy extensively trains and tests provides some indication of the possible consequences resulting from those proposed activities. In the confined waters of Washington State's Hood Canal where the Navy has been training and intensively testing for decades and harbor seals are present year-round, the population level has remained stable suggesting the area's carrying capacity may have been reached (Jeffries et al. 2003). In a similar manner, the beaches and shallow water areas within the PMRF at Kauai (in the main Hawaiian Islands) continue to be an important haulout and nursing area for endangered Hawaiian Monk Seals. While there has been a decline in the population of Hawaiian monk seals in the northwestern Hawaiian Islands, in the main Hawaiian Islands the numbers have continued to increase (Littnan 2011). If seals are exposed to sonar or other active acoustic sources they may react in a number of ways depending on their experience with the sound source and what activity they are engaged in at the time of the acoustic exposure. Seals may not react at all until the sound source is approaching within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Significant behavioral reactions would not be expected in most cases and long-term consequences for individuals or pinniped populations are unlikely.

Recovery from a hearing threshold shift (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days depending on the severity of the initial shift. More severe shifts may not fully recover and thus would be considered PTS. Threshold shifts do not necessarily affect all hearing frequencies equally, so threshold shifts may not necessarily interfere with an animal's ability to hear biologically relevant sounds. As discussed previously in this section, it is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual given that natural hearing loss occurs in marine mammals as a result of disease, parasitic infestations, and age-related impairment (Ketten 2012).

Phocids (Harbor Seal, Northern Elephant Seal, and Ribbon Seal)

Harbor seal, northern elephant seal, and ribbon seal are the species of phocid pinnipeds that may be present within the Study Area. Elephant seals were visually identified 16 times at-sea during the GOALS II survey (Rone et al. 2013) as single individuals and no other phocids were encountered.

There are six stocks of Harbor seal that may be present in the general Gulf of Alaska area although migrating harbor seals generally use of only nearshore pelagic areas based on an analysis of the findings in Alaska from Womble and Gende (2013). Modeled effects for harbor seal were apportioned based on the ratio of abundance for each stock as provided in the Alaska Stock Assessment Report (Allen and Angliss 2013). Northern elephant seal are the California breeding stock and Ribbon seal are the Alaska Stock.

Predicted effects to phocids are from anti-submarine warfare events involving surface ships, submarines, and aircraft during the Carrier Strike Group exercise. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources), ranges to TTS for hull-mounted sonar (e.g., sonar Bin MF1; SQS-53) can be on the order of a several kilometers for phocid seals (see discussion in Section 3.8.3.3.1.1, Range to Effects). Some behavioral effects could hypothetically take place at distances exceeding 54 mi. (87 km), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. For behavioral exposures, long-term consequences would not be expected. Costs and long-term consequences to the individual and

population as a result of a phocid receiving a TTS is the same as presented above under the general discussion for pinniped. Population-level consequences are not expected.

Acoustic modeling predicts phocids could be exposed to sound that may result in 45 TTS and 204 behavioral reactions (see Table 3.8-16 for details regarding the species and six harbor seal stocks). The majority of all exposures (approximately 98 percent) are attributed to northern elephant seal. Exposures to harbor seals (four total) are predicted based on animals being at sea in deep water such as is present in the TMAA. Individual ribbon seal may be present in the Study Area but they are expected to be rare in occurrence. Based on that rare occurrence, ribbon seal are unlikely to be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds.

Otariids (Sea Lion and Fur Seal)

Northern fur seal, California sea lion, and Steller sea lion comprise the otariid species of pinniped in the Study Area. Otariids may be exposed to sonar or other active acoustic stressors associated with anti-submarine warfare events involving surface ships, submarines, and aircraft during the Carrier Strike Group exercise, which generally take place in deep ocean areas away from the shelf and coastal margins. Olesiuk reported that evidence from various sources indicates that juvenile and non-breeding northern fur seal are virtually ubiquitous throughout the Northeastern Pacific Ocean, albeit in densities lower than at the coastal margins (Olesiuk 2012). It is likely that Steller sea lion and the rare California sea lion, which share haulout locations with them in the Gulf of Alaska, are generally foraging in the vicinity to their haulouts and will therefore be concentrated outside the Study Area. Northern fur seals were visually detected at-sea during the GOALS II survey (Rone et al. 2013) on 78 occasions and on five of those occasions in pairs. California sea lion and Steller sea lion were not identified during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts otariids could be exposed during the Carrier Strike Group exercise to sound that may result in 1 TTS and 2,675 behavioral reactions (see Table 3.8-16 for details).

For behavioral exposures otariid, long-term consequences would not be expected. Costs and long-term consequences to the individual and population as a result of a northern fur seal receiving a TTS exposure is the same as presented above under the general discussion for pinnipeds. Population-level consequences are not expected.

Steller Sea Lion (Endangered Species Act-Listed Threatened Western Distinct Population Segment and the Recovered Eastern Distinct Population Segment)

Acoustic modeling predicts that the Western stock of Steller sea lion (also considered the Western DPS under the ESA) could be exposed to sound from sonar and other active acoustic sources that may result in 572 behavioral reactions. Acoustic modeling predicts that the Eastern stock of Steller sea lion could be exposed to sound from sonar and other active acoustic sources that may result in 671 behavioral reactions. As discussed in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources) ranges to some behavioral impacts could take place at distances exceeding 100 km (62 mi.), although significant behavioral effects are much more likely at higher received levels within a few kilometers of the sound source. Significant behavioral reactions would not be expected and long-term consequences for individuals or populations are unlikely. Pursuant to the ESA, training activities in the Study Area may affect and are likely to adversely affect the ESA-listed Western stock of Steller sea lion. In the Alaska region, critical habitat has been designated for Steller sea lions in the Aleutian Islands and Western Alaska. Steller sea lion critical habitat is not present within the Study Area.

3.8.3.3.5.7 Mustelid (Northern Sea Otter)

Because sea otter are rare in waters where depths exceed 35 m (115 ft.), it is extremely unlikely that sea otters would be present in proximity to most training taking place in the TMAA where the water depth greatly exceeds a sea otter's preferred habitat. Sea otters seldom range more than approximately 1 nm from shore, although some individuals, particularly juvenile males, may travel farther offshore (Ralls et al. 1995, 1996; Riedman and Estes 1990; U.S. Fish and Wildlife Service 2003). As a result, sea otter may on rare occasions be present in the Study Area. Acoustic modeling for sea otter was not undertaken given almost all sea otter should be far from where activities involving sonar and other active acoustic sources are proposed to occur, they inhabit complex shallow water environments where acoustic modeling is very imprecise and therefore not representative of actual likely impacts, and sea otter spend little time underwater thus very much limiting the potential for exposure to underwater sound in any case. The unlikely potential for sea otter to hear underwater sound would especially be the case for wandering sea otter in the TMAA since the average depth within the Study Area greatly exceeds the foraging depth for sea otter; therefore, they would generally not be exposed to the sound field from distant sources given their nearshore shallow water habitat. Ghoul and Reichmuth (2013) have shown that sea otters are not especially well adapted for hearing underwater, which suggests that the function of this sense has been less important in their survival and evolution than in comparison to pinniped. Finally, USFWS has stated that they had no evidence that defense-related activities have had any adverse effects on the well-monitored experimental population of southern sea otters at San Nicolas Island or in the SOCAL Range Complex (U.S. Fish and Wildlife Service 2011). Pursuant to the ESA, training activities in the Study Area may affect and are not likely to adversely affect the ESA-listed Southwest Alaska stock of Northern sea otter. In the Alaska region, critical habitat has been designated for Northern sea otters, but those nearshore areas are not present within the Study Area. Given these factors, long-term consequences for individuals or the population would not be expected.

3.8.3.3.5.8 Conclusion

Training activities under Alternative 2 include the use of sonar and other active acoustic sources as described in Table 2.3-1. These activities may result in inadvertent exposure of marine mammals in the Study Area to underwater sound.

Pursuant to the MMPA, the use of sonar and other acoustic sources during training activities under Alternative 2:

- *May expose marine mammals up to 36,411 times annually to sound levels that would be considered Level B harassment, as defined by the MMPA*
- *May expose Dall's porpoises up to 3 times annually to sound levels that would be considered Level A harassment, as defined by the MMPA*

Pursuant to the ESA, the use of sonar and other acoustic sources during training activities as described under Alternative 2:

- *May affect, and is likely to adversely affect, the North Pacific right whale, humpback whale, blue whale, fin whale, sei whale, sperm whale, and the Western Distinct Population Segment of Steller sea lion*
- *May affect, and is not likely to adversely affect Western North Pacific gray whale, and the Southwest Alaska stock of Northern sea otter*
- *Would have no effect on North Pacific right whale, Steller sea lion, or Northern sea otter critical habitat*

3.8.3.3.6 Impacts from Explosives

Marine mammals could be exposed to energy and sound from underwater explosions associated with proposed activities as described in Chapter 2 (Description of Proposed Action and Alternatives). Predicted impacts on marine mammals from at-sea explosions are based on a modeling approach that considers many factors. The inputs for the models consider the net explosive weight, the properties of detonations underwater, and environmental factors such as depth of the explosion, overall water depth, water temperature, and bottom type. The net explosive weight accounts for the mass and type of explosive material. Energy from an explosion is capable of causing mortality, injury to the lungs or gastrointestinal tract, hearing loss, or a behavioral response depending on the level of exposure.

Section 3.8.3.1.2.1 (Direct Injury) presents a review of observations and experiments involving marine mammals and reactions to impulsive sounds and underwater detonations. Energy from explosions is capable of causing mortality, direct injury, hearing loss, or a behavioral response depending on the level of exposure. The death of an animal will, of course, eliminate future reproductive potential and cause a long-term consequence for the individual that must then be considered for potential long-term consequences for the population. Exposures that result in long-term injuries such as PTS may limit an animal's ability to find food, communicate with other animals, or interpret the surrounding environment. Impairment of these abilities can decrease an individual's chance of survival or impact its ability to successfully reproduce. TTS can also impair an animal's abilities, but the individual may recover quickly with little significant effect. Behavioral responses can include shorter surfacings, shorter dives, fewer blows (breaths) per surfacing, longer intervals between blows, ceasing or increasing vocalizations, shortening or lengthening vocalizations, and changing frequency or intensity of vocalizations (National Research Council 2005). However, it is not clear how these responses relate to long-term consequences for the individual or population (National Research Council 2005).

Explosions in the ocean or near the water surface can introduce loud, impulsive, broadband sounds into the marine environment. These sounds are likely within the audible range of most cetaceans, but the duration of individual sounds is very short. The direct sound from explosions used during training activities last less than a second, and most events involve the use of only one or a few explosions. Furthermore, events are dispersed in time and throughout the Study Area. These factors reduce the likelihood of these sources causing substantial auditory masking in marine mammals.

3.8.3.3.6.1 Range to Effects

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria (Section 3.8.3.1.4, Thresholds and Criteria for Predicting Acoustic and Explosive Impacts on Marine Mammals) and the explosive propagation calculations from the NAEMO (Section 3.8.3.1.6.3). The range to effects is important information in

estimating the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher-level effects, especially physiological effects such as injury and mortality.

Figure 3.8-11 through Figure 3.8-14 show the range to slight lung injury and mortality for five representative animals of different masses for 0.5–1,000 lb. net explosive weight detonations (Bins E2, E5, E9, and E12). Modeled ranges for onset slight lung injury and onset mortality are based on the smallest calf/pup weight in each category and therefore represents a conservative estimate (i.e., longer ranges) since populations contain many animals larger than calves/pups and are therefore less susceptible to injurious effects. Animals within these water volumes would be expected to receive minor injuries at the outer ranges, increasing to more substantial injuries, and finally mortality as an animal approaches the detonation point.

It is also important to note that the Navy's modeling uses onset mortality criteria based on receipt of impulse energy, where only 1 percent of the animals exposed would not survive the injuries received. All animals within the range to onset mortality are quantified as mortalities, although many animals would actually recover from or otherwise survive the injury that is the basis of the mortality criteria.

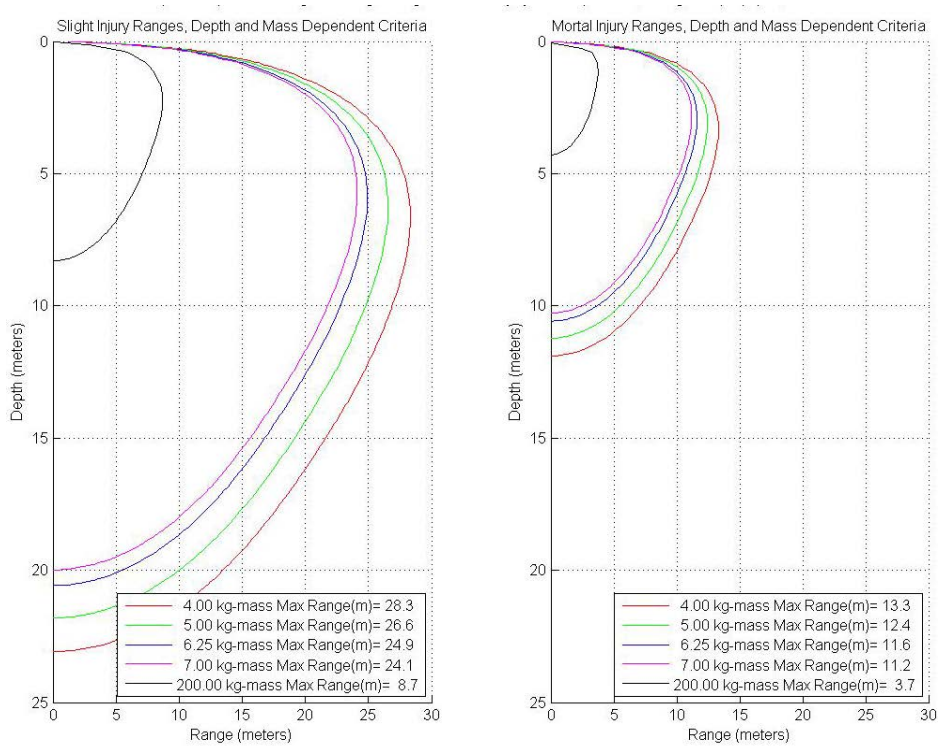

Figure 3.8-11: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 0.5-Pound Net Explosive Weight Charge (Bin E2) Detonated at 1-Meter Depth

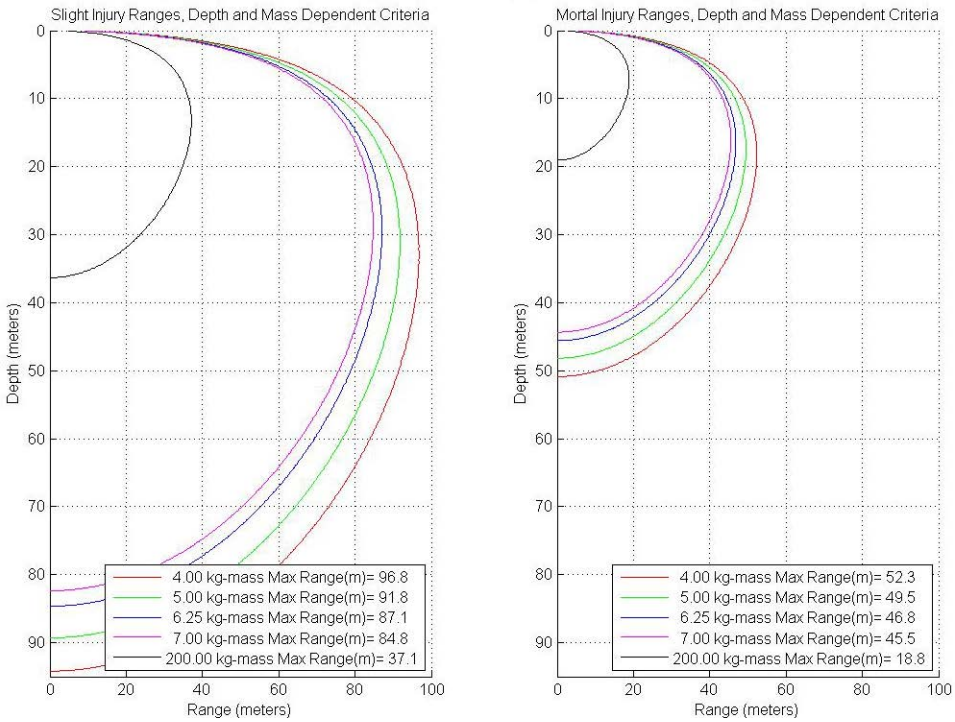

Figure 3.8-12: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 10-Pound Net Explosive Weight Charge (Bin E5) Detonated at 1-Meter Depth

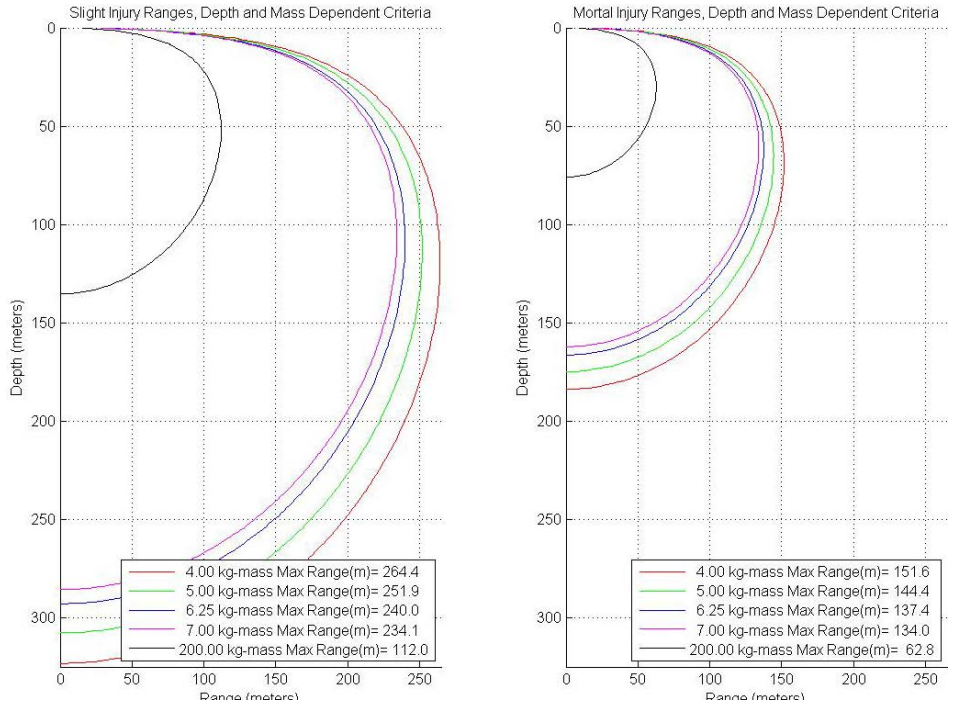

Figure 3.8-13: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 250-Pound Net Explosive Weight Charge (Bin E9) Detonated at 1-Meter Depth

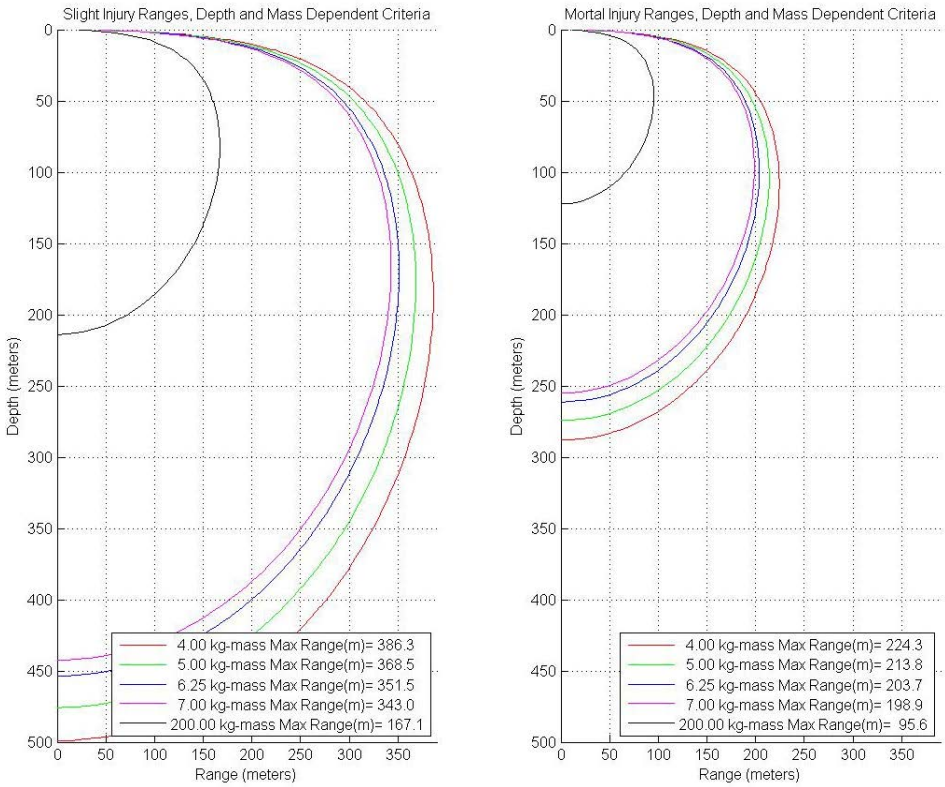

Figure 3.8-14: Threshold Profiles for Slight Lung Injury (left) and Mortality (right) Based on Five Representative Animal Masses for a 1,000-Pound Net Explosive Weight Charge (Bin E12) Detonated at 1-Meter Depth

Table 3.8-18 shows the average approximate ranges to the potential effect based on the thresholds described in Section 3.8.3.1.4 (Thresholds and Criteria for Predicting Acoustic and Explosive Impacts on Marine Mammals). Similar to slight lung injury and mortality ranges discussed above, behavioral, TTS, and PTS ranges also represent conservative estimates (i.e., longer ranges) based on assuming all impulses are 1 second in duration. In fact, most impulses are much less than 1 second and therefore contain less energy than what is being used to produce the estimated ranges below.

Table 3.8-18: Average Approximate Range to Effects from Explosions for Marine Mammals within the Study Area

Hearing Group Criteria/Predicted Impact	Average Approximate Range (meters) to Effects for Sample Explosive Bins					
	Bin E4 (2.6–5 lb. NEW)	Bin E5 (6–10 lb. NEW)	Bin E7 (21–60 lb. NEW)	Bin E9 (101–250 lb. NEW)	Bin E10 (251–500 lb. NEW)	Bin E12 (651–1,000 lb. NEW)
Low-frequency Cetaceans						
Onset Mortality	10	20	40	65	80	95
Onset Slight Lung Injury	30	40	71	110	140	170
Onset Slight GI Tract Injury	44	80	90	140	170	230
PTS	105	120	170	240	310	400
TTS	185	445	300	540	690	975
Behavioral Response	230	210	380	680	930	1,320
Mid-frequency Cetaceans						
Onset Mortality	35	45	90	135	165	200
Onset Slight Lung Injury	80	85	155	235	285	345
Onset Slight GI Tract Injury	44	50	90	140	170	230
PTS	40	55	105	150	205	240
TTS	115	125	205	340	410	515
Behavioral Response	140	140	260	420	610	700
High-Frequency Cetaceans						
Onset Mortality	40	50	95	145	175	215
Onset Slight Lung Injury	90	90	165	250	305	370
Onset Slight GI Tract Injury	40	50	90	140	170	230
PTS	155	155	280	450	630	670
TTS	305	295	580	835	1,110	1,280
Behavioral Response	365	365	655	2,600	2,075	8,375
Otariidae and Mustelidae						
Onset Mortality	60	60	115	180	215	260
Onset Slight Lung Injury	115	115	205	310	370	450
Onset Slight GI Tract Injury	40	50	90	140	170	230
PTS	25	25	25	50	70	90
TTS	55	85	145	195	270	340
Behavioral Response	80	110	170	280	335	430
Phocinea						
Onset Mortality	40	50	100	150	185	225
Onset Slight Lung Injury	100	100	175	265	320	385
Onset Slight GI Tract Injury	40	50	90	140	170	230
PTS	115	125	190	335	430	535
TTS	235	205	405	680	840	1,070
Behavioral Response	300	260	560	830	1,030	1,340

Notes: GI = gastrointestinal, lb. = pounds, NEW = Net Explosive Weight, PTS = Permanent Threshold Shift, TTS = Temporary Threshold Shift

3.8.3.3.6.2 Avoidance Behavior and Mitigation Measures as Applied to Explosions

As discussed above, within the NAEMO, animats (virtual animals) do not move horizontally or react in any way to avoid sound at any level. In reality, various researchers have demonstrated that cetaceans can perceive the location and movement of a sound source (e.g., vessel, seismic source, etc.) relative to their own location and react with responsive movement away from the source, often at distances of a kilometer or more (Au and Perryman 1982, Jansen et al. 2010, Richardson et al. 1995, Tyack et al. 2011, Watkins 1986, Wursig et al. 1998). Section 3.8.3.1.2 (Analysis Background and Framework) reviews research and observations of marine mammals' reactions to sound sources including seismic surveys and explosives. The NAEMO also does not account for the implementation of mitigation, which would prevent many of the model-predicted injurious and mortal exposures to explosives. Therefore, the model-estimated mortality and Level A effects are further analyzed and adjusted to account for animal movement (avoidance) and implementation of mitigation measures (Section 3.8.3.1.6, Quantitative Analysis), using identical procedures to those described in the technical report *Post-Model Quantitative Analysis of Animal Avoidance Behavior and Mitigation Effectiveness for the Gulf of Alaska Training* (U.S. Department of the Navy 2014b).

If explosive activities are preceded by multiple vessel traffic or hovering aircraft, harbor porpoise and beaked whales are assumed to move beyond the range to onset mortality before detonations occur. For the Carrier Strike Group exercise events, this is only applicable and assessed to occur during the Sinking Exercise. Because the NAEMO does not include avoidance behavior, the model-estimated mortalities are based on unlikely behavior for these species—that they would tolerate staying in an area of high human activity. Therefore, harbor porpoise and beaked whales that were model-estimated to be within range of a mortality criteria exposure are assumed to avoid the vicinity of a Sinking Exercise and are analyzed as being in the range of potential injury prior to the start of the explosive activity for that event.

The NAEMO does not consider mitigation, which is discussed in detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). As explained in Section 3.8.3.1.8 (Implementing Mitigation to Reduce Sound Exposures), to account for the implementation of mitigation measures, the acoustic analysis assumes a model-predicted mortality or injury would not occur if an animal at the water surface would likely be observed during those activities with Lookouts up to and during the use of explosives, considering the mitigation effectiveness (Table 3.8-19) and sightability of a species based on g(0) (see Table 3.8-9 in Section 3.8.3.1.8, Implementing Mitigation to Reduce Sound Exposures). The mitigation effectiveness is considered over two regions of an activity's mitigation zone: (1) the range to onset mortality closer to the explosion and (2) range to onset PTS. The model-estimated mortalities and injuries are reduced by the portion of animals that are likely to be seen [Mitigation Effectiveness x Sightability, g(0)]; these animals are instead assumed to be present within the range to injury and range to TTS, respectively.

During an activity with a series of explosions (not concurrent multiple explosions), an animal is expected to exhibit an initial startle reaction to the first detonation followed by a behavioral response after multiple detonations. At close ranges and high sound levels approaching those that could cause PTS, avoidance of the area around the explosions is the assumed behavioral response for most cases. The ranges to PTS for each functional hearing group for a range of explosive sizes (single detonation) are shown in Table 3.8-18. Animals not observed by Lookouts within the ranges to PTS at the time of the initial couple of explosions are assumed to experience PTS; however, all animals that exhibit avoidance reactions beyond the initial range to PTS are assumed to move away from the expanding range to PTS effects with each additional explosion.

Table 3.8-19: Impulse Activities Adjustment Factors Integrating Implementation of Mitigation into Modeling Analyses for the Study Area

Activity[1,2]	Factor for Adjustment of Preliminary Modeling Estimates		Mitigation Platform Used for Assessment
	Injury Zone	Mortality Zone	
Bombing Exercise (Air-to-Surface)	0.5	1	Aircraft
Sinking Exercise	0.5	1	Aircraft

[1] Ranges to effect differ for functional hearing groups based on weighted threshold values. HF = high frequency cetaceans; MF = mid-frequency cetaceans; LF = low frequency cetaceans. The adjustment factor for all other activities (not listed) is zero and there is no adjustment of the preliminary modeling estimates as a result of implemented mitigation for those activities (e.g., Anti-Submarine Tracking Exercise – Extended Echo Ranging; Gunnery Exercises).
[2] If less than half of the mitigation zone can be continuously visually observed or if the mitigation zone cannot be visually observed during most of the scenarios within the activity due to the type of surveillance platform(s), number of Lookouts, and size of the mitigation zone, mitigation is not considered in the acoustic effects analysis of that activity and the activity is not listed in this table. For activities in which only mitigation in the mortality zone is considered in the analysis, no value is provided for the injury zone.

Odontocetes have been demonstrated to have directional hearing, with best hearing sensitivity facing a sound source (Kastelein et al. 2005b, Mooney et al. 2008, Popov and Supin 2009). Therefore, an odontocete avoiding a source would receive sounds along a less sensitive hearing axis, potentially reducing impacts. Because the NAEMO does not account for avoidance behavior, the model-estimated effects are based on the unlikely behavior that animals would remain in the vicinity of potentially injurious sound sources. Therefore, only the initial exposures resulting in model-estimated PTS are expected to actually occur. The remaining model-estimated PTS exposures (resulting from accumulated energy) are considered to be TTS due to avoidance. Activities involving multiple non-concurrent explosive or other impulsive sources are listed in Table 3.8-20.

Table 3.8-20: Activities during the Carrier Strike Group Exercise with Multiple Non-Concurrent Impulse or Explosions

Activity
Bombing Exercise (Air-to-Surface)
Gunnery Exercise (Surface-to-Surface) – Large-Caliber
Sinking Exercise

3.8.3.3.7 Model Predicted Effects from Use of Explosives

Tables 3.8-21 through 3.8-23 present the annual predicted effects to marine mammals from activities involving the use of explosives for the No Action Alternative, Alternative 1, and Alternative 2. Annual totals presented in these tables are the summation of all annual activities involving explosives associated with the Carrier Strike Group exercise occurring between April and October each year (see Chapter 2, Table 2.3-1).

This analysis uses the NAEMO (Section 3.8.3.1.6.3) to predict effects using the explosive criteria and thresholds described in Section 3.8.3.1.4 (Thresholds and Criteria for Predicting Acoustic and Explosive Impacts on Marine Mammals) and avoidance and mitigation factors are then used as described in Section 3.8.3.1.6 (Quantitative Analysis) to more accurately enumerate likely effects to marine mammals.

It is also important to note that acoustic impacts presented in Table 3.8-21 through 3.8-23 are the total number of exposures under the effects criteria and not necessarily the number of individuals exposed. As discussed in Section 3.8.3.1.5 (Behavioral Responses), an animal could be predicted to receive more than one acoustic effect over the course of a year. Species presented in tables had species density values (i.e., theoretically present to some degree) within the areas modeled for the given alternative and activities, although modeling may still indicate no effects after summing all annual exposures. This acoustic effects analysis uses the NAEMO followed by post-model consideration of avoidance and implementation of mitigation to predict effects using the explosive criteria and thresholds.

The NAEMO does not account for several factors that must be considered in the overall explosive analysis. When there is uncertainty in model input values, a conservative approach is often chosen to assure that potential effects are not underestimated. As a result, the NAEMO provides estimates that are conservative (overestimates the likely impacts). The following is a list of several such factors that cause the model to overestimate potential effects:

- The onset mortality criterion is based on the impulse at which 1 percent of the animals receiving an injury would not recover. Therefore, many animals that the modeling would count as a mortality under the current criteria may actually recover from their injuries.
- Slight lung injury criteria are based on the impulse at which 1 percent of the animals exposed would incur a slight lung injury from which full recovery would be expected. Therefore, many animals that are estimated to suffer slight lung injury in this analysis may actually not incur injuries.
- The metrics used for the threshold for slight lung injury and mortality (i.e., acoustic impulse) are based on the animal's mass. The smaller an animal, the more susceptible that individual is to these effects. In this analysis, all individuals of a given species are assigned the weight of that species newborn calf or pup weight. Since many individuals in a population are larger than a newborn calf or pup of that species, this assumption causes the acoustic model to overestimate the number of animals that may suffer slight lung injury or mortality. As discussed in the explanation of onset mortality and onset slight lung injury criteria, the volumes of water in which the threshold for onset mortality may be exceeded are generally less than a fifth for an adult animal versus a calf or pup.
- Many explosions from munitions such as bombs and missiles will actually occur upon impact with above-water targets. However, for this analysis, sources such as these were modeled as exploding at approximately 1 yd. (1 m) depth. This overestimates the amount of explosive and acoustic energy entering the water and therefore overestimates effects on marine mammals.

These predicted impacts shown below are the result of the acoustic analysis, including acoustic effect modeling followed by consideration of animal avoidance of multiple exposures, avoidance of areas with high level of activity by sensitive species, and mitigation. It is important to note that acoustic impacts presented in the following tables are the total number of impacts and not necessarily the number of individuals impacted. As discussed in Section 3.8.3.1.5 (Behavioral Responses), an animal could be predicted to receive more than one acoustic impact over the course of the Carrier Strike Group exercise or Sinking Exercise.

3.8.3.3.8 No Action Alternative

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-1, training activities under the No Action Alternative would use explosive ordnance that results in underwater

sound or energy. Training activities involving explosions could be conducted throughout the Study Area but typically would not occur in the portion of the TMAA on the shelf or near the shelf break.

As presented in Table 3.8-21, for the No Action Alternative, the acoustic modeling and post-modeling analyses predicts that for all species except Dall's porpoise, there will be no exposures resulting in Level B or Level A harassment as defined under the MMPA for military readiness activities. The acoustic modeling and post-modeling analyses predicts that during the Carrier Strike Group exercise, there would be an estimated 22 exposures to Dall's porpoises from impulsive sound (explosives) resulting in Level B[15] harassment and no exposures resulting in Level A[16] as defined under the MMPA for military readiness activities. There are no exposures resulting in mortality predicted by the modeling for any marine mammal species and none are expected based on the history of having conducted identical events in other training range complexes for decades.

3.8.3.3.8.1 Mysticetes

During the GOALS II survey (Rone et al. 2013), 318 mysticetes were detected and identified by species with an additional 119 large whales also detected, some of which were likely to be mysticete species. Acoustic modeling indicates that mysticetes would not be exposed during the Carrier Strike Group exercise to sound or energy from explosives associated with training activities, which would exceed the current impact thresholds. Table 3.8-21 presents predicted ranges to specified effects for low-frequency cetaceans (mysticetes).

Table 3.8-21: Annual Predicted Effects to Marine Mammals from Use of Explosives under the No Action Alternative

Species	Stock	Behavioral	TTS	PTS	GI	SLI	Mortality
North Pacific right whale	Eastern North Pacific	0	0	0	0	0	0
Humpback whale	Western North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Blue whale	Eastern North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Fin whale	Northeast Pacific	0	0	0	0	0	0
Sei whale	Eastern North Pacific	0	0	0	0	0	0
Minke whale	Alaska	0	0	0	0	0	0
Gray whale	Eastern North Pacific	0	0	0	0	0	0
	Western North Pacific	0	0	0	0	0	0
Sperm whale	North Pacific	0	0	0	0	0	0

[15] This is the combined summation of all non-TTS and TTS exposures (behavioral effects) for all species and stocks in the Study Area for an annual total based on a 12-month period.
[16] This is the combined summation of all PTS, gastrointestinal, and slight lung injury exposures for all species and stocks in the Study Area for an annual total based on a 12-month period.

Table 3.8-21: Annual Predicted Effects to Marine Mammals from Use of Explosives under the No Action Alternative (continued)

Species	Stock	Behavioral	TTS	PTS	GI	SLI	Mortality
Killer whale	Alaskan Resident	0	0	0	0	0	0
	Eastern North Pacific Offshore	0	0	0	0	0	0
	AT1 Transient	0	0	0	0	0	0
	GOA, Aleutian Island, and Bering Sea Transient	0	0	0	0	0	0
Pacific white-sided dolphin	North Pacific	0	0	0	0	0	0
Harbor porpoise	Gulf of Alaska	0	0	0	0	0	0
	Southeast Alaska	0	0	0	0	0	0
Dall's porpoise	Alaska	22	1	0	0	0	0
Cuvier's beaked whale	Alaska	0	0	0	0	0	0
Baird's beaked whale	Alaska	0	0	0	0	0	0
Stejneger's beaked whale	Alaska	0	0	0	0	0	0
Steller sea lion	Eastern U.S.	0	0	0	0	0	0
	Western U.S.	0	0	0	0	0	0
California sea lion	U.S.	0	0	0	0	0	0
Northern fur seal	Eastern Pacific-Alaska	0	0	0	0	0	0
Northern elephant seal	California Breeding	0	0	0	0	0	0
Harbor seal	North Kodiak	0	0	0	0	0	0
	South Kodiak	0	0	0	0	0	0
	Prince William Sound	0	0	0	0	0	0
	Glacier Bay/Icy Strait	0	0	0	0	0	0
	Sitka/Chatham	0	0	0	0	0	0
	Dixon/Cape Decision	0	0	0	0	0	0
Ribbon seal	Alaska	0	0	0	0	0	0
Northern sea otter	Southeast Alaska	0	0	0	0	0	0
	Southcentral Alaska	0	0	0	0	0	0
	Southwest Alaska	0	0	0	0	0	0
Sub-Total		22	1	0	0	0	0
MMPA Totals		**Level B**		**Level A**			**Mortality**
		23		0			0

Notes: GI = gastrointestinal, GOA = Gulf of Alaska, PTS = Permanent Threshold Shift, SLI = Slight Lung Injury, TTS = Temporary Threshold Shift, U.S. = United States

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales are not expected to be present in the Study Area (Section 3.8.2.6.3, Distribution). Within the Gulf of Alaska, a July 2012 sighting of a North Pacific right whale approximately 50 mi. (80 km) from the southern edge of the TMAA Study Area (Matsuoka et al. 2013) and subsequent

acoustic detections in July 2013 (U.S. Department of the Navy 2013g) also occurred outside the Study Area in the near the designated right whale Critical Habitat off Kodiak Island. A bottom-moored passive acoustic monitoring device on Quinn Seamount also detected North Pacific right whale calls between July and September 2013, but these calls were believed to have originated over 100 km from the hydrophone (Debich et al. 2014).

It is also not expected that North Pacific right whale would be exposed to sound or energy associated with the use of explosives during training activities given those activities only occur during limited intervals of the 21-day Carrier Strike Group exercise. Given that a North Pacific right whale has not been seen in the Study Area since at least the 1960s (indicating a highly unlikely presence), it would be extremely unlikely for there to be a co-occurrence of a right whale in the Study Area while use of explosives was occurring. Additionally, mitigation measures would be implemented if a North Pacific right whale were detected within the mitigation zone. Even in the event of an extremely unlikely co-occurrence, given that any effect would likely not be measureable, detectable, or significant, the Navy has determined possible effects to North Pacific right whale from Navy training in the Study Area are discountable. As discussed in Section 3.8.3.2.1 (Application of the Endangered Species Act to Marine Mammals), because it is possible that a North Pacific right whale may potentially be present and may potentially detect or otherwise be exposed to sound resulting from Navy training, use of explosives in the Study Area may affect and is not likely to adversely affect North Pacific right whale.

Blue Whales (Endangered Species Act-Listed)

Blue whales were visually detected five times during the GOALS II survey (Rone et al. 2013) as single individuals or in pairs. Blue whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, blue whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Humpback Whales (Endangered Species Act-Listed)

Humpback whales visually detected during the GOALS II survey (Rone et al. 2013) had an average group size of 3.12. Humpback whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, humpback whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Sei Whales (Endangered Species Act-Listed)

During the GOALS II survey (Rone et al. 2013), three large whales determined to be either fin or sei whales were detected. Sei whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, sei whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Fin Whales (Endangered Species Act-Listed)

As noted above for sei whales, during the GOALS II survey (Rone et al. 2013), only three large whales determined to be either fin or sei whales were detected. Acoustic modeling indicates fin whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, fin whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Gray Whales, Western North Pacific Stock (Endangered Species Act-Listed)

No gray whales were detected in the TMAA Study Area during the GOALS II survey (Rone et al. 2013). Acoustic modeling indicates that gray whales would not be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds. Gray whales of the Western North Pacific stock may migrate through the Study Area although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur. Since gray whales of the Western North Pacific stock could potentially be present in the Study Area, they may be exposed to low levels of sound or energy. Pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

3.8.3.3.8.2 Odontocetes

Acoustic modeling indicates that except for Dall's porpoise, odontocetes would not be exposed to sound or energy from explosives associated with training activities during the Carrier Strike Group exercise, which would exceed the current impact thresholds under the No Action Alternative.

Sperm Whales (Endangered Species Act-Listed)

Sperm whales are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Sperm whales were visually detected 19 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts that sperm whales would not be exposed to sound or energy from explosions associated with proposed activities, which would exceed the current impact thresholds. Straley et al. (2014) reported on findings from satellite tags attached to 10 sperm whales in the Gulf of Alaska. The tags demonstrated that at least three of these animals went as far south as waters off Mexico. This suggests that potential behavioral disturbances resulting in avoidance of Navy events or acoustic sources are unlikely to have any meaningful consequences for animals that cover such distances. Long-term consequences for individuals or populations would not be expected. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, sperm whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Dall's Porpoise

Dall's porpoise (classified as high-frequency cetaceans [Section 3.8.2.3.1, High-Frequency Cetaceans]) are present in the Study Area and are part of the Alaska stock. Dall's porpoise were encountered as individuals and in groups 337 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts that Dall's porpoise could be exposed to sound or energy from explosions that may result in 1 TTS and 22 behavioral reactions; both of these effects are considered behavioral harassment under the MMPA. The population of Dall's porpoises for which these effects are predicted has a stock exceeding approximately 83,000 animals (Table 3.8-1).

Acoustic modeling for the No Action Alternative predicts one TTS effect annually for Dall's porpoises from use of explosives during training. As discussed in Section 3.8.3.3.3.1 (Range to Effects), the range to TTS (a temporary partial loss of hearing sensitivity) for a high frequency cetacean such as Dall's porpoise is on average less than approximately 1,400 yd. (1,280 m) from the largest explosive (Bin E12) used in the TMAA. Recovery from a TTS can take a few minutes to a few days, depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts.

Acoustic modeling indicates 22 effects to Dall's porpoises as a result of sound or energy from underwater explosions that would result in a behavioral response. Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if high frequency cetaceans are exposed to explosions, they may react by alerting, ignoring the stimulus, changing their behaviors or vocalizations, or avoiding the area by swimming away or diving. Some behavioral impacts from the largest explosive (Bin E12) used in the TMAA could take place at distances exceeding approximately 4.5 nm (Table 3.8-18), although significant behavioral effects are much more likely at higher received levels closer to the explosion. Overall, predicted effects are low, and mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce potential impacts. Occasional behavioral reactions to intermittent explosions are unlikely to cause long-term consequences for individual animals or populations.

3.8.3.3.8.3 Pinnipeds

During the GOALS II survey (Rone et al. 2013), 16 elephant seals, 78 Northern fur seals, and 6 unidentified pinnipeds were visually detected. Acoustic modeling indicates that during the Carrier Strike Group exercise, pinnipeds would not be exposed to sound or energy from explosives associated with training activities, which would exceed the current impact thresholds.

Steller Sea Lion (Endangered Species Act-Listed Threatened Western Distinct Population Segment and the Recovered Eastern Distinct Population Segment)

Acoustic modeling predicts that Steller sea lions would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. The Western U.S. stock of Steller sea lions (also constituting the Western DPS) is listed as depleted under the MMPA and endangered under the ESA. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, the Western U.S. stock of Steller sea lions may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species. The Eastern U.S. stock of Steller sea lions has recovered and been removed from the List of Endangered and Threatened Wildlife under the ESA. In the Alaska region, critical habitat has been designated for Steller sea lions in the Aleutian Islands and Western Alaska. There would be no impact to Critical Habitat designated for Steller sea lion since it does not occur within the Study Area.

3.8.3.3.8.4 Mustelid (Northern Sea Otters)

The sea otter may on rare occasion be present in the Study Area. Because it is unlikely that a sea otter would be in waters where depths exceed 35 m (115 ft.), it is extremely unlikely that sea otters would be present within the range to effects for training events using explosives (see Table 3.8-24). Acoustic modeling for sea otter was not undertaken given they are far from where activities involving in water explosives are proposed to occur, they inhabit complex shallow water environments where acoustic

modeling is very imprecise and therefore not representative, and they spend little time underwater thus very much limiting the potential for sea otter to hear underwater sound in any case. Research indicates sea otters often remained undisturbed, quickly become tolerant of the various sounds, and even when purposefully harassed, they generally moved only a short distance (100–200 m) before resuming normal activity. The USFWS has determined that previous Department of Defense actions have not posed a threat to the San Nicolas Island (California) colony of southern sea otter and the average growth rate for the translocated colony has been higher than that for those inhabiting the central California coastline in recent years (U.S. Fish and Wildlife Service 2011). Given these factors, long-term consequences for individuals or the population would not be expected.

3.8.3.3.8.5 Conclusion

Training activities under the No Action Alternative include sound or energy from underwater explosions resulting from activities as described in Table 2.3-1 of Chapter 2 (Description of Proposed Action and Alternatives). These activities could result in inadvertent exposure of marine mammals in the Study Area to sound or energy from the use of explosives.

Pursuant to the MMPA, the use of explosives during training activities under the No Action Alternative:

- *May expose Dall's porpoises up to 23 times annually to sound or pressure levels that would be considered Level B harassment, as defined by the MMPA*
- *Would not result in Level A harassment, serious injury, or incidental mortality to any marine mammals*

Pursuant to the ESA, the use of explosives during training activities as described under the No Action Alternative:

- *May affect, and is not likely to adversely affect, North Pacific right whale, humpback whale, blue whale, fin whale, sei whale, Western North Pacific gray whale, sperm whale, the Western stock of Steller sea lion, and the Southwest Alaska stock of Northern sea otter*
- *Would have no effect on North Pacific right whale, Steller sea lion, or Northern sea otter critical habitat*

3.8.3.3.9 Alternative 1

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-1, training activities under Alternative 1 would use explosive ordnance that results in underwater sound or energy. Training activities involving explosions could be conducted throughout the Study Area but typically would not occur in the portion of the TMAA on the shelf or near the shelf break.

As presented in Table 3.8-22 for Alternative 1, the acoustic modeling and post-modeling analyses predicts that for all species except Dall's porpoise, there will be no exposures resulting in Level B or Level A harassment as defined under the MMPA for military readiness activities. The acoustic modeling and post-modeling analyses predicts that during the Carrier Strike Group exercise there would be 36 exposures to Dall's porpoises from impulsive sound (explosives) resulting in Level B[17] harassment and 1 exposure resulting in Level A[18] as defined under the MMPA for military readiness activities. There are

[17] This is the combined summation of all non-TTS and TTS exposures (behavioral effects) for all species and stocks in the Study Area for an annual total based on a 12-month period.

[18] This is the combined summation of all PTS, gastrointestinal, and slight lung injury exposures for all species and stocks in the Study Area for an annual total based on a 12-month period.

no exposures resulting in mortality predicted by the modeling for any marine mammal species and none are expected based on the history of having conducted identical events in other training range complexes for decades.

3.8.3.3.9.1 Mysticetes

During the GOALS II survey (Rone et al. 2013), 318 mysticetes were detected and identified by species with an additional 119 large whales also detected, some of which were likely to be mysticete species. Acoustic modeling indicates that during the Carrier Strike Group exercise, mysticetes would not be exposed to sound or energy from explosives associated with training activities, which would exceed the current impact thresholds. Table 3.8-22 presents predicted ranges to specified effects for low-frequency cetaceans (mysticetes).

Table 3.8-22: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 1

Species	Stock	Behavioral	TTS	PTS	GI	SLI	Mortality
North Pacific right whale	Eastern North Pacific	0	0	0	0	0	0
Humpback whale	Western North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Blue whale	Eastern North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Fin whale	Northeast Pacific	0	0	0	0	0	0
Sei whale	Eastern North Pacific	0	0	0	0	0	0
Minke whale	Alaska	0	0	0	0	0	0
Gray whale	Eastern North Pacific	0	0	0	0	0	0
	Western North Pacific	0	0	0	0	0	0
Sperm whale	North Pacific	0	0	0	0	0	0
Killer whale	Alaskan Resident	0	0	0	0	0	0
	Eastern North Pacific Offshore	0	0	0	0	0	0
	AT1 Transient	0	0	0	0	0	0
	GOA, Aleutian Island, and Bering Sea Transient	0	0	0	0	0	0
Pacific white-sided dolphin	North Pacific	0	0	0	0	0	0
Harbor porpoise	Gulf of Alaska	0	0	0	0	0	0
	Southeast Alaska	0	0	0	0	0	0
Dall's porpoise	Alaska	34	2	1	0	0	0
Cuvier's beaked whale	Alaska	0	0	0	0	0	0
Baird's beaked whale	Alaska	0	0	0	0	0	0
Stejneger's beaked whale	Alaska	0	0	0	0	0	0

Table 3.8-22: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 1 (continued)

Species	Stock	Behavioral	TTS	PTS	GI	SLI	Mortality
Steller sea lion	Eastern U.S.	0	0	0	0	0	0
	Western U.S.	0	0	0	0	0	0
California sea lion	U.S.	0	0	0	0	0	0
Northern fur seal	Eastern Pacific-Alaska	0	0	0	0	0	0
Northern elephant seal	California Breeding	0	0	0	0	0	0
Harbor seal	North Kodiak	0	0	0	0	0	0
	South Kodiak	0	0	0	0	0	0
	Prince William Sound	0	0	0	0	0	0
	Glacier Bay/Icy Strait	0	0	0	0	0	0
	Sitka/Chatham	0	0	0	0	0	0
	Dixon/Cape Decision	0	0	0	0	0	0
Ribbon seal	Alaska	0	0	0	0	0	0
Northern sea otter	Southeast Alaska	0	0	0	0	0	0
	Southcentral Alaska	0	0	0	0	0	0
	Southwest Alaska	0	0	0	0	0	0
Sub-Total		34	2	1	0	0	0
MMPA Totals		**Level A**		**Level B**			**Mortality**
		36		1			0

Notes: GI = gastrointestinal, GOA = Gulf of Alaska, PTS = Permanent Threshold Shift, SLI = Slight Lung Injury, TTS = Temporary Threshold Shift, U.S. = United States

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales are not expected to be present in the Study Area (Section 3.8.2.6.3, Distribution). Within the Gulf of Alaska, a July 2012 sighting of a North Pacific right whale approximately 50 mi. (80 km) from the southern edge of the TMAA Study Area (Matsuoka et al. 2013) and subsequent acoustic detections in July 2013 (U.S. Department of the Navy 2013g) also occurred outside the Study Area in the near the designated right whale Critical Habitat off Kodiak Island. A bottom moored passive acoustic monitoring device on Quinn Seamount also detected North Pacific right whale calls between July and September 2013, but these calls were believed to have originated over 100 km from the hydrophone (Debich et al. 2014).

It is also not expected that North Pacific right whale would be exposed to sound or energy associated with the use of explosives during training activities given those activities only occur during limited intervals of the 21-day Carrier Strike Group exercise. Given that a North Pacific right whale has not been seen in the Study Area since at least the 1960s (indicating a highly unlikely presence), it would be extremely unlikely for there to be a co-occurrence of a right whale in the Study Area while use of explosives was occurring. Additionally, mitigation measures would be implemented if a North Pacific right whale were detected within the mitigation zone. Even in the event of an extremely unlikely co-occurrence, given that any effect would likely not be measureable, detectable, or significant, the Navy

has determined possible effects to North Pacific right whale from Navy training in the Study Area are discountable. As discussed in Section 3.8.3.2.1 (Application of the Endangered Species Act to Marine Mammals), because it is possible that a North Pacific right whale may potentially be present and may potentially detect or otherwise be exposed to sound resulting from Navy training, use of explosives in the Study Area may affect and is not likely to adversely affect North Pacific right whale.

Blue Whales (Endangered Species Act-Listed)

Blue whales were visually detected five times during the GOALS II survey (Rone et al. 2013) as single individuals or in pairs. Blue whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, blue whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Humpback Whales (Endangered Species Act-Listed)

Humpback whales visually detected during the GOALS II survey (Rone et al. 2013) had an average group size of 3.12. Humpback whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, humpback whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Sei Whales (Endangered Species Act-Listed)

During the GOALS II survey (Rone et al. 2013), three large whales determined to be either fin or sei whales were detected. Sei whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, sei whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Fin Whales (Endangered Species Act-Listed)

As noted above for sei whales, during the GOALS II survey (Rone et al. 2013), only three large whales determined to be either fin or sei whales were detected. Acoustic modeling indicates fin whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, fin whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Gray Whales, Western North Pacific Stock (Endangered Species Act-Listed)

No gray whales were detected in the TMAA Study Area during the GOALS II survey (Rone et al. 2013). Acoustic modeling indicates that gray whales would not be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds. Gray whales of the Western North Pacific stock may migrate through the Study Area although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur. Since gray whales

of the Western North Pacific stock could potentially be present in the Study Area, they may be exposed to low levels of sound or energy. Pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

3.8.3.3.9.2 Odontocetes

Under Alternative 1, acoustic modeling indicates that except for Dall's porpoise, odontocetes would not be exposed during the Carrier Strike Group exercise to sound or energy from explosives associated with training activities, which would exceed the current impact thresholds.

Sperm Whales (Endangered Species Act-Listed)

Sperm whales are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Sperm whales were visually detected 19 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts that sperm whales would not be exposed to sound or energy from explosions associated with proposed activities, which would exceed the current impact thresholds. Straley et al. (2014) reported on findings from satellite tags attached to 10 sperm whales in the Gulf of Alaska. The tags demonstrated that at least three of these animals went as far south as waters off Mexico. This suggests that potential behavioral disturbances resulting in avoidance of Navy events or acoustic sources are unlikely to have any meaningful consequences for animals that cover such distances. Long-term consequences for individuals or populations would not be expected. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, sperm whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Dall's Porpoise

Dall's porpoise (classified as high-frequency cetaceans [Section 3.8.2.3.1, High-Frequency Cetaceans]) are present in the Study Area and are part of the Alaska stock. Dall's porpoise were encountered as individuals and in groups 337 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling for Alternative 1 predicts that Dall's porpoise could be exposed to sound or energy from explosions that may result in 1 PTS, 2 TTS, and 36 behavioral reactions. The population of Dall's porpoises for which these effects are predicted has a stock exceeding approximately 83,000 animals (Table 3.8-1).

A total of one PTS effect annually is predicted for Dall's porpoises from use of explosives during training. As discussed in Section 3.8.3.3.6.1 (Range to Effects), ranges to PTS as an injury effect are on average less than approximately 730 yd. (670 m) for high frequency cetaceans from the largest explosive (Bin E12) used in the TMAA. Recovery from a TTS (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days, depending on the severity of the initial shift. PTS would not fully recover. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. It is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual, given many mammals lose hearing ability as they age. Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts.

Acoustic modeling predicts two TTS effects annually for Dall's porpoises from use of explosives during training. As discussed in Section 3.8.3.3.6.1 (Range to Effects), the range to TTS (a temporary partial loss of hearing sensitivity) for a high frequency cetacean such as Dall's porpoise is on average less than approximately 1,400 yd. (1,280 m) from the largest explosive (Bin E12) used in the TMAA. Recovery from

a TTS can take a few minutes to a few days, depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts.

Acoustic modeling indicates 34 effects to Dall's porpoises as a result of sound or energy from underwater explosions that would result in a behavioral response. Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if high frequency cetaceans are exposed to explosions, they may react by alerting, ignoring the stimulus, changing their behaviors or vocalizations, or avoiding the area by swimming away or diving. Some behavioral impacts from the largest explosive (Bin E12) used in the TMAA could take place at distances exceeding approximately 4.5 nm (Table 3.8-18), although significant behavioral effects are much more likely at higher received levels closer to the explosion. Overall, predicted effects are low, and mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce potential impacts. Occasional behavioral reactions to intermittent explosions are unlikely to cause long-term consequences for individual animals or populations.

3.8.3.3.9.3 Pinnipeds

During the GOALS II survey (Rone et al. 2013), 16 elephant seals, 78 Northern fur seals, and 6 unidentified pinnipeds were visually detected. Acoustic modeling indicates that during the Carrier Strike Group exercise, pinnipeds would not be exposed to sound or energy from explosives associated with training activities, which would exceed the current impact thresholds.

Steller Sea Lion (Endangered Species Act-Listed Threatened Western Distinct Population Segment and the Recovered Eastern Distinct Population Segment)

Acoustic modeling predicts that Steller sea lions would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. The Western U.S. stock of Steller sea lions (also constituting the Western DPS) is listed as depleted under the MMPA and endangered under the ESA. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, the Western U.S. stock of Steller sea lions may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species. The Eastern U.S. stock of Steller sea lions has recovered and been removed from the List of Endangered and Threatened Wildlife under the ESA. In the Alaska region, critical habitat has been designated for Steller sea lions in the Aleutian Islands and Western Alaska. There would be no impact to Critical Habitat designated for Steller sea lion since it does not occur within the Study Area.

3.8.3.3.9.4 Mustelid (Northern Sea Otters)

The sea otter may on rare occasion be present in the Study Area. Because it is unlikely that a sea otter would be in waters where depths exceed 35 m (115 ft.), it is extremely unlikely that sea otters would be present within the range to effects for training events using explosives (see Table 3.8-26). Acoustic modeling for sea otter was not undertaken given they are far from where activities involving in water explosives are proposed to occur, they inhabit complex shallow water environments where acoustic modeling is very imprecise and therefore not representative, and they spend little time underwater thus very much limiting the potential for sea otter to hear underwater sound in any case. Research indicates sea otters often remained undisturbed, quickly become tolerant of the various sounds, and even when purposefully harassed, they generally moved only a short distance (100–200 m) before resuming normal activity. The USFWS has determined that previous Department of Defense actions have not posed a

threat to the San Nicolas Island (California) colony of southern sea otter and the average growth rate for the translocated colony has been higher than that for those inhabiting the central California coastline in recent years (U.S. Department of the Interior 2012a). Given these factors, long-term consequences for individuals or the population would not be expected. Pursuant to the ESA, training activities in the Study Area may affect and are not likely to adversely affect the ESA-listed Southwestern Alaska stock of Northern sea otter. In the Alaska region, critical habitat has been designated for Northern sea otters, but those nearshore areas are not present within the Study Area.

3.8.3.3.9.5 Conclusion

Training activities under Alternative 1 include sound or energy from underwater explosions resulting from activities as described in Table 2.3-1 of Chapter 2 (Description of Proposed Action and Alternatives). These activities could result in inadvertent exposure of marine mammals in the Study Area to sound or energy from the use of explosives.

Pursuant to the MMPA, the use of explosives during training activities under Alternative 1:

- *May expose Dall's porpoises up to 36 times annually to sound or pressure levels that would be considered Level B harassment, as defined by the MMPA*
- *May expose a Dall's porpoise 1 time annually to sound or pressure levels that would be considered Level A harassment, as defined by the MMPA*
- *Would not result in serious injury or incidental mortality to any marine mammals*

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1:

- *May affect, and is not likely to adversely affect, North Pacific right whale, humpback whale, blue whale, fin whale, sei whale, Western North Pacific gray whale, sperm whale, the Western stock of Steller sea lion, and the Southwest Alaska stock of Northern sea otter*
- *Would have no effect on North Pacific right whale, Steller sea lion, or Northern sea otter critical habitat*

3.8.3.3.10 Alternative 2

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.3-1, training activities under Alternative 2 would use explosive ordnance that results in underwater sound or energy. Training activities involving explosions could be conducted throughout the Study Area but typically would not occur in the portion of the TMAA on the shelf or near the shelf break.

As presented in Table 3.8-23, for Alternative 2, the acoustic modeling and post-modeling analyses predicts that as a result of the two annual Carrier Strike Group exercises, for all species except Dall's porpoise, there will be no exposures resulting in Level B or Level A harassment as defined under the MMPA for military readiness activities. The acoustic modeling and post-modeling analyses predicts 112 exposures to Dall's porpoises from impulsive sound (explosives) resulting in Level B[19] harassment and 3 exposures resulting in Level A[20] as defined under the MMPA for military readiness activities. There are no exposures resulting in mortality predicted by the modeling for any marine mammal species and none

[19] This is the combined summation of all non-TTS and TTS exposures (behavioral effects) for all species and stocks in the Study Area for an annual total based on a 12-month period.
[20] This is the combined summation of all PTS, gastrointestinal, and slight lung injury exposures for all species and stocks in the Study Area for an annual total based on a 12-month period.

are expected based on the history of having conducted identical events in other training range complexes for decades.

3.8.3.3.10.1 Mysticetes

During the GOALS II survey (Rone et al. 2013), 318 mysticetes were detected and identified by species with an additional 119 large whales also detected, some of which were likely to be mysticete species. Acoustic modeling indicates that mysticetes would not be exposed to sound or energy from explosives associated with training activities during the Carrier Strike Group exercises, which would exceed the current impact thresholds. Table 3.8-23 presents predicted ranges to specified effects for low-frequency cetaceans (mysticetes).

Table 3.8-23: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 2

Species	Stock	Behavioral	TTS	PTS	GI	SLI	Mortality
North Pacific right whale	Eastern North Pacific	0	0	0	0	0	0
Humpback whale	Western North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Blue whale	Eastern North Pacific	0	0	0	0	0	0
	Central North Pacific	0	0	0	0	0	0
Fin whale	Northeast Pacific	0	0	0	0	0	0
Sei whale	Eastern North Pacific	0	0	0	0	0	0
Minke whale	Alaska	0	0	0	0	0	0
Gray whale	Eastern North Pacific	0	0	0	0	0	0
	Western North Pacific	0	0	0	0	0	0
Sperm whale	North Pacific	0	0	0	0	0	0
Killer whale	Alaskan Resident	0	0	0	0	0	0
	Eastern North Pacific Offshore	0	0	0	0	0	0
	AT1 Transient	0	0	0	0	0	0
	GOA, Aleutian Island, and Bering Sea Transient	0	0	0	0	0	0
Pacific white-sided dolphin	North Pacific	0	0	0	0	0	0
Harbor porpoise	Gulf of Alaska	0	0	0	0	0	0
	Southeast Alaska	0	0	0	0	0	0
Dall's porpoise	Alaska	94	18	2	0	1	0
Cuvier's beaked whale	Alaska	0	0	0	0	0	0
Baird's beaked whale	Alaska	0	0	0	0	0	0
Stejneger's beaked whale	Alaska	0	0	0	0	0	0
Steller sea lion	Eastern U.S.	0	0	0	0	0	0
	Western U.S.	0	0	0	0	0	0
California sea lion	U.S.	0	0	0	0	0	0
Northern fur seal	Eastern Pacific-Alaska	0	0	0	0	0	0
Northern elephant seal	California Breeding	0	0	0	0	0	0

Table 3.8-23: Annual Predicted Effects to Marine Mammals from Use of Explosives under Alternative 2 (continued)

Harbor seal	North Kodiak	0	0	0	0	0	0
	South Kodiak	0	0	0	0	0	0
	Prince William Sound	0	0	0	0	0	0
	Glacier Bay/Icy Strait	0	0	0	0	0	0
	Sitka/Chatham	0	0	0	0	0	0
	Dixon/Cape Decision	0	0	0	0	0	0
Ribbon seal	Alaska	0	0	0	0	0	0
Northern sea otter	Southeast Alaska	0	0	0	0	0	0
	Southcentral Alaska	0	0	0	0	0	0
	Southwest Alaska	0	0	0	0	0	0
Sub-Total		94	18	2	0	1	0
MMPA Totals		**Level B**		**Level A**			**Mortality**
		112		3			0

Notes: GI = gastrointestinal, GOA = Gulf of Alaska, PTS = Permanent Threshold Shift, SLI = Slight Lung Injury, TTS = Temporary Threshold Shift, U.S. = United States

North Pacific Right Whales (Endangered Species Act-Listed)

North Pacific right whales are not expected to be present in the Study Area (Section 3.8.2.6.3, Distribution). Within the Gulf of Alaska, a July 2012 sighting of a North Pacific right whale approximately 50 mi. (80 km) from the southern edge of the TMAA Study Area (Matsuoka et al. 2013) and subsequent acoustic detections in July 2013 (U.S. Department of the Navy 2013g) also occurred outside the Study Area in the near the designated right whale Critical Habitat off Kodiak Island. A bottom moored passive acoustic monitoring device on Quinn Seamount also detected North Pacific right whale calls between July and September 2013, but these calls were believed to have originated over 100 km from the hydrophone (Debich et al. 2014). It is also not expected that North Pacific right whale would be exposed to sound or energy associated with the use of explosives during training activities given those activities only occur during limited intervals of the 21-day Carrier Strike Group exercise. Given that a North Pacific right whale has not been seen in the Study Area since at least the 1960s (indicating a highly unlikely presence), it would be extremely unlikely for there to be a co-occurrence of a right whale in the Study Area while use of explosives was occurring. Additionally, mitigation measures would be implemented if a North Pacific right whale were detected within the mitigation zone. Even in the event of an extremely unlikely co-occurrence, given that any effect would likely not be measureable, detectable, or significant, the Navy has determined possible effects to North Pacific right whale from Navy training in the Study Area are discountable. As discussed in Section 3.8.3.2.1 (Application of the Endangered Species Act to Marine Mammals), because it is possible that a North Pacific right whale may potentially be present and may potentially detect or otherwise be exposed to sound resulting from Navy training, use of explosives in the Study Area may affect and is not likely to adversely affect North Pacific right whale.

Blue Whales (Endangered Species Act-Listed)

Blue whales were visually detected five times during the GOALS II survey (Rone et al. 2013) as single individuals or in pairs. Blue whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, blue whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Humpback Whales (Endangered Species Act-Listed)

Humpback whales visually detected during the GOALS II survey (Rone et al. 2013) had an average group size of 3.12. Humpback whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, humpback whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Sei Whales (Endangered Species Act-Listed)

During the GOALS II survey (Rone et al. 2013), three large whales determined to be either fin or sei whales were detected. Sei whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, sei whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Fin Whales (Endangered Species Act-Listed)

As noted above for sei whales, during the GOALS II survey (Rone et al. 2013), only three large whales determined to be either fin or sei whales were detected. Acoustic modeling indicates fin whales would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, fin whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Gray Whales, Western North Pacific Stock (Endangered Species Act-Listed)

No gray whales were detected in the TMAA Study Area during the GOALS II survey (Rone et al. 2013). Acoustic modeling indicates that gray whales would not be exposed to sonar or other active acoustic sources associated with training activities, which would exceed the current impact thresholds. Gray whales of the Western North Pacific stock may migrate through the Study Area although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur. Since gray whales of the Western North Pacific stock could potentially be present in the Study Area, they may be exposed to low levels of sound or energy. Pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

3.8.3.3.10.2 Odontocetes

Under Alternative 2, acoustic modeling indicates that, except for Dall's porpoise, odontocetes would not be exposed to sound or energy from explosives associated with training activities during the Carrier Strike Group exercises, which would exceed the current impact thresholds.

Sperm Whales (Endangered Species Act-Listed)

Sperm whales are classified as mid-frequency cetaceans (Section 3.8.2.3.2, Mid-Frequency Cetaceans). Sperm whales were visually detected 19 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling predicts that sperm whales would not be exposed to sound or energy from explosions associated with proposed activities, which would exceed the current impact thresholds. Long-term consequences for individuals or populations would not be expected. Although acoustic modeling

indicates any effects are discountable as being extremely unlikely to occur, sperm whales may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species.

Dall's Porpoise

Dall's porpoise (classified as high-frequency cetaceans [Section 3.8.2.3.1, High-Frequency Cetaceans]) are present in the Study Area and are part of the Alaska stock. Dall's porpoise were encountered as individuals and in groups 337 times during the GOALS II survey (Rone et al. 2013). Acoustic modeling for Alternative 2 predicts that Dall's porpoise could be exposed to sound or energy from explosions that may result in 1 slight lung injury, 2 PTS, 18 TTS, and 94 behavioral reactions.

The explosive impact injury criteria are based upon newborn calf weights, and therefore these effects are over predicted by the model, assuming most animals within the population are larger than a newborn calf. Furthermore, as explained in Section 3.8.3.1.4.8 (Mortality and Injury from Explosives), the criteria for slight lung injury are very conservative (e.g., overestimate the effect). Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) are designed to avoid potential effects from underwater detonations, especially higher order effects such as injury and death. Nevertheless, conservative modeling predicts it is possible for Dall's porpoise to be injured by an explosion. Considering that Dall's porpoises for which these effects are predicted have a stock exceeding approximately 83,000 animals (Table 3.8-1), the one recoverable slight lung injury predicted annually for an animal in the population would be extremely unlikely to have measurable long-term consequences to the population.

A total of 2 PTS and 18 TTS effects are predicted for Dall's porpoises from use of explosives during training. As discussed in Section 3.8.3.3.6.1 (Range to Effects), ranges to PTS as an injury effect are on average less than approximately 730 yd. (670 m) for the high frequency cetaceans from the largest explosive (Bin E12) used in the TMAA. Recovery from a TTS (i.e., TTS; temporary partial loss of hearing sensitivity) can take a few minutes to a few days, depending on the severity of the initial shift. PTS would not fully recover. Threshold shifts do not necessarily affect hearing sensitivity across all frequencies equally, so some threshold shifts may not interfere with an animal hearing biologically relevant sounds. It is uncertain whether some permanent loss of hearing sensitivity over a part of a marine mammal's hearing range would have long-term consequences for that individual, given many mammals lose hearing ability as they age. Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts.

Acoustic modeling indicates 94 effects to Dall's porpoises as a result of sound or energy from underwater explosions that would constitute a behavioral response. Research and observations (Section 3.8.3.1.2.6, Behavioral Reactions) show that if high frequency cetaceans are exposed to explosions, they may react by alerting, ignoring the stimulus, changing their behaviors or vocalizations, or avoiding the area by swimming away or diving. Some behavioral impacts from the largest explosive (Bin E12) used in the TMAA could take place at distances exceeding approximately 4.5 nm (Table 3.8-18), although significant behavioral effects are much more likely at higher received levels closer to the explosion. Overall, predicted effects are low, and mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce potential impacts. Occasional behavioral reactions to intermittent explosions are unlikely to cause long-term consequences for individual animals or populations.

3.8.3.3.10.3 Pinnipeds

During the GOALS II survey (Rone et al. 2013), 16 elephant seals, 78 Northern fur seals, and 6 unidentified pinnipeds were visually detected. Acoustic modeling indicates that pinnipeds would not be exposed to sound or energy from explosives associated with training activities during the Carrier Strike Group exercise, which would exceed the current impact thresholds.

Steller Sea Lion (Endangered Species Act-Listed Threatened Western Distinct Population Segment and the Recovered Eastern Distinct Population Segment)

Acoustic modeling predicts that Steller sea lions would not be exposed to sound or energy from explosions associated with training activities, which would exceed the current impact thresholds. The Western U.S. stock of Steller sea lions (also constituting the Western DPS) is listed as depleted under the MMPA and endangered under the ESA. Although acoustic modeling indicates any effects are discountable as being extremely unlikely to occur, the Western U.S. stock of Steller sea lions may be exposed to low levels of sound or energy from a training activity involving the use of explosives. Therefore, pursuant to the ESA, use of explosives during Navy training may affect and is not likely to adversely affect this species. The Eastern U.S. stock of Steller sea lions has recovered and been removed from the List of Endangered and Threatened Wildlife under the ESA. In the Alaska region, critical habitat has been designated for Steller sea lions in the Aleutian Islands and Western Alaska. There would be no impact to Critical Habitat designated for Steller sea lion since it does not occur within the Study Area.

3.8.3.3.10.4 Mustelid (Northern Sea Otters)

The sea otter may on rare occasion be present in the Study Area. Because it is unlikely that a sea otter would be in waters where depths exceed 35 m (115 ft.), it is extremely unlikely that sea otters would be present within the range to effects for training events using explosives (see Table 3.8-18). Acoustic modeling for sea otter was not undertaken given they are far from where activities involving in water explosives are proposed to occur, they inhabit complex shallow water environments where acoustic modeling is very imprecise and therefore not representative, and they spend little time underwater, thus very much limiting the potential for a sea otter to hear underwater sound in any case. Research indicates sea otters often remained undisturbed, quickly become tolerant of the various sounds and, even when purposefully harassed, they generally moved only a short distance (100–200 m) before resuming normal activity. The USFWS has determined that previous Department of Defense actions have not posed a threat to the San Nicolas Island (California) colony of southern sea otter and the average growth rate for the translocated colony has been higher than that for those inhabiting the central California coastline in recent years (U.S. Department of the Interior 2012a). Given these factors, long-term consequences for individuals or the population would not be expected.

3.8.3.3.10.5 Conclusion

Training activities under Alternative 2 include sound or energy from underwater explosions resulting from activities as described in Table 2.3-1 of Chapter 2 (Description of Proposed Action and Alternatives). These activities could result in inadvertent exposure of marine mammals in the Study Area to sound or energy from use of explosives.

Pursuant to the MMPA, the use of explosives during training activities under Alternative 2:

- *May expose Dall's porpoises up to 112 times annually to sound or pressure levels that would be considered Level B harassment, as defined by the MMPA*
- *May expose Dall's porpoises up to 3 times annually to sound or pressure levels that would be considered Level A harassment, as defined by the MMPA*
- *Would not result in serious injury or incidental mortality to any marine mammals*

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2:

- *May affect, and is not likely to adversely affect, North Pacific right whale, humpback whale, blue whale, fin whale, sei whale, Western North Pacific gray whale, sperm whale, and the Western stock of Steller sea lion, and the Southwest Alaska stock of Northern sea otter*
- *Would have no effect on North Pacific right whale, Steller sea lion, or Northern sea otter critical habitat*

3.8.4 Summary of Impacts (Combined Impacts of All Stressors) on Marine Mammals

This section discusses the potential for combined impacts of all stressors from the Proposed Action, including those presented in the 2011 EIS/OEIS, when considered with the new supplemental analysis of acoustic stressors (i.e., sonar and other active acoustic sources; explosives) presented in the sections above and summarized in Sections 3.8.6 (Marine Mammal Protection Act Determinations) and 3.8.7 (Endangered Species Act Determinations).

As presented in the introduction to Section 3.8.3 (Environmental Consequences), there are no changes to the proposed activities from those analyzed in the 2011 EIS/OEIS. The analysis in this supplemental document is based on (1) a revision of the criteria and thresholds for quantifying impacts to marine mammals, (2) a new modeling methodology, and (3) the findings from the latest scientific research and new data available since 2010 regarding marine mammals that may be present in the Study Area. These improvements since the Final EIS/OEIS have provided a more accurate quantification of the likely effects to marine mammals from the Proposed Action, and the resulting analysis of acoustic stressors indicates an approximate 90 percent reduction in the number of predicted effects from sonar and other active acoustic sources and an approximate 80 percent reduction in the number of predicted effects from the use of explosives compared to the conclusions of the 2011 Final EIS/OEIS.

Overall, there is a large reduction in the number of predicted acoustic stressor impacts and there is no change in activities from what was presented in the 2011 EIS/OEIS regarding other potential stressors under the current Proposed Action. In comparison to the analysis in the 2011 EIS/OEIS, it is therefore less likely that there would be any impacts from multiple stressors that would result in long-term consequences for individuals or populations of marine mammals.

Based on the 2011 EIS/OEIS Proposed Action, NMFS issued an MMPA LOA (National Oceanic and Atmospheric Administration 2011b) and a Biological Opinion pursuant to the ESA (National Oceanic and Atmospheric Administration 2011c, d). In the Biological Opinion, NMFS concluded that Navy activities in the Study Area are not likely to jeopardize the continued existence of threatened and endangered marine mammal species and that designated marine mammal critical habitat is not likely to be adversely affected. Given that the analysis in this Supplemental EIS/OEIS estimates fewer effects to ESA-listed marine mammals, it is the Navy's conclusion that these previous conclusions by NMFS pursuant to the MMPA and ESA are still valid.

3.8.5 Summary of Observations During Previous Navy Activities

The Navy and NMFS have long recognized the public interest and concern over the welfare of marine species in areas of the ocean where the Navy has been training and testing for decades. Since 2006, in an intensive effort to specifically address the concerns over potential impact of ongoing training and testing, the Navy, non-Navy marine mammal scientists, and research institutions in consultation with NMFS have conducted scientific monitoring and research in and around ocean areas in the Atlantic and Pacific oceans where the Navy has been and proposes to continue training and testing. Data collected from Navy monitoring, scientific research findings, and annual reports have been provided to NMFS[21] and may provide information relevant to the analysis of impacts to marine mammals for a variety of reasons, including data on species distribution, habitat use, and evaluating potential animal responses to Navy activities. Monitoring is performed using a variety of methods, including visual surveys from surface vessels and aircraft, as well as passive acoustics, satellite tagging, photo-identification, and biopsy sampling. Navy monitoring can generally be divided into two types of efforts: (1) collecting long-term data on distribution, abundance, and habitat use patterns within Navy activity areas; and (2) collecting data during individual training or testing activities. The Navy also contributes to funding of basic research, including behavioral response studies specifically designed to determine the effects to marine mammals from the Navy's main mid-frequency surface ship anti-submarine warfare active acoustic (sonar) system. These reports and associated peer-reviewed, published studies provide the current best data on observed marine mammal responses to Navy activities.

Worldwide, the majority of the training and testing activities Navy is proposing for the next 5 years are similar if not identical to activities that have been occurring in the same locations for decades. For example, the mid-frequency sonar system on the cruisers, destroyers, and frigates has the same sonar system components in the water as was first deployed in the 1970s. While the signal analysis and computing processes onboard these ships have been upgraded with modern technology, the power and output of the sonar transducer, which puts signals into the water, have not changed. For this reason, the history of past marine mammal observations, research, and monitoring reports remain applicable to the analysis of effects from the proposed future training and testing activities.

3.8.5.1 Alaska Specific Monitoring and Research

During the LOA development process for the 2011 EIS/OEIS, the Navy and NMFS agreed that monitoring in the Gulf of Alaska should focus on augmenting existing baseline data, since regional data on species occurrence and density are extremely limited. There have been four reports to date covering work in the Gulf of Alaska (U.S. Department of the Navy 2011c, 2011d, 2012, 2013f). Collecting baseline data was deemed a priority prior to focusing on exercise monitoring and behavioral response as is now being done in other Navy operating areas and ranges. There have been no previous dedicated monitoring efforts during Navy training activities in the TMAA with the exception of deployed HARPs. Research undertaken by the Navy in the Gulf of Alaska includes the following:

- Deployment (July 2011) of two long-term bottom-mounted passive acoustic monitoring buoys resulting in over 5,756 hours of passive acoustic data (Baumann-Pickering et al. 2012b, 2013; Debich et al. 2013; U.S. Department of the Navy 2013f)
- An additional passive acoustic monitoring buoy deployed (September 2012) at Pratt Seamount (U.S. Department of the Navy 2013f)

[21] Navy monitoring reports are available at the Navy website, www.navymarinespeciesmonitoring.us/, and also at the NMFS website, www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

- Two additional passive acoustic monitoring buoys deployed in June 2013 within the TMAA Study Area (U.S. Department of the Navy 2013f)
- Line transect survey (GOALS) conducted by NMFS in April 2009 (see Rone et al. 2010)
- An additional line-transect survey in the TMAA Study Area (GOALS II) in summer 2013 (Rone et al. 2013)

The final cruise report from the GOALS II survey was prepared in April 2014, and the following has been summarized from Rone et al. (2014). Overall, the GOALS II survey provided first time estimates of abundance and density for five species in the central Gulf of Alaska region. Satellite tags on a blue whale and a Baird's beaked whale provided the first movement and habitat use data for the region. Photographic identification data gathered will build upon the growing Pacific catalog. In total, the visual team surveyed 4,504 kilometers (km). Based on the total effort, there were 802 sightings (1,998 individuals) of 13 confirmed marine mammal species, with an additional 162 sightings (228 individuals) of unidentified cetaceans and pinnipeds. Passive acoustic monitoring was conducted continuously totaling approximately 456 hours of effort and resulting in 379 acoustic detections and 267 localizations of six confirmed cetacean species. There were also 186 passive sonobuoys deployed, which resulted in seven confirmed cetacean species acoustically detected. The GOALS II survey has provided one of the most comprehensive datasets on marine mammal occurrence, abundance, and distribution within the central Gulf of Alaska region (Rone et al. 2014).

The Navy is committed to structuring the Navy-sponsored research and monitoring program to address both NMFS' regulatory requirements as part of any MMPA authorizations while at the same time making significant contributions to the greater body of marine mammal science (see U.S. Department of the Navy 2013f).

In 2016, monitoring in the Gulf of Alaska will be a transitional year so that ongoing data collection from the Navy's current GOA rulemaking can be completed. Therefore, monitoring in 2016 may be a combination of previously funded Fiscal Year 2015 (FY-15) "carry-over" projects in the GOA study area, and new FY-16 project starts prioritized across all Navy at-sea training and testing ranges based on the Navy-wide strategic planning process. A more detailed description of the status of the Navy's planned projects of its monitoring program funded in 2016 will be updated through their Navy Marine Species Monitoring web portal at http://www.navymarinespeciesmonitoring.us/.

3.8.5.2 U.S. West Coast Baleen Whale Tagging

A Navy-funded effort in the Pacific Northwest is ongoing and involves attaching long-term satellite tracking tags to migrating gray whales off the coast of Oregon and northern California (U.S. Department of the Navy 2013e). This study is being conducted by the University of Oregon and has also included tagging of other large whale species such as humpback whales, fin whales, and killer whales when encountered. This effort is not programmed, affiliated, or managed as part of the GOA TMAA monitoring, and is a separate regional project, but has provided information on marine mammals and their movements that has application to the Gulf of Alaska.

In one effort between May 2010 and May 2013, satellite tracking tags were placed on 3 gray whales, 11 fin whales, 5 humpback whales, and 2 killer whales off the Washington coast (Schorr et al. 2013). One tag on an Eastern North Pacific Offshore stock killer whale in a pod encountered off Washington at Grays Harbor Canyon, remained attached and continued to transmit for approximately 3 months. In this period, the animal transited a distance of approximately 4,700 nm, which included time spent in the nearshore margins of the TMAA in the Gulf of Alaska where it would be considered part of the Offshore

stock (for stock designations, see Allen and Angliss 2014). In a second effort between 2012 and 2013, tags were attached to 11 Pacific Coast Feeding Group gray whales near Crescent City, California; in general, the tag-reported positions indicated these whales were moving southward at this time of year (Mate 2013a). The Navy's 2013 annual monitoring report for the Northwest Training and Testing Range contains the details of the findings from both research efforts described above (U.S. Department of the Navy 2013e). Finally, the Navy will be continuing a multi-year long-term satellite track tagging of blue and fin whales along the U.S. west coast. Tag attachment will occur in Southern California starting in the summer of 2014. However, with tag duration that can reach up to 350 days, information on potential movements of blue and fin whales along the west coast and potentially into the Gulf of Alaska could be obtained. Information on blue and fin whale movement and residency time while in the Gulf of Alaska will be reported in the Navy's annual monitoring reports.

3.8.5.3 Monitoring and Research at Other Pacific Navy Range Complexes

In the Pacific, the vast majority of scientific field work, research, and monitoring efforts have been expended in Southern California and Hawaii where the Navy has historically concentrated training and testing activities (see U.S. Department of the Navy 2013a, b). Between 2006 and 2013 across all Navy Range Complexes (in the Atlantic, Gulf of Mexico, and the Pacific), there have been over 80 reports (Major Exercise Reports, Annual Exercise Reports, and Annual Monitoring Reports; see Table 3.8-24) submitted to NMFS to further research goals aimed at understanding Navy's impact on the environment as it carries out its mission to train and test. In addition to this multi-year record of reports from across the Navy, there has also been ongoing behavioral response research efforts (in Southern California and the Bahamas) specifically focused on determining the potential effects from Navy mid-frequency sonar (De Ruiter et al. 2013a, Goldbogen et al. 2013, Tyack et al. 2011). This multi-year compendium of monitoring, observation, study, and broad scientific research is informative with regard to assessing the effects of Navy training and testing in general. Given this record involves the same Navy training and testing activities being considered for the TMAA and includes all the marine mammal taxonomic families present and many of the same species as those expected within the TMAA, this broad record covering Navy activities elsewhere is applicable to assessing locations such as the TMAA.

For example, in the Hawaii and Southern California Navy training and testing ranges from 2008 to 2012, Navy-funded marine mammal monitoring research completed over 5,000 hours of visual survey effort covering over 76,400 nm, sighted 338,875 individual marine mammals, took more than 64,600 digital photos and 45 hours of digital video, attached 74 satellite tracking tags to individual marine mammals, and collected over 45,000 hours of passive acoustic recordings. In Hawaii alone between 2006 and 2012, there were 21 scientific marine mammal surveys conducted before, during, or after major exercises.

The Navy has continued to review emergent science and fund research to better assess the potential impacts that may result from the continuation of ongoing training and testing in the historically used range complexes worldwide. Along with behavioral response studies and the results of research efforts and monitoring before, during, and after training and testing events across the Navy since 2006, the Navy's assessment is that it is unlikely there will be impacts to populations of marine mammals (such as whales, dolphins, and porpoise) having any long-term consequences as a result of the proposed continuation of training in the ocean areas historically used by the Navy including the TMAA.

Table 3.8-24: Navy Exercise and Monitoring Report Submissions for the Pacific from 2011 through 1 December 2013

Year Submitted	Range	Document
2011	SOCAL Range Complex and Hawaii Range Complex	Annual Range Complex Exercise Report, Aug 2010–Aug 2011
		Marine Mammal Monitoring, 2011 Annual Report
	Mariana Islands Range Complex	Annual Range Complex Exercise Report, Aug 2010–Feb 2011
		Marine Species Monitoring, Annual Report
	Keyport Range Complex	Annual Range Complex Exercise Report, Year 1, Apr 2011–Sept 2011
		Annual Range Complex Monitoring Report, Year 1, Apr 2011–Nov 2011
	Northwest Training Range Complex	Annual Range Complex Exercise Report, Year 1, Nov 2010–May 2011
		Annual Range Complex Monitoring Report, Year 1, Nov 2010 –May 2011
	Gulf of Alaska	Annual Monitoring Report, 2011, Year 1
		Annual Exercise Report, 17 May 2011–31 Oct 2011
2012	SOCAL Range Complex and Hawaii Range Complex	Annual Range Complex Exercise Report, 2 Aug 2011–1 Aug 2012
		Marine Species Monitoring, 2012 Annual Report
	Mariana Islands Range Complex	Marine Species Monitoring, 2012
		Annual Range Complex Exercise Report, 16 Feb 2011–15 Feb 2012
	Keyport Range Complex	Annual Range Complex Exercise Report, Year 2
		Annual Range Complex Monitoring Report, Year 2
	Northwest Training Range Complex	Annual Range Complex Unclassified Exercise Report, Year 2
		Annual Range Complex Monitoring Report
		Environmental Monitoring Report, EOD/UNDET
	Gulf of Alaska	Annual Monitoring Report, 2012, Year 2
2013	SOCAL Range Complex	Comprehensive Exercise and Monitoring Report For the U.S. Navy's SOCAL Range Complex, 2009–2012
	Mariana Islands Range Complex	Annual Marine Species Monitoring Report, Year 4
	Keyport Range Complex	Annual Range Complex Exercise Report, Year 3
		Annual Range Complex Monitoring Report, Year 3
	Northwest Training Range Complex	Annual Range Complex Unclassified Exercise Report, Year 3
		Marine Species Monitoring, 2013 Annual Report
	Hawaii Range Complex	Comprehensive Exercise and Monitoring Report For the U.S. Navy's Hawaii Range Complex, 2009–2012
	Gulf of Alaska	Annual Monitoring Report, 2013, Year 3

Notes: (1) These reports are publically available at the Navy website (www.navymarinespeciesmonitoring.us/) and from the NMFS Office of Protected Resources website (www.nmfs.noaa.gov/pr/permits/incidental.htm#applications). (2) EOD = Explosive Ordnance Disposal, Navy = United States Department of the Navy, UNDET = Underwater Detonation, U.S. = United States

This assessment of likelihood is based on four indicators from areas in the Pacific where Navy training and testing has been ongoing for decades: (1) evidence suggesting or documenting increases in the numbers of marine mammals present, (2) examples of documented presence and site fidelity of species and long-term residence by individual animals of some species, (3) use of training and testing areas for breeding and nursing activities, and (4) 6 years of comprehensive monitoring data indicating a lack of any observable effects to marine mammal populations as a result of Navy training and testing activities.[22] While there is evidence that shows increases and/or viability of marine mammal populations there is no direct evidence from years of monitoring on Navy ranges (since 2006) that indicate any long-

[22] Monitoring of Navy activities began in July 2006 as a requirement under issuance of an Incidental Harassment Authorization by NMFS for the Rim of the Pacific exercise and has continued to the present for Major Training Events in Hawaii, Southern California, and the Mariana Islands as well as other monitoring as part of the coordinated efforts under the Navy's Integrated Comprehensive Monitoring Plan developed in coordination with NMFS and other interested parties.

term consequences to marine mammal populations as a result of ongoing training and testing. Barring any evidence to the contrary, therefore, what limited and preliminary evidence there is from the Navy's 80+ reports and other focused scientific investigations should be considered. This is especially the case given the seemingly widespread public misperception that Navy training and testing, especially involving use of mid-frequency sonar, will cause large numbers of marine mammals to be injured or die. Examples to the contrary where the Navy has conducted training and testing activities for decades can be found throughout the literature.

Work by Moore and Barlow (2011) indicates that since 1991, there is strong evidence of increasing fin whale abundance in the California Current area, which includes the SOCAL Range Complex. They predict continued increases in fin whale numbers over the next decade, and that perhaps fin whale densities are reaching "current ecosystem limits." Research by Falcone and Shorr (2012) suggests that fin whales may have population sub-units with higher-than-expected residency to the Southern California Bight, which includes part of the Navy's SOCAL Range Complex. Similar findings have also documented the seasonal range expansion and increasing presence of Bryde's whales south of Point Conception in Southern California (Kerosky et al. 2012, Smultea and Jefferson 2014). Findings from Smultea and Jefferson (2014) for these same waters off Southern California, including the SOCAL Range Complex, appear to show that since the 1950s, humpback whales and Risso's dolphins have increased in relative occurrence while common bottlenose and northern right whale dolphins; Dall's porpoise; and gray whales, killer whales, minke whales, Cuvier's beaked whales, and sperm whales do not appear to have changed. There is possible indication of recent decreased relative occurrence of the Pacific white-sided dolphin, and short-finned pilot whales have not been recorded in the area since the 1990s, concurrent with the observed relative increase in Risso's dolphins (Smultea and Jefferson 2014).

For humpback whales that winter in the Hawaiian Islands, research has confirmed that the overall humpback whale population in the North Pacific has continued to increase and is now greater than some prior estimates of pre-whaling abundance (Barlow et al. 2011). The Hawaiian Islands, the location of the Hawaii Range Complex for decades, continue to function as a critical breeding, calving, and nursing area for this endangered species (National Marine Fisheries Service [2013] has recently proposed humpbacks in the North Pacific be delisted due to their recovery). In a similar manner, the beaches and shallow water areas within the PMRF at Kauai (in the main Hawaiian Islands) continue to be an important haulout and nursing area for endangered Hawaiian monk seals. While there has been a decline in the population of Hawaiian monk seals in the northwestern Hawaiian Islands, in the main Hawaiian Islands the numbers have continued to increase (Littnan 2011); the main Hawaiian Islands is where the Navy trains and tests. In similar findings from Hood Canal, Washington, where Navy training and testing activities have been occurring for decades, surveys of harbor seals show a fairly stable population after years of recovery, suggesting the area's carrying capacity may have been reached (Jeffries et al. 2003) in that location. At the Navy-managed San Nicolas Island, the southern sea otters residing there tend to be larger and heavier than those along the coast, and on average the population has been increasing at approximately 9 percent annually from the early 1990s to the mid-2000s and approximately 7.6 percent in the last 5 years (2008–2013), an increase that has not been matched by sea otter along the central California coastline (U.S. Fish and Wildlife Service 2014). The USFWS has determined that previous Department of Defense actions have not posed a threat to that colony of southern sea otter (U.S. Fish and Wildlife Service 2011).

As increases in population would seem to indicate, evidence for the presence and/or residence of marine mammal individuals and populations would also seem to suggest a lack of long-term or detrimental effects from Navy training and testing historically occurring in the same locations. The

intensively used instrumented range at the PMRF remains the likely foraging area (given its proximity) for a resident pod of spinner dolphins that was the focus for part of the monitoring effort during the 2006 Rim of the Pacific Exercise. More recently at the PMRF, Martin and Kok (2011) reported on the presence of minke whales, humpback whales, beaked whales, pilot whales, and sperm whales on or near the range during a Submarine Commander Course involving three surface ships and a submarine using mid-frequency sonar over the span of the multiple-day event. The analysis showed it was possible to evaluate the behavioral response of a localized minke whale and found there did not appear to be a significant reaction by the minke whale to the mid-frequency sonar transmissions (although overall minke calling rates were reduced during the training event). In subsequent analysis of the data set, Manzano-Roth et al. (2013) determined that beaked whales (tentatively identified as Blainville's beaked whales) continued to make foraging dives at estimated distances of 13 to 52 km from active mid-frequency sonar, but that the animals shifted to the southern edge of the range with differences in the dive vocal period duration and dive rate.

In Southern California, based on a series of surveys from 2006 to 2008 and the high number encounter rate, Falcone et al. (2009) proposed that their observations suggested the ocean basin west of San Clemente Island may be an important region for Cuvier's beaked whales. For over three decades, this ocean area west of San Clemente has been the location of the Navy's instrumented training range and is one of the most intensively used training and testing areas in the Pacific, given the proximity to the Naval installations in San Diego. Data from visual surveys documenting the presence of Cuvier's beaked whales for the ocean basin west of San Clemente Island (Falcone et al. 2009; Falcone and Schorr 2012, 2013, 2014; Smultea and Jefferson 2014) are consistent with concurrent results from passive acoustic monitoring that estimated regional Cuvier's beaked whale densities were higher than indicated by the NMFS's broad scale visual surveys for the U.S. west coast (Hildebrand and McDonald 2009). Photo identification methods in the SOCAL Range Complex have identified approximately 100 individual Cuvier's beaked whales, with 40 percent having been seen in one or more prior years, with re-sightings up to 7 years apart(Falcone and Schorr 2014). The Navy's use of the SOCAL Range Complex has not precluded beaked whales from continuing to inhabit the area, nor has there been documented declines or beaked whale mortalities in the area associated with Navy training and testing activities. The long-term presence of beaked whales at the Navy range off Southern California is consistent with that for a similar Navy instrumented range (AUTEC) located off Andros Island in the Bahamas where Blainville's beaked whales (*Mesoplodon densirostris*) are routinely acoustically detected (see McCarthy et al. 2011, Tyack et al. 2011).

Moore and Barlow (2013) have noted a decline in beaked whales over a broad area of the Pacific Ocean (the California Current Large Marine Ecosystem) out to 300 nm from the coast and extending from the Canadian-U.S. border to the tip of Baja Mexico and suggested that anthropogenic sound (including sonar) cannot be ruled out as a possible contributing cause in that decline (Moore and Barlow 2013). There are scientific caveats and limitations to the data used for that analysis, as well as oceanographic and species assemblage changes on the U.S. west coast not thoroughly addressed in Moore and Barlow (2013). Interestingly however, and as noted by Moore and Barlow (2013), in the small portion of that area overlapping the Navy's SOCAL Range Complex, long-term residency by individual Cuvier's beaked whales and higher densities provide indications that the proposed decline of beaked whales off the U.S. west coast is not apparent where the Navy has been intensively training and testing with sonar and other systems for decades. The long-term presence of beaked whales at the Navy range off Southern California is consistent with that for a similar Navy instrumented range (the Atlantic Undersea Test and Evaluation Center) located off Andros Island in the Bahamas where Blainville's beaked whales (*Mesoplodon densirostris*) are routinely acoustically detected (see Tyack et al 2011; McCarthy et al.

2011). Navy funding for monitoring of beaked whale and other marine species (involving visual survey, passive acoustic recording, and tagging studies) will continue in Southern California and elsewhere to develop additional data toward a clearer understanding of marine mammals inhabiting the Navy's range complexes. As noted previously (Falcone and Schorr 2012, 2014; Falcone et al. 2009; Hildebrand and McDonald 2009; Smultea and Jefferson 2014), in the small portion of the California Current Large Marine Ecosystem overlapping the Navy's SOCAL Range Complex, seemingly stable populations, long-term residency by individual Cuvier's beaked whales, and higher densities provide indications that the proposed decline noted elsewhere is not apparent where the Navy has been intensively training and testing with sonar and other systems for decades. Navy funding for monitoring of beaked whale and other marine species (involving visual survey, passive acoustic recording, and tagging studies) will continue in Southern California to develop additional data toward a clearer understanding of marine mammals inhabiting the Navy's range complexes.

To summarize, while the evidence covers most marine mammal taxonomic suborders, it is limited to a few species and only suggestive of the general viability of those species in intensively used Navy training and testing areas. There is no direct evidence that routine Navy training and testing spanning decades has negatively impacted marine mammal populations at any Navy Range Complex. Although there have been a few strandings associated with use of sonar in other locations, as Ketten (2012) has recently summarized, "to date, there has been no demonstrable evidence of acute, traumatic, disruptive, or profound auditory damage in any marine mammal as the result of anthropogenic noise exposures, including sonar." Therefore, based on the best available science (Barlow et al. 2011; Falcone and Schorr 2012, 2014; Falcone et al. 2009; Jeffries et al. 2003; Littnan 2011; Manzano-Roth et al. (2013); Martin and Kok 2011; McCarthy et al. 2011; McSweeney et al. 2007, 2009; Moore and Barlow 2011; Southall 2012; Tyack et al. 2011; Southall et al. 2012; Smultea and Jefferson 2014), including data developed in the series of 80+ reports submitted to NMFS, the Navy believes that long-term consequences for individuals or populations are unlikely to result from Navy training and testing activities in the TMAA.

To reiterate, while the evidence is limited to a few species and only suggestive of the general viability of those species, there is no direct evidence that routine Navy training and testing spanning decades in the Pacific at the SOCAL Range Complex and the Hawaii Range Complex has negatively impacted those species. It is assumed that these findings from Pacific locations where training activities have been occurring for years and involving many of the same marine mammal species are applicable to an assessment of likely impacts in the GOA TMAA. Therefore, based on the best available science (Barlow et al. 2011; Carretta et al. 2009; Falcone and Schorr 2012, 2014; Falcone et al. 2009; Hildebrand and McDonald 2009; Jeffries et al. 2003; Littnan 2011; Martin and Kok 2011; Manzano-Roth et al. 2014; McCarthy et al. 2011; McSweeney et al. 2007, 2009; Moore and Barlow 2011; Southall et al. 2012), the Navy believes that long-term consequences for individuals or populations in the GOA TMAA are unlikely to result from training activities.

Until an incident in March 2011, there were no known incidents or records of any explosives training activity involving injury to a marine mammal. At the SSTC at Coronado, California, on average per year there are approximately 415 in-water detonations occurring during an estimated 311 training events at that location. Despite the Navy's excellent decades-long track record, on 4 March 2011, it is clear that an underwater demolition training event resulted in the known mortalities to four[23] long-beaked common

[23] Immediately after the detonation at the Silver Strand Training Complex (Coronado, California), Navy personnel found and recovered three dead long-beaked common dolphin;, they reported the incident to the Navy chain of command, who informed NMFS, and Navy then transferred the recovered animals to the local stranding network for necropsy. Three days later, a long–beaked common dolphin was discovered at Oceanside, California (approximately 40 mi. [65 km] up the coast) and another was

dolphins. Range clearance procedures had been implemented, and there were no marine mammals in the area when the timed-fuse countdown to detonation began. Personnel moved back from the site, and just before the detonation was to occur, dolphins were observed moving into the clearance zone. Due to the danger to personnel, the Navy could not attempt to divert those animals, stop the timer, or disarm the explosive. As a result of this incident, in consultation with NMFS, the Navy modified the mitigation measures in existence when this incident occurred to prevent a reoccurrence (see Chapter 5 regarding Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices). There are no underwater demolition training events or use of timed-fuses associated with underwater demolition proposed for the Study Area or as part of the Carrier Strike Group exercise or Sinking Exercise.

Although potential impacts to Dall's porpoises from the Proposed Action may include injury (but not "serious injury"[24]), these impacts are not expected to decrease the overall fitness of the Dall's porpoise population in the Study Area. There are no mortalities predicted by the acoustic modeling and none are expected. In cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

3.8.6 Marine Mammal Protection Act Determinations

Pursuant to the MMPA, the Navy is seeking a 5-year LOA from the NMFS for stressors associated with training activities involving the use of sonar and other active acoustic sources and explosives as described in Chapter 2. The use of sonar, other active sources, and explosives may result in Level A harassment and Level B harassment of certain marine mammals.

3.8.7 Endangered Species Act Determinations

The NMFS administers the ESA for marine mammals in the Study Area. The guidelines followed to make a determination of no effect; may affect, not likely to adversely affect; or may affect, likely to adversely affect can be found in the *ESA Consultation Handbook* (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

In accordance with ESA requirements, the Navy has undertaken Section 7 consultation with NMFS for the ongoing activities in the TMAA as described in Chapter 2. A summary of the Navy's findings are provided in Table 3.8-25, which has the determinations made for each acoustic substressor (sonar and other active acoustic sources and explosives) and ESA-listed marine mammal species pursuant to the ESA from the analysis presented previously. There is no designated critical habitat located within the Study Area so for all substressors, training activities would have no effect on any critical habitat.

discovered 10 days after the training event at La Jolla, California (approximately 15 mi. [45 km] from the training site). Due to the species being one which commonly strands and the number of days and distance from the event, the association of this last stranded animals with the event is not certain (see Danil and St. Leger 2011).

[24] None of the annual six (total) predicted injuries to Dall's porpoise under Alternative 2 would be considered by NMFS to be "serious injury" under the MMPA regulatory definition. For details regarding the regulatory definition of serious injury, see 50 Code of Federal Regulations 229.2 and the NMFS website at [http://www.nmfs.noaa.gov/op/pds/documents/02/238/02-238-01.pdf].

Table 3.8-25: Endangered Species Act Effects Determinations for Acoustic Stressors

Species	Acoustic Stressor	
	Sonar and Other Active Acoustic Sources	Explosives
North Pacific Right Whale	May affect, likely to adversely affect	May affect, likely to adversely affect
Humpback Whale	May affect, likely to adversely affect	May affect, not likely to adversely affect
Sei Whale	May affect, likely to adversely affect	May affect, not likely to adversely affect
Fin Whale	May affect, likely to adversely affect	May affect, not likely to adversely affect
Blue Whale	May affect, likely to adversely affect	May affect, not likely to adversely affect
Gray Whale, Western North Pacific Stock	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Sperm Whale	May affect, likely to adversely affect	May affect, not likely to adversely affect
Steller Sea Lion, Western Stock	May affect, likely to adversely affect	May affect, not likely to adversely affect
Northern Sea Otter, Southwest Alaska Stock	May affect, not likely to adversely affect	May affect, not likely to adversely affect

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3.9 Birds

TABLE OF CONTENTS

3.9 BIRDS 3.9-1
3.9.1 AFFECTED ENVIRONMENT 3.9-1
3.9.1.1 Existing Conditions 3.9-1
3.9.1.2 Current Requirements and Practices 3.9-4
3.9.2 ALTERNATIVES ANALYSIS 3.9-4
3.9.3 CONCLUSION 3.9-4

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.9 BIRDS

3.9.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for birds remains the same as that identified in the March 2011 Gulf of Alaska (GOA) Navy Training Activities Final EIS/OEIS, which is the Temporary Maritime Activities Area (TMAA) (the Study Area). Similar to the Final EIS/OEIS, this section provides an overview of the species, distribution, and occurrence of birds that are either resident or migratory through the ROI.

3.9.1.1 Existing Conditions

The nearest shoreline (Kenai Peninsula) is located approximately 24 nautical miles (nm) north of the TMAA's northern boundary. The approximate middle of the TMAA is located 140 nm offshore. Given that the TMAA is more than 12 nm from the closest point of land, it is therefore outside the United States (U.S.) territorial seas.

As presented in the 2011 GOA Final EIS/OEIS, the habitat found within the Study Area supports a wide diversity of resident and migratory seabirds and waterfowl. Since the TMAA occurs mostly over the outer shelf slope and deeper ocean waters, this area is dominated by species that utilize the region seasonally and are not land-based outside the nesting season. Birds that are year-round residents or that migrate from northern waters frozen over in the winter use the protected embayments of Kodiak Island and the mainland shoreline to avoid harsh winter storms.

Descriptions of the ROI ecosystem, climate, productivity, and oceanographic conditions were presented in the 2011 GOA Final EIS/OEIS. The ROI continues to be one of the world's most productive ocean regions, and the habitats associated with these cold and turbulent waters contain identifiable collections of microhabitats that sustain resident and migratory species of birds. The waters of the ROI provide nutrient-rich offshore areas for seabirds that rely on upwelling zones and shelf currents to transport prey to the surface. This Supplemental EIS/OEIS addresses the same activities within the TMAA as did the 2011 GOA Final EIS/OEIS. As such, the general description in the 2011 GOA Final EIS/OEIS of the existing conditions within the TMAA remains valid.

The 2011 GOA Final EIS/OEIS lists the bird species known to occur or breed in the coastal zones within the Gulf of Alaska. The information regarding the species presence or absence in the study area has not changed since the publication of the 2011 GOA Final EIS/OEIS. As such, the species list presented in the Final EIS/OEIS remains valid. Four of these species are protected under the authority of the Endangered Species Act (ESA); two are federally listed as endangered (short-tailed albatross [*Phoebastria albatrus*] and the eskimo curlew [*Numenius borealis*]), and two are federally listed as threatened (Steller's eider [*Polysticta stelleri*] and spectacled eider [*Somateria fischeri*]). Additionally, the yellow-billed loon (*Gavia adamsii*) is listed as a candidate species.

As presented in the 2011 GOA Final EIS/OEIS, based loosely on their geographic distribution and feeding habits, birds observed in the Study Area are divided into two groups: seabirds and waterfowl. Seabirds, such as alcids, shearwaters, and gulls, typically feed in open waters ranging from the shoreline and estuaries to the open ocean. Waterfowl, such as ducks and geese, are typically found near shore on the open coast and in estuaries, but some also use inland freshwater habitats. In general, seabird activity is most concentrated along the GOA coastline, while waterfowl are found primarily in the bays and shallow waters.

3.9.1.1.1 Seabirds

The seabird colonies off the coast of Alaska are among the largest in population in the continental United States. As presented in the 2011 GOA Final EIS/OEIS, seabirds known to occur within the ROI include those that are pelagic (generally foraging far offshore over the continental shelf and in oceanic waters) and those that feed in nearshore zones, but can transit the TMAA. Pelagic species include albatross, petrels, shearwaters, jaegers, skuas, gulls, terns, and alcids. Nearshore seabirds feed within sight of land and include species such as loons, grebes, brown pelicans, gulls, cormorants, murres, and phalaropes. The general information regarding representative species presence, utilization, and distribution throughout the ROI presented in the 2011 GOA Final EIS/OEIS remains valid.

The following ESA-listed and ESA-candidate species seabirds are known to occur in the Gulf of Alaska.

3.9.1.1.1.1 Short-Tailed Albatross

As presented in the 2011 GOA Final EIS/OEIS, the short-tailed albatross (*Phoebastria albatrus*) was listed as endangered throughout its range under the ESA in 2000 (65 Federal Register [FR] 46643). There is no designated critical habitat under ESA for the short-tailed albatross. Since the publication of the 2011 GOA Final EIS/OEIS, the status of the short-tailed albatross has not changed, although the current worldwide population estimate is approximately 3,000 birds (as compared to the 1,200 birds reported in the 2011 GOA Final EIS/OEIS) and is increasing at a rate of 5–8 percent per year (U.S. Fish and Wildlife Service 2012a).

The human-induced threats to the short-tailed albatross are described in the 2011 GOA Final EIS/OEIS. Following a review of recent literature (JSTOR, Web of Science, Google Scholar, EBSCO Academic, and U.S. Fish and Wildlife Service [USFWS] websites), these threats (hooking and drowning on commercial long-line gear, entanglement in derelict fishing gear, ingestion of plastic debris, contamination from oil spills, and potential predation by introduced mammals on breeding islands) have remained persistent since the publication of the 2011 GOA Final EIS/OEIS.

The life history of short-tailed albatrosses (lifespan, nesting, foraging, distribution, and presence in the Study Area) was also described in the 2011 GOA Final EIS/OEIS and has not changed since the publication of the 2011 GOA Final EIS/OEIS.

As such, the description in the 2011 GOA Final EIS/OEIS of the short-tailed albatross has not changed appreciably, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS.

3.9.1.1.2 Waterfowl

The general description, preferred habitats, and distribution of waterfowl throughout the Study Area were described in the 2011 GOA Final EIS/OEIS. Waterfowl spend most of their lifecycle on the water, typically breeding in freshwater habitats, and many species move to shoreline or nearshore habitats when breeding is complete. The usage of the ROI by these species has not changed since the publication of the 2011 GOA Final EIS/OEIS. As such, the general discussion in the 2011 GOA Final EIS/OEIS of representative species presence, utilization, and distribution within the ROI remains valid.

The following ESA-listed waterfowl species are known to occur in the Study Area.

3.9.1.1.2.1 Steller's Eider

The Alaska breeding population of Steller's eiders (*Polysticta stelleri*) was listed as threatened under the ESA in 1997 (62 FR 31748). Steller's eiders are not expected to occur in the Study Area, and there is no critical habitat or foraging areas in or within the vicinity of the TMAA. Since the publication of the 2011 GOA Final EIS/OEIS, the listing status of the Steller's eider has not been revised, and the population distribution and seasonal variation of the Steller's eider has not changed from those described in the 2011 GOA Final EIS/OEIS.

During the months of April to October, when training activities are planned to occur, Steller's eiders can be found in nearshore areas, and in particular protected lagoons with tidal flats located hundreds of miles to the northwest and west of the ROI. During the winter, the distribution of Steller's eiders includes the nearshore areas around Kodiak Island, Cook Inlet, the southern side of the Alaska Peninsula, and the eastern Aleutian Islands. As stated in the 2011 GOA Final EIS/OEIS, there are no naval activities in the TMAA during the winter, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS. Therefore, the statement indicating that Steller's eiders are not likely to be present in the Study Area or be affected by any of the proposed activities remains valid. For this reason, the Steller's eider will not be carried forward for analysis in this Supplemental EIS/OEIS.

3.9.1.1.2.2 Spectacled Eider

The spectacled eider (*Somateria fischeri*) was designated as threatened throughout its range in May 1993 (58 FR 27474). Critical habitat for the spectacled eider was designated in 2001 (66 FR 9146). However, none of the critical habitat designation overlaps with the TMAA.

Spectacled eiders are not expected to occur in the Study Area during the time period of training activities. Three primary nesting areas are known for the spectacled eider: the central coast of the Yukon-Kuskokwim Delta, the arctic coastal plain of Alaska, and the arctic coastal plain of Russia. Important late summer and fall molting areas have been identified in eastern Norton Sound and Ledyard Bay in Alaska, and in Mechigmenskiy Bay and an area offshore between the Kolyma and Indigirka River Deltas in Russia. Wintering flocks of spectacled eiders have been observed in openings in sea ice in the Bering Sea between St. Lawrence and St. Matthew Islands (U.S. Fish and Wildlife Service 2012b).

As there are no naval activities in the TMAA during the winter, and there is no new information or circumstances that would alter analysis of the 2011 GOA Final EIS/OEIS, spectacled eiders are not likely to be affected by any of the proposed activities. For this reason, the spectacled eider will not be carried forward for analysis in this Supplemental EIS/OEIS.

3.9.1.1.2.3 Yellow-Billed Loon

The yellow-billed loon (*Gavia adamsii*) was designated a candidate species throughout its range in March 2009 (74 FR 12932). There is no critical habitat designated for the yellow-billed loon.

Yellow-billed loons are not expected to occur in the Study Area during the time period of training activities. During the months of April to October, when training activities are planned to occur, yellow-billed loons can be found near freshwater lakes in the Arctic tundra located hundreds of miles to the north of the ROI. During the winter, the distribution of yellow-billed loons includes the coastal waters of southern Alaska from the Aleutian Islands to Puget Sound (U.S. Fish and Wildlife Service 2002). As there are no naval activities in the TMAA during the winter, yellow-billed loons are not likely to be affected by any of the proposed activities. For this reason, the yellow-billed loon will not be carried forward for analysis in this Supplemental EIS/OEIS.

3.9.1.1.2.4 Eskimo Curlew

The Eskimo curlew (*Numenius borealis*) was designated as an endangered species throughout its range in March 1967 (32 FR 4001). There is no critical habitat designated for the Eskimo curlew. It is highly possible that the species is extinct as the last confirmed observation took place in Nebraska in 1987 (76 FR 36491). For this reason, the Eskimo curlew will not be carried forward for analysis in this Supplemental EIS/OEIS.

3.9.1.1.3 Hearing Capabilities of Birds

As presented in the 2011 GOA Final EIS/OEIS, research suggests an in-air maximum auditory sensitivity between 1 and 5 kilohertz (kHz) for most bird species. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kHz (Beason 2004). Very few can hear below 20 Hertz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 20 kHz (Dooling et al. 2000). While birds, like humans, potentially can hear underwater, there continues to be little published literature of the hearing abilities of birds underwater. The additional information supplements and reinforces the information presented in the 2011 GOA Final EIS/OEIS, and there is no new information or circumstances that would alter the analysis of the 2011 GOA Final EIS/OEIS. As such, the additional description regarding hearing capabilities presented in the 2011 GOA Final EIS/OEIS remain valid.

3.9.1.2 Current Requirements and Practices

As presented in the 2011 GOA Final EIS/OEIS, standard operating procedures and best management practices implemented by the U.S. Department of the Navy (Navy) for resource protection would reduce potential effects to birds. Avoidance of birds and their nesting and roosting habitats provides the greatest degree of protection from potential impacts within the Study Area. These avoidance measures (measures to evaluate and reduce or eliminate bird/aircraft strike hazards to aircraft, aircrews, and birds that are implemented during operations in the TMAA) remain similar to those presented in the 2011 GOA Final EIS/OEIS. As such, the descriptions presented in the 2011 GOA Final EIS/OEIS remain valid.

3.9.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to birds, as well as a review of new literature, to include laws, regulations, and publications pertaining to birds. Although additional information relating to existing environmental conditions was found, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to birds is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.9.3 CONCLUSION

As described above, there is new information on existing environmental conditions with regard to birds. However, this new information does not change the affected environment, which forms the environmental baseline of the birds analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect birds in the TMAA. Therefore, conclusions for bird impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remains unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action

Alternative, Alternative 1, and Alternative 2 on birds under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.9-3 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

The take of an individual bird from the Proposed Action is allowed under the Migratory Bird Treaty Act provided it does not result in a significant adverse effect on a population of a migratory bird species. As presented in the 2011 GOA Final EIS/OEIS, the Proposed Action would not diminish the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem, nor would it adversely affect migratory bird populations. Because the Proposed Action has not changed and there is no new information that would change the analysis conducted in support of the 2011 GOA Final EIS/OEIS, the Navy is not required to confer with the USFWS on the development and implementation of conservation measures to minimize or mitigate adverse effects to migratory birds that are not listed under the ESA.

In accordance with Section 7 of the ESA (50 Code of Federal Regulation [C.F.R.] §402), during the preparation of the 2011 Final EIS/OEIS the Navy prepared a biological evaluation and submitted it to the USFWS. The Navy received a concurrence letter from USFWS (March 2010), which agreed that the Navy's actions may affect, but were unlikely to adversely affect, the short-tailed albatross. As provided in 50 C.F.R. §402.16, re-initiation of formal consultation is normally required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

Previous analysis for ESA-listed bird species remains unchanged in this Supplemental EIS/OEIS. The Navy evaluated listed species potentially affected by Navy training activities in the TMAA covered by the 2011 GOA Final EIS/OEIS. The criteria for re-initiation of consultation with USFWS for listed bird species, as set forth in 50 C.F.R. §402.16, are not triggered. Specifically, there has not been an exceedance of incidental take for listed birds; there is no new information that reveals new effects to listed bird species that were not previously considered; Navy training activities in the TMAA are not being substantially modified in a manner that would cause effect to listed bird species that was not previously considered; and there has not been a new species of bird listed within the TMAA.

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3.10 Cultural Resources

TABLE OF CONTENTS

3.10 CULTURAL RESOURCES 3.10-1
3.10.1 AFFECTED ENVIRONMENT 3.10-1
3.10.1.1 Existing Conditions 3.10-1
3.10.1.2 Current Requirements and Practices 3.10-1
3.10.2 ALTERNATIVES ANALYSIS 3.10-1
3.10.3 CONCLUSION 3.10-1

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

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3.10 CULTURAL RESOURCES

3.10.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for cultural resources remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.10.1.1 Existing Conditions

As presented in the 2011 GOA Final EIS/OEIS, the focus of cultural resources is on submerged resources, which are sites that may, or may not, have cultural affiliation. Submerged resources in the Alaska Region may include prehistoric and/or historic coastal migration and settlement sites, shipwrecks, airplanes, or pieces of ship components, such as cannons or guns. Following a review of recent literature, including a review of the Bureau of Ocean Energy Management's list of shipwrecks in Alaska (Bureau of Ocean Energy Management 2011), no additional submerged cultural resources have been identified within the Study Area. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS is still valid.

3.10.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, the United States Department of the Navy (Navy) has established protective measures to reduce potential effects on cultural resources from training exercises in coastal waters and on land and sea ranges. Protective measures include using inert ordnance or avoiding known shipwreck sites. Precise locations for shipwrecks in the TMAA are not known. However, as stated in the 2011 GOA Final EIS/OEIS, should there be a shipwreck discovery, the Navy would cease the specific training that could potentially impact the resource until federal authorities (e.g., Navy Federal Preservation Officer, Alaska State Historic Preservation Officer) are notified and appropriate actions determined.

3.10.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to cultural resources, as well as a review of new literature, to include laws, regulations, and publications pertaining to cultural resources. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to cultural resources is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.10.3 CONCLUSION

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the cultural resources analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect cultural resources in the TMAA. Therefore, conclusions for cultural resources impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on cultural resources under both the National Environmental Protection

Act and Executive Order 12114, please refer to Table 3.10-3 (Summary of Effects by Alternative) on pages 3.10-10 and 3.10-11 of the 2011 GOA Final EIS/OEIS.

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3.11 Transportation and Circulation

TABLE OF CONTENTS

3.11 TRANSPORTATION AND CIRCULATION 3.11-1
3.11.1 AFFECTED ENVIRONMENT 3.11-1
3.11.1.1 Existing Conditions 3.11-1
3.11.1.2 Current Requirements and Practices 3.11-1
3.11.2 ALTERNATIVES ANALYSIS 3.11-1
3.11.3 CONCLUSION 3.11-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.11 TRANSPORTATION AND CIRCULATION

3.11.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for transportation and circulation remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.11.1.1 Existing Conditions

3.11.1.1.1 Air Traffic (Military, Commercial, and General Aviation)

Air traffic was discussed in the 2011 GOA Final EIS/OEIS. Following a review of recent literature and discussions with individuals from Alaska's Anchorage Air Route Traffic Control Center (ARTCC), air traffic activities, to include military aviation and commercial and general aviation within the ROI, have not appreciably changed since the 2011 GOA Final EIS/OEIS (Belisle 2013). Additionally, during the early planning phases before an exercise commences, the military and the local Federal Aviation Administration (FAA) officials (Anchorage ARTCC) work in close coordination to schedule and mitigate any potential conflicts to the commercial and general aviation communities. Furthermore, there are no new United States (U.S.) Department of the Navy (Navy) military aviation activities being proposed in this Supplemental EIS/OEIS. As such, the information and analysis regarding air traffic presented in the 2011 GOA Final EIS/OEIS is still valid.

3.11.1.1.2 Marine Traffic (Military and Civilian Vessel Traffic)

Marine traffic, to include both military and civilian vessel traffic, was discussed in the 2011 GOA Final EIS/OEIS. There are no new proposed military marine traffic activities in this Supplemental EIS/OEIS; as such, the discussion in the Final EIS/OEIS remains valid. Please refer to Section 3.12 (Socioeconomics), Section 3.12.1.1.1 (Commercial Shipping), and Section 3.12.1.1.3 (Tourism and Recreation) of this Supplemental EIS/OEIS for updated discussions of civilian vessel traffic and recreational vessel traffic. In sum, there has been no appreciable change to military and civilian vessel traffic in the Study Area since the 2011 GOA Final EIS/OEIS.

3.11.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, the Navy's scheduled activities are published for access by all vessels and operators by use of Notices to Mariners issued by the U.S. Coast Guard (USCG) and Notices to Airmen issued by the FAA. Additionally, to ensure the broadest dissemination of information about hazards to commercial and recreational vessels within the region, the Navy provides schedule conflicts along with other USCG concerns at U.S. Department of Homeland Security Navigation Center, Local Notice to Mariners (http://www.navcen.uscg.gov/?pageName=lnmDistrict&region=17). As such, the information regarding current requirements and practices presented in the 2011 GOA Final EIS/OEIS is still valid.

3.11.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to transportation and circulation, as well as a review of new literature, to include laws, regulations, and publications pertaining to transportation and circulation. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing

conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to transportation and circulation is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.11.3 CONCLUSION

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the transportation and circulation analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect transportation and circulation in the TMAA. Therefore, conclusions for transportation and circulation impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on transportation and circulation under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.11-1 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

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3.12 Socioeconomics

TABLE OF CONTENTS

3.12 SOCIOECONOMICS.....3.12-1
3.12.1 AFFECTED ENVIRONMENT.....3.12-1
3.12.1.1 Existing Conditions.....3.12-1
3.12.1.2 Current Requirements and Practices.....3.12-2
3.12.2 ALTERNATIVES ANALYSIS.....3.12-2
3.12.3 CONCLUSION.....3.12-3

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

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3.12 SOCIOECONOMICS

3.12.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for socioeconomics remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.12.1.1 Existing Conditions

Socioeconomics concerns remain the same as those issues previously identified in the 2011 GOA Final EIS/OEIS. Further, the United States (U.S.) Department of the Navy's (Navy's) operating procedures to prevent or lessen impacts on the local socioeconomic community—as described in the 2011 GOA Final EIS/OEIS—remain applicable in this Supplemental EIS/OEIS.

As discussed in the 2011 GOA Final EIS/OEIS, military, commercial, institutional, and recreational activities take place in the TMAA; there are no continuously restricted zones in this area. However, as noted in the 2013 Special Local Notice to Mariners (NTMs), Navy operating areas are in "use on a continuing basis by Navy ships and aircraft," and because of the "frequency and variety of exercises conducted in the [operating areas] and the difficulty in scheduling them far in advance due to uncertainties of weather, it is not possible to issue individual NTM each time an exercise is scheduled" (U.S. Coast Guard 2013). The U.S. Coast Guard (USCG) does utilize a broadcast NTM system, which is used to let mariners, pilots, fisherman and other commercial users of the area know when Navy training is scheduled or occurring.

Section 3.14 (Public Safety) of this Supplemental EIS/OEIS has a discussion of the availability of the TMAA to civilian vessels and safety procedures for the areas of cooperative use between the Navy and the public. This section will focus on commercial shipping, commercial fishing, and recreation and tourism.

3.12.1.1.1 Commercial Shipping

As discussed in the 2011 GOA Final EIS/OEIS, the Study Area is traversed by large and small marine vessels, with several commercial ports occurring near the TMAA. Two of these ports were ranked in the top 150 U.S. ports by tonnage in 2011, Anchorage (90th) and Valdez (25th) (U.S. Army Corps of Engineers 2011). Commercially used waterways are controlled by the use of directional shipping lanes for large vessels (cargo, container ships, and tankers). In 2011, the latest year in which summary statistics are available, there were over 3,423 commercial ship transits (both inbound and outbound) from the ports and harbors of Valdez, Anchorage, Homer, Seward, Kodiak, and Cordova (Waterborne Commerce Statistics Center 2011). Ships that travel from major ports to the lower 48 states and Hawaii, as well as marine traffic between coastal ports, enter the TMAA briefly; however, according to USCG District 17, Juneau, Alaska, no incidents have occurred between commercial shipping and Navy activities (Fields 2013). While the Navy does not publish a daily NTMs, USCG District 17, Juneau, Alaska communicates any active Navy training or testing activity to shipping vessels through a broadcast NTMs on VHF-FM Channel 16 and 22A (U.S. Coast Guard 2013).

3.12.1.1.2 Commercial Fishing

Commercial fishing was discussed in the 2011 GOA Final EIS/OEIS. Following a review of recent literature, as well as discussions with the Alaskan Ocean Observing System, Alaska Region of the National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the Anchorage office of the

Alaska Department of Fish and Game (ADFG), commercial fishing in the Study Area has not significantly changed since the Final EIS/OEIS. According to the Alaska Region of NOAA Fisheries, the region still produces about half the fish caught in U.S. waters.

Furthermore, while there has been less overall yearly catch (by poundage) of Tanner and Dungeness crab since 2007 (as described in the 2011 GOA Final EIS/OEIS), the percent of total crab catch in Alaska coming from the Study Area remains at 2 percent—the same as in 2007 (Alaska Department of Fish and Game 2010). According to the ADFG, the reason for similar percentages in catch between 2007 and now can be explained by the fact that 2007 was an unusually high year for almost all Alaska's fisheries, including those in the Study Area, and all fisheries have since seen catch levels return to normal levels. Other commercial catch numbers in the Study Area (specifically those for weathervane scallops) remain statistically the same as those percentages analyzed in the 2011 GOA Final EIS/OEIS.

3.12.1.1.3 Tourism and Recreation

Recreation and tourism was described and analyzed in the 2011 GOA Final EIS/OEIS. Recreation and tourist areas around the TMAA include the Kenai Peninsula, Kodiak Island, Prince William Sound, and Resurrection Bay. According to the Alaska Department of Commerce, there has been no quantifiable decrease in tourism as a result of Navy training and testing. The tourism rates in 2008 and 2009 did drop significantly; however, a March 2010 report for the Alaska Department of Commerce opined that the flat tourism economy occurred because of an overall national economic downturn—there was no implication of Navy impact. Tourism numbers have since improved, and in 2012, the levels of tourism had almost returned to 2006–2007 levels.

Recreationally, the number of registered boats in Alaska has dropped since the release of the 2011 GOA Final EIS/OEIS by approximately 2,100 fewer registered boats in 2012. While this represents less than 10 percent of recreational boats in Alaska, according to the Alaska Department of Vehicles, it is unlikely this decline is attributable to current Navy activities (Ruby 2013). There are a myriad of reasons that could cause such a drop: (1) registration fees are slightly higher; (2) the national economic downturn has caused people to sell personal boats; (3) non-powered boats, under certain new conditions in Alaska, no longer require registration; and (4) boat registration is on a 3-year cycle, which has caused many individuals to simply forget to renew (Ruby 2013).

In sum, there has not been a significant change to overall recreation and tourism in the Study Area since the 2011 GOA Final EIS/OEIS. As such, the information and analysis presented in the 2011 GOA Final EIS/OEIS remains valid.

3.12.1.2 Current Requirements and Practices

Standard Operating Procedures and best management practices to assure access and safety to shipping, fishing, and recreation are discussed in detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.12.2 ALTERNATIVES ANALYSIS

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to socioeconomics, as well as a review of new literature, to include laws, regulations, and publications pertaining to socioeconomics. Although additional information relating to existing environmental conditions was found, the new information

does not indicate an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to socioeconomics is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.12.3 CONCLUSION

As described above, there is new information on existing environmental conditions with regard to socioeconomics. However, this new information does not change the affected environment, which forms the environmental baseline of the socioeconomics analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect socioeconomics in the TMAA. Therefore, conclusions for socioeconomic impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on socioeconomics under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.12-1 (Summary Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

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3.13 Environmental Justice and Protection of Children

TABLE OF CONTENTS

3.13 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN 3.13-1
3.13.1 AFFECTED ENVIRONMENT 3.13-1
3.13.1.1 Existing Conditions 3.13-1
3.13.2 ALTERNATIVES ANALYSIS 3.13-1
3.13.3 CONCLUSION 3.13-1

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.13 Environmental Justice and Protection of Children

3.13.1 Affected Environment

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for environmental justice and protection of children remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.13.1.1 Existing Conditions

As stated in the 2011 GOA Final EIS/OEIS, with the exception of Cape Cleare on Montague Island, which is located over 12 nautical miles (nm) from the northern point of the TMAA, the nearest shoreline (Kenai Peninsula) is located approximately 24 nm north of the TMAA's northern boundary. The approximate middle of the TMAA is located 140 nm offshore. The TMAA consists of open water surface and subsurface operating areas, and overlying airspace with no population centers present. Additionally, no new or additional United States Department of the Navy (Navy) training activities are being proposed in this Supplemental EIS/OEIS that would affect environmental justice or the protection of children. As such, the information and analysis regarding environmental justice and protection of children presented in the 2011 GOA Final EIS/OEIS is still valid.

3.13.2 Alternatives Analysis

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to environmental justice and protection of children, as well as a review of new literature, to include laws, regulations, and publications pertaining to environmental justice and protection of children. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to environmental justice and protection of children is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.13.3 Conclusion

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the environmental justice and protection of children analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect environmental justice and protection of children in the TMAA. Therefore, conclusions for environmental justice and protection of children impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on environmental justice and protection of children under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.13-1 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

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3.14 Public Safety

TABLE OF CONTENTS

3.14 PUBLIC SAFETY 3.14-1
3.14.1 AFFECTED ENVIRONMENT 3.14-1
3.14.1.1 Existing Conditions 3.14-1
3.14.1.2 Current Requirements and Practices 3.14-2
3.14.2 ALTERNATIVES ANALYSIS 3.14-2
3.14.3 CONCLUSION 3.14-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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3.14 PUBLIC SAFETY

3.14.1 AFFECTED ENVIRONMENT

For purposes of this Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS), the Region of Influence (ROI) for public safety remains the same as that identified in the March 2011 Gulf of Alaska Navy Training Activities Final EIS/OEIS and includes the Temporary Maritime Activities Area (TMAA) (the Study Area).

3.14.1.1 Existing Conditions

The United States (U.S.) Department of the Navy's (Navy's) operating procedures and current safety protocols to prevent injury and ensure the safety of the public—as described in the 2011 GOA Final EIS/OEIS—remain applicable in this Supplemental EIS/OEIS. As stated in the 2011 GOA Final EIS/OEIS, Navy training activities in the TMAA comply with numerous established safety procedures to ensure that neither participants nor non-participants engage in activities that endanger life or property. The Navy continues to do its utmost to prevent civilian and military personnel injuries from impacts that may arise directly as physical injuries from hazardous activities or indirectly as a result of exposure to hazardous materials expended during a training event. In addition to a discussion with Fleet Area Control and Surveillance Facility, a recent literature search was done of local and appropriate news organizations, as well as post-training or incident reports filed by those in charge of training activities, to determine if there were any changes to military safety protocols since the finalization of the 2011 GOA Final EIS/OEIS. The research to date for this Supplemental EIS/OEIS indicate that no change to the current protocols is necessary, as there have been no reported injuries as a result of direct or indirect exposure to Navy activities.

3.14.1.1.1 Operating Areas

Because it operates and trains under a culture of safety, the Navy continually evaluates its operating procedures and safety protocols, as needed, to protect the public and military personnel involved in the training. Although the Navy has evaluated its operating procedures and safety protocols applicable to training activities in the TMAA, there have been no new significant developments.

As discussed in the 2011 GOA Final EIS/OEIS, military, commercial, institutional, and recreational activities take place in the TMAA; there are no continuously restricted zones in this area. However, as standard practice, Local Notice to Mariners (NTM) are issued each time an exercise is scheduled, informing non-participants of the types of activities being conducted, recommended avoidance distances, and other general safety concerns. The U.S. Coast Guard (USCG) utilizes a "Broadcast NTM" system, which is used to let mariners or pilots know when Navy training is scheduled or occurring.

Furthermore, as discussed in the 2011 GOA Final EIS/OEIS, in order to protect the public as much as possible, the Navy delays or cancels weapons' delivery activities if training areas are not clear of civilians or other non-participants, in accordance with Department of Defense (DoD) Instruction (DoD Directive 4540.1, *Use of Airspace by U.S. Military Aircraft and Firings Over the High Seas*).

3.14.1.1.2 Ordnance Handling

As described in the 2011 GOA Final EIS/OEIS, some training activities use ordnance; however, no new or additional ordnance are being proposed for use by the Navy in this Supplemental EIS/OEIS. As such, the procedures for handling and storing of ordnance presented in the 2011 GOA Final EIS/OEIS remain applicable and valid.

3.14.1.1.3 Public Access and Proximity

The waters of the TMAA are always available to civilian vessels; however, civilian vessels should avoid the area if a Navy vessel is flying a large red flag, which indicates hazardous, or possible, weapons delivery training. When no red flag is visible, the Navy and USCG still urge mariners to use extreme caution when transiting an operating area and to listen to Broadcast NTM. Additional standard operating procedures and best management practices to ensure the public's safety are discussed in the 2011 GOA Final EIS/OEIS and this Supplemental EIS/OEIS (see Chapter 4, Cumulative Impacts) and are currently used.

3.14.1.2 Current Requirements and Practices

As stated in the 2011 GOA Final EIS/OEIS, Navy training activities in the TMAA comply with numerous established safety procedures to ensure that neither participants nor non-participants engage in activities that endanger life or property. These procedures are continually evaluated and updated as needed to protect the public and military personnel involved in the training. As such, the public safety concerns remain the same as those safety issues previously analyzed in the 2011 GOA Final EIS/OEIS. Standard operating procedures and best management practices to ensure the public's safety are discussed in detail in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) of this Supplemental EIS/OEIS.

3.14.2 Alternatives Analysis

All three alternatives (No Action Alternative, Alternative 1, and Alternative 2), as discussed in the 2011 GOA Final EIS/OEIS, remain the same for this Supplemental EIS/OEIS. The Navy conducted a review of existing federal and state regulations and standards relevant to public safety, as well as a review of new literature, to include laws, regulations, and publications pertaining to public safety. No additional information was found that indicates an appreciable change to the existing environmental conditions as described in the 2011 GOA Final EIS/OEIS. Because the existing conditions have not changed appreciably, and no new Navy training activities are being proposed to occur in the TMAA in this Supplemental EIS/OEIS, re-analysis of the alternatives with respect to public safety is not warranted. Subsequently, the conclusions made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS.

3.14.3 Conclusion

As described above, there is no information on existing environmental conditions that changes the affected environment, which forms the environmental baseline of the public safety analysis in the 2011 GOA Final EIS/OEIS. Additionally, no new Navy training activities are being proposed in this Supplemental EIS/OEIS that would affect public safety in the TMAA. Therefore, conclusions for public safety impacts made for the alternatives analyzed in the 2011 GOA Final EIS/OEIS remain unchanged in this Supplemental EIS/OEIS. For a summary of effects of the No Action Alternative, Alternative 1, and Alternative 2 on public safety under both the National Environmental Policy Act and Executive Order 12114, please refer to Table 3.14-2 (Summary of Effects by Alternative) in the 2011 GOA Final EIS/OEIS.

4 Cumulative Impacts

TABLE OF CONTENTS

4 CUMULATIVE IMPACTS 4-1

4.1 INTRODUCTION 4-1
4.2 APPROACH TO ANALYSIS 4-1
4.2.1 OVERVIEW 4-1
4.2.2 IDENTIFY APPROPRIATE LEVEL OF ANALYSIS FOR EACH RESOURCE 4-2
4.2.3 DEFINE THE GEOGRAPHIC BOUNDARIES AND TIMEFRAME FOR ANALYSIS 4-2
4.2.4 DESCRIBE CURRENT RESOURCE CONDITIONS AND TRENDS 4-2
4.2.5 IDENTIFY POTENTIAL IMPACTS OF THE PROPOSED ACTION THAT MIGHT CONTRIBUTE TO CUMULATIVE IMPACTS 4-3
4.2.6 IDENTIFY OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS THAT AFFECT EACH RESOURCE 4-3
4.2.7 ANALYZE POTENTIAL CUMULATIVE IMPACTS 4-4
4.3 OTHER ACTIONS ANALYZED IN THE CUMULATIVE IMPACTS ANALYSIS 4-4
4.3.1 OVERVIEW 4-4
4.3.2 ACTIONS CONSIDERED BUT DISMISSED 4-9
4.3.2.1 Offshore Power Generation 4-9
4.3.2.2 Restoration, Research, and Conservation Projects and Programs 4-9
4.3.2.3 Other Military Activities 4-10
4.3.2.4 United States Coast Guard 4-11
4.3.2.5 Environmental Regulations and Planning 4-12
4.3.2.6 Other Environmental Considerations 4-12
4.3.3 ACTIONS CONSIDERED AND RETAINED 4-13
4.3.3.1 Restoration, Research, and Conservation Projects and Programs 4-13
4.3.3.2 Other Military Activities 4-13
4.3.3.3 Other Environmental Considerations 4-14
4.4 RESOURCE-SPECIFIC CUMULATIVE IMPACTS 4-20
4.4.1 RESOURCE AREAS DISMISSED FROM CUMULATIVE IMPACTS ANALYSIS 4-20
4.4.2 MARINE MAMMALS 4-20
4.4.2.1 Impacts of The Proposed Action That May Contribute to Cumulative Impacts 4-20
4.4.2.2 Impacts of Other Actions 4-21
4.4.2.3 Coastal Development 4-24
4.4.2.4 Cumulative Impacts on Marine Mammals 4-24
4.5 SUMMARY OF CUMULATIVE IMPACTS 4-25

LIST OF TABLES

TABLE 4.3-1: OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS IDENTIFIED FOR THE CUMULATIVE IMPACTS ANALYSIS. 4-5

LIST OF FIGURES

FIGURE 4-1: COMMERCIAL VESSEL DENSITY INVOLVING THE STUDY AREA IN 2011 4-15

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4 CUMULATIVE IMPACTS

4.1 INTRODUCTION

The analysis of cumulative impacts (or cumulative effects)[1] presented in this section follows the requirements of the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) guidance (Council on Environmental Quality 1997). The CEQ regulations (40 Code of Federal Regulations [C.F.R.] §§ 1500-1508) provide the implementing regulations for NEPA. The regulations define cumulative impacts as:

> "…the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 C.F.R. §1508.7)."

While a single project may have minor impacts, overall impacts may be collectively significant when the project is considered together with other projects on a regional scale. A cumulative impact is the additive effect of all actions in the geographic area. The CEQ provides guidance on cumulative impact analysis in *Considering Cumulative Impacts under the National Environmental Policy Act* (Council on Environmental Quality 1997). This guidance further identifies cumulative impacts as those environmental impacts resulting "from spatial and temporal crowding of environmental perturbations. The impacts of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the impacts of the first perturbation." This guidance observes that "no universally accepted framework for cumulative impacts analysis exists…" while noting that certain general principles have gained acceptance. The CEQ provides guidance on the extent to which agencies of the federal government are required to analyze the environmental impacts of past actions when they describe the cumulative environmental effect of an action. This guidance provides that an analysis of cumulative impacts might encompass geographic boundaries beyond the immediate area of an action and a timeframe that includes past actions and foreseeable future actions. Thus, the CEQ guidelines observe, "[it] is not practical to analyze cumulative impacts of an action on the universe; the list of environmental impacts must focus on those that are truly meaningful."

4.2 APPROACH TO ANALYSIS

4.2.1 OVERVIEW

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action in combination with past, present, and reasonably foreseeable future actions. The cumulative impacts analysis included the following steps, described in more detail below:

1. Identify appropriate level of analysis for each resource.
2. Define the geographic boundaries and timeframe for the cumulative impacts analysis.
3. Describe current resource conditions and trends.
4. Identify potential impacts of the Proposed Action that might contribute to cumulative impacts.

[1] Council on Environmental Quality regulations provide that the terms "cumulative effects" and "cumulative impacts" are synonymous (40 C.F.R. § 1508.8[b]); the terms are used interchangeably by various sources, but the term "cumulative impacts" will be used in this document except for quotations, for continuity.

5. Identify past, present, and other reasonably foreseeable future actions that affect each resource.
6. Analyze potential cumulative impacts.

4.2.2 Identify Appropriate Level of Analysis for Each Resource

In accordance with guidance set forth by the CEQ, the cumulative impacts analysis focused on impacts that are "truly meaningful," (Council on Environmental Quality 1997). The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The rationale for the level of analysis applied to each resource is described in Section 4.4 (Resource-Specific Cumulative Impacts).

4.2.3 Define the Geographic Boundaries and Timeframe for Analysis

The geographic boundaries for the cumulative impacts analysis included the entire Gulf of Alaska (GOA) Navy Training Activities Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) Study Area (Study Area) (Figure 2.1-1). The geographic boundaries for cumulative impacts analysis for marine mammals were expanded to include activities outside the GOA Supplemental EIS/OEIS Study Area that might impact migratory marine mammals. Primary considerations from outside the Study Area include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

Determining the timeframe for the cumulative impacts analysis requires estimating the length of time the impacts of the Proposed Action would last and considering the specific resource in terms of its history of degradation (Council on Environmental Quality 1997). The Proposed Action includes ongoing and anticipated future training activities. While the United States (U.S.) Department of the Navy (Navy) training requirements change over time in response to global events, geopolitical events, or other factors, the general types of activities addressed by this Supplemental EIS/OEIS are expected to continue into the reasonably foreseeable future, along with the associated impacts. Likewise, some non-military activities addressed in this cumulative impacts analysis (e.g., oil and gas production, maritime traffic, commercial fishing) are expected to continue into the reasonably foreseeable future. Therefore, the cumulative impacts analysis is not bounded by a specific future timeframe. For past actions, the cumulative impacts analysis only considers those actions or activities that have ongoing impacts.

While the cumulative impacts analysis is not limited by a specific timeframe, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the indefinite future. Navy environmental planning and compliance for training activities is an ongoing process. The Navy intends to submit applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act (MMPA) authorizations supported by this Supplemental EIS/OEIS. The anticipated effective dates for these MMPA authorizations would be a 5-year period from April 2016 through April 2021. Future environmental planning documents will include cumulative impacts analysis based on information available at that time.

4.2.4 Describe Current Resource Conditions and Trends

In Chapter 3 (Affected Environment and Environmental Consequences), the Navy describes current resource conditions and trends, and discusses how past and present human activities influence each resource. The current aggregate impacts of past and present actions are reflected in the baseline information presented in Chapter 3 (Affected Environment and Environmental Consequences). This

information is used in the cumulative impacts analysis to understand how past and present actions are currently impacting each resource and to provide the context for the cumulative impacts analysis.

4.2.5 Identify Potential Impacts of The Proposed Action That Might Contribute to Cumulative Impacts

Direct and indirect impacts of the Proposed Action, presented in Chapter 3 (Affected Environment and Environmental Consequences), were reviewed to identify impacts relevant to the cumulative impacts analysis. Key factors considered included the current status and sensitivity of the marine mammal species and the intensity, duration, and spatial extent of the impacts for each stressor related to training activities. In general, long-term rather than short-term impacts and widespread rather than localized impacts were considered more likely to contribute to cumulative impacts. For example, for biological resources, population-level impacts were considered more likely to contribute to cumulative impacts than were individual-level impacts. Negligible impacts were not considered further in the cumulative impacts analysis. For marine mammals, any training activity that can be estimated by NAEMO and is expected to result in Level A harassment or Level B harassment, as defined by MMPA, was considered in the cumulative impacts analysis. For Endangered Species Act (ESA)-listed species, any training activity that may affect and is likely to adversely affect the species was considered in the cumulative impacts analysis. Training activities that were determined by the Navy to have no effect or that may affect but are not likely to adversely affect ESA-listed species were not analyzed in detail in the cumulative impacts analysis.

4.2.6 Identify Other Actions and Other Environmental Considerations That Affect Each Resource

A list of other actions was compiled for the Study Area and surrounding areas based on information obtained during the scoping process (Appendix C, Public Participation), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses for actions not included in this document, and other available information. Identified future actions were reviewed to determine if they should be considered further in the cumulative impacts analysis. Factors considered when identifying other actions to be included in the cumulative impacts analysis included the following:

- Whether the other action is reasonably foreseeable, rather than merely possible or speculative
- The timing and location of the other actions in relation to proposed training activities
- Whether the other action and the Proposed Action would affect the same resources
- The current conditions, trends, and vulnerability of resources affected by the other action
- The duration and intensity of the impacts of the other action
- Whether the impacts have been truly meaningful, historically significant, or identified previously as a cumulative impact concern

In addition to identifying reasonably foreseeable future actions, other environmental considerations for the cumulative impacts analysis were identified and described. These other considerations include major stressors or issues (e.g., ocean pollution, ocean noise, coastal development, etc.) that tend to be widespread and arise from routine human activities and multiple past, present, and future actions. Including these other environmental considerations allows an analysis of the current aggregate impacts of past and present actions, as well as reasonably foreseeable future actions.

4.2.7 Analyze Potential Cumulative Impacts

The current impacts of past and present actions and the anticipated impacts of reasonably foreseeable future actions were characterized and summarized. The incremental impacts of the Proposed Action were then added to the combined impacts of all other actions to describe the cumulative impacts that would result if the Proposed Action were implemented. The cumulative impacts analysis considered additive, synergistic, and antagonistic impacts. A qualitative analysis was conducted in most cases based on the available information.

4.3 Other Actions Analyzed in the Cumulative Impacts Analysis

4.3.1 Overview

Table 4.3-1 lists the other actions and other environmental considerations identified for the cumulative impacts analysis, including activities presented in the 2011 GOA Final EIS/OEIS with updated information. Descriptions of each action and environmental consideration carried forward for analysis are provided in the following sections.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained or Dismissed for Further Analysis
Offshore Power Generation					
1	Marine Hydrokinetic Projects	Federal Energy Regulatory Commission	Turnagain Arm of Cook Inlet	Present and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
2	Feasibility Study for the Yakutat Alaska Wave Energy Project	Resolute Marine Energy	Yakutat, Alaska	Future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
Restoration, Research, and Conservation Projects and Programs					
3	Alaska Groundfish Harvest Specifications EIS***	NMFS	Bering Sea, Aleutian Islands, and Gulf of Alaska groundfish fisheries	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
4	Alaska Groundfish Fisheries Programmatic Supplemental EIS***	NMFS	Bering Sea, Aleutian Islands, and Gulf of Alaska groundfish fisheries	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
5	Alaska Predator Ecosystem Experiment ***	NMFS	Prince William Sound, Cook Inlet, and northern Gulf of Alaska	Past	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
6	Cook Inlet Beluga Whale Subsistence Harvest – Supplemental EIS***	NMFS	Cook Inlet, Alaska	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
7	Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska	NMFS, Alaska Regional Office	Entire Study Area	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
8	GulfWatch Alaska Monitoring Plan	Alaska Ocean Observing System	Prince William Sound, lower Cook Inlet, outer Kenai Peninsula coast	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
9	Alaska Aerospace Corporation Kodiak Launch Complex***	Alaska Aerospace Corporation	Kodiak, Alaska	Past, present, and future	Retained
10	Alaska Region promotion of safety, protection of the environment, and conservation of resources through vigorous regulatory oversight and enforcement	Bureau of Safety and Environmental Enforcement	Arctic Ocean, Bering Sea and the northern Pacific Ocean	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained or Dismissed for Further Analysis
Other Military Activities					
11	Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar***	U.S. Department of the Navy	Pacific-Indian and Atlantic-Mediterranean Ocean areas	Past, present, and future	Retained
12	JPARC Master Plan**	Alaskan Command	JPARC	Past, present, and future	Retained
13	Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex in Alaska*	U.S. Department of the Army U.S. Department of the Air Force	JPARC	Past, present, and future	Retained
14	Naval Special Warfare Maritime Training Activities***	U.S. Department of the Navy	Kodiak Island	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
15	U.S. Navy Climate Change Roadmap	U.S. Department of the Navy	All of Study Area	Present and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
U.S. Coast Guard					
16	North Pacific Regional Fisheries Training Center	U.S. Coast Guard	Kodiak, Alaska	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
17	Draft Programmatic Environmental Assessment Arctic Operations and Training Exercises Alaska	U.S. Coast Guard	Above the Arctic Circle – Proposed Forward Operating Locations are Barrow, Nome, Kotzebue, and Port Clarence, Alaska	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
Environmental Regulations and Planning					
18	Coastal and Marine Spatial Planning	Regional Ocean Commissions	All of Study Area	Future	Dismissed because action involves only planning and policy-related activities (discussed in Chapter 6, Additional Regulatory Considerations).

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained or Dismissed for Further Analysis
Other Environmental Considerations					
19	Commercial and Recreational Fishing	NMFS and private industry	All of Study Area and open ocean areas	Past, present, and future	Retained
20	Maritime Traffic	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
20a	Knik Arm Crossing***	Knik Arm Bridge and Toll Authority	Cook Inlet Knik Army	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
20b	Port MacKenzie Development***	Matanuska-Susitna Borough	Cook Inlet along the Knik Arm	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
20c	Port of Anchorage Expansion***	U.S. Army Corps of Engineers, Alaska District	Port of Anchorage	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
21	Shoreline Development	Local regulatory agencies	Northern coastline of Gulf of Alaska	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
22	ShoreZone – Shoreline Mapping of the North Slope of Alaska	Bureau of Ocean Energy Management	Beaufort Sea, Chukchi Sea	Past, present, and future	Dismissed because action primarily involves collection and interpretation of aerial imagery of the intertidal zone, nearshore, and estuarine environments, which are outside the Study Area.
23	Oceanographic Research	Numerous	All of Study Area and open ocean areas	Past, present, and future	Retained
24	Academic Research	Numerous	All of Study Area and open ocean areas	Past, present, and future	Retained
25	Ocean Noise	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
26	Ocean Pollution, Tsunami Debris, and Other Marine Debris in Alaska	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained or Dismissed for Further Analysis
Other Environmental Considerations					
27	Non-Point Sources, Point Sources, and Atmospheric Deposition	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
28	Marine Tourism	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained

* indicates this activity was found in the 2011 GOA Final EIS/OEIS; ** indicates this activity was found in the JPARC EIS; *** indicates this activity was found in both the JPARC EIS and the 2011 GOA Final EIS/OEIS

Notes: EIS = Environmental Impact Statement, GOA = Gulf of Alaska, JPARC = Joint Pacific Alaska Range Complex, LFA = Low Frequency Active, NMFS = National Marine Fisheries Service, OEIS = Overseas Environmental Impact Statement, SURTASS = Surveillance Towed Array Sensor System, U.S. = United States

4.3.2 ACTIONS CONSIDERED BUT DISMISSED

4.3.2.1 Offshore Power Generation

4.3.2.1.1 Marine Hydrokinetic Projects

As of April 2014, the Federal Energy Regulatory Commission (FERC) has issued 5 preliminary permits for marine and hydrokinetic projects and 16 pending preliminary permits; there are also three in pre-filing status for license. Four licenses have been issued for pilot projects. In Alaskan waters, one hydrokinetic preliminary permit has been issued at Yakuitat and will expire in December 2015; there are no pending permits. (Federal Energy Regulatory Commission 2014a, 2014b). Marine hydrokinetic projects were dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action and distance from the Study Area.

4.3.2.1.2 Feasibility Study for the Yakutat Alaska Wave Energy Project

The FERC issued a preliminary permit in 2013 to Resolute Marine Energy, Inc. to develop a wave power project outside of Yakutat, Alaska. The conceptual project is a 500–750 kilowatt (kW) project consisting of several 50–100 kW units to be located near shore. The 2013 permit allows Resolute Marine Energy, Inc. to conduct pilot studies and assess the technical and economic feasibility of the project (National Marine Fisheries Service 2013a). The Feasibility Study for the Yakutat Alaska Wave Energy Project was dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action and distance from the Study Area.

4.3.2.2 Restoration, Research, and Conservation Projects and Programs

4.3.2.2.1 Alaska Groundfish Harvest Specifications Environmental Impact Statement

Analysis for the NMFS Alaska Groundfish Harvest Specifications Environmental Impact Statement is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.2.2 Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement

Analysis for the NMFS Alaska Groundfish Fisheries Programmatic Supplemental EIS is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.2.3 Alaska Predator Ecosystem Experiment

Analysis for the Alaska Predator Ecosystem Experiment is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed, and additional studies from 2007 to the present are focused on specific and direct research on Steller sea lion and large whale foraging ecology and population dynamics around the Kodiak archipelago (National Marine Fisheries Service 2013b), which supports the original analysis in the 2011 GOA Final EIS/OEIS.

4.3.2.2.4 Cook Inlet Beluga Whale Subsistence Harvest – Supplemental Environmental Impact Statement

Analysis for the NMFS Supplemental EIS to assess the environmental impacts associated with National Oceanic and Atmospheric Administration's (NOAA's) implementation of a management plan to govern the subsistence harvest of Cook Inlet beluga whales is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.2.5 Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska

The Final EIS for Essential Fish Habitat (EFH) Identification and Conservation in Alaska was completed in 2005. The Record of Decision (ROD) documented the selection of three actions:

- Describe and identify EFH as the revised general distribution;
- Adopt the site-based approach for identifying Habitat Areas of Particular Concern;
- Establish expanded closures in the Aleutian Islands and Gulf of Alaska to minimize the effects of fishing on EFH.

Additionally, the ROD documented the decision to proceed with associated fishery management plan amendments and rulemaking, and an EFH 5-year review by NOAA Fisheries and the North Pacific Marine Fisheries Commission resulted in revisions of the Fishery Management Plans. The EFH Omnibus Amendments were approved in October 2012.

Analysis for the NMFS reexamination of the effects of fishing on EFH is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.2.6 GulfWatch Alaska Monitoring Plan

The Exxon Valdez Oil Spill Trustee Council and state and federal agencies are supporting a 5-year, $12 million long-term monitoring program in the Gulf of Alaska region affected by the 1989 Exxon Valdez oil spill. This monitoring effort is dismissed from further cumulative analysis because the monitoring plan will not alter regulations to Navy actions within the Study Area, and therefore results in negligible to minor impacts on resources in the area affected by the activity and the Proposed Action (Alaska Ocean Observing System 2013).

4.3.2.2.7 Alaska Region Promotion of Safety, Protection of the Environment, and Conservation of Resources Through Vigorous Regulatory Oversight and Enforcement (Alaska Region Bureau of Safety and Environmental Enforcement Activities)

The Bureau of Safety and Environmental Enforcement, Alaska Region, has regulatory oversight and enforcement responsibility for more than one billion acres on the Outer Continental Shelf and more than 6,000 miles (mi.) of coastline. Historically, lease sales have occurred in Cook Inlet, the Gulf of Alaska, Norton Sound, and in the Bering, Beaufort, and Chukchi Seas. Currently there are active leases in the Chukchi and Beaufort Seas. The Alaska Region Promotion of Safety, Protection of the Environment, and Conservation of Resources Through Vigorous Regulatory Oversight and Enforcement is dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action.

4.3.2.3 Other Military Activities

4.3.2.3.1 Naval Special Warfare Maritime Training Activities – Kodiak Island

Analysis of Naval Special Warfare (NSW) activities on Kodiak Island is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed, although a new Environmental Assessment is currently being conducted for training activities at Kodiak. Cumulative impacts will be re-analyzed upon completion of that document and incorporated into this Supplemental EIS/OEIS when available. Until that time, NSW training on Kodiak Island is dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action.

4.3.2.3.2 United States Department of the Navy Climate Change Roadmap

The Navy Climate Change Roadmap outlines the Navy's approach to observing, predicting, and adapting to climate change by providing a chronological list of Navy-associated action items, objectives, and desired effects for Fiscal Year (FY) 2010–2014. The Navy Climate Change Roadmap focuses on strategy, policy, and plans; operations and training; investments in capability and infrastructure; strategic communications and outreach; and environmental assessment and prediction. The Roadmap has five main objectives.

1. The Navy is fully mission-capable through changing climatic conditions, while actively contributing to national requirements for addressing climate change.
2. The Naval force structure and infrastructure are capable of meeting combatant commander requirements in all probable climatic conditions over the next 30 years.
3. The Navy understands the timing, severity, and impact of current and projected changes in the global environment.
4. The media, public, government, Joint, interagency, and international community understand how and why the Navy is effectively addressing climate change.
5. For the Navy to be recognized as a valuable joint, interagency, and international partner in responding to climate change (U.S. Department of the Navy 2010).

Every 4 years, the director of Task Force Climate Change will review and revise the roadmap following promulgation of the Quadrennial Defense Review, and will incorporate the review's guidance as appropriate. The U.S. Navy Climate Change Roadmap is dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action.

4.3.2.4 United States Coast Guard

4.3.2.4.1 North Pacific Regional Fisheries Training Center

The United States Coast Guard (USCG) training center located in Kodiak, Alaska, instructs 13 different courses to 750–1,000 students per year. Instruction includes fisheries-related topics, both international and domestic.

4.3.2.4.2 Draft Programmatic Environmental Assessment Arctic Operations and Training Exercises

The Proposed Action is to conduct increased operations and training exercises in the Arctic to meet Coast Guard mission responsibilities due to the increase of national and international activities in the area. This would provide a shore, air, and sea Coast Guard presence to meet the seasonal surge mission requirements, typically mid-March through mid-November. The Preferred Alternative consists of five main elements:

1. Shore Operations: Forward Operating Locations and logistics/staging locations would serve as temporary Coast Guard homebases for sea and air support during the seasonal surge of Arctic activities. The locations include Barrow, Nome, Kotzebue, Port Clarence, and various air strips and Distant Early Warning line sites. The Coast Guard would conduct inspections of commercial and non-commercial vessels in major ports in Alaska to ensure compliance with law and further the missions of drug and migrant interdiction and marine safety.
2. Air Operations: The Coast Guard would execute air searches to locate missing persons and vessels. Routine patrols and Arctic Domain Awareness Flights serve to locate, identify, and document human contacts north of the Arctic Circle.

3. Sea Operations: The Coast Guard would search for missing vessels, and operate two icebreakers to support oceanographic and meteorological research, search and rescue, and law enforcement missions. Conducting routine patrols, establishing safety zones around offshore oil exploration, and providing at-sea berthing and support facilities are being considered.
4. Training Exercises: Rescue exercises, flight crew training, small boat training, and oil recovery training exercises would be conducted.
5. Building Partnerships: Tribal/Local Government Engagement: Formal and informal government-to-government and community engagement with tribes and local community leadership is vital to all of the Coast Guard's missions (U.S. Homeland Security 2014).

The proposed Coast Guard operations and training exercises are dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action.

4.3.2.5 Environmental Regulations and Planning

4.3.2.5.1 Coastal and Marine Spatial Planning

Dismissed because action involves only planning and policy-related activities.

4.3.2.6 Other Environmental Considerations

4.3.2.6.1 Knik Arm Crossing

Analysis for the Knik Arm Crossing is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed although construction was originally expected to begin in 2013 and be completed in 2017. Construction is currently expected to begin in 2014 and be completed in 2018 (Knik Arm Bridge and Toll Authority 2013a, b).

4.3.2.6.2 Port MacKenzie Development

Analysis for the Port MacKenzie Development is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.6.3 Port of Anchorage Expansion

Analysis for the Port of Anchorage Expansion is provided in the 2011 GOA Final EIS/OEIS, Chapter 4 (Cumulative Impacts). The effects and analysis have not changed.

4.3.2.6.4 Shoreline Development

Shoreline development adjacent to the Study Area is prompted for commercial, industrial, transportation, and residential purposes. Development has impacted and continues to impact coastal resources through point and nonpoint source pollution, concentrated recreational use, and ship traffic using major port facilities. The Study Area also includes coastal tourism development (e.g., hotels, resorts, restaurants, food industry, and residential homes) and the infrastructure supporting coastal development (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, and recreational fishing facilities). However, the Study Area is greater than 12 nautical miles off the coast of Alaska, and therefore shoreline development will have minimal impact on resources in the Study Area. Shoreline development is dismissed from consideration because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action.

4.3.2.6.5 ShoreZone-Shoreline Mapping of the North Slope of Alaska

ShoreZone-Shoreline Mapping of the North Slope of Alaska is dismissed from consideration because of negligible to minor impacts on resources in the Temporary Maritime Activities Area (TMAA). The action primarily involves collection and interpretation of aerial imagery of the intertidal zone, nearshore, and estuarine environments, which are outside the TMAA.

4.3.3 ACTIONS CONSIDERED AND RETAINED

4.3.3.1 Restoration, Research, and Conservation Projects and Programs

4.3.3.1.1 Alaska Aerospace Corporation Kodiak Launch Complex

Kodiak Launch Complex is the nation's only high-latitude, full-service spaceport. It was specifically designed to provide support for space launches to polar orbit and is an all-indoor, all-weather processing facility (Alaska Aerospace Corporation 2013). In 2011, a Letter of Authorization was issued to the Alaska Aerospace Corporation to take species of seals and sea lions incidental to space vehicle and missile launch operations at the Kodiak Launch Complex (National Marine Fisheries Service 2011 – Federal Register 76(91), 27308-27309).

4.3.3.2 Other Military Activities

4.3.3.2.1 Surveillance Towed Array Sensor System Low Frequency Active Sonar

In August 2011, the Navy released a Draft Supplemental EIS/Supplemental OEIS that evaluated the potential environmental impacts of employing the Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) Sonar (U.S. Department of the Navy 2011). The Navy currently plans to operate up to four SURTASS-LFA Sonar systems for routine training, testing, and military operations. Based on current Navy national security and operational requirements, routine training, testing, and military operations using these sonar systems could occur in the Pacific Ocean, although outside the TMAA.

4.3.3.2.2 Joint Pacific Alaska Range Complex Master Plan

The master plan defines military requirements for the Joint Pacific Alaska Range Complex (JPARC). The plan identifies both short-term and funded actions as well as possible long-range capabilities. The master plan serves as the basis for development of the subsequent Proposed Action and Alternatives in the JPARC Modernization and Enhancement EIS.

4.3.3.2.3 Environmental Impact Statement for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex in Alaska

The Army and Air Force, through Alaskan Command, proposed to modernize and enhance the JPARC to enable realistic joint training for the Army, Navy, Marine Corps, and Air Force. The JPARC Modernization and Enhancement EIS analyzed potential environmental consequences associated with expanding and establishing new Military Operations Areas, restricted airspace, airspace corridors, ground maneuver training areas, and training complexes. The Final EIS was published in June 2013, for which a Record of Decision (U.S. Departments of the Army and Air Force 2013) was approved and signed on 6 August 2013. The Army decision is to implement Battle Area Complex Restricted Area (R) Addition Alternative B (Preferred Alternative), Restricted Area Expansion of R-2205 including the Digital Multi-Purpose Training Range Proposed Action (Preferred Alternative), and Unmanned Aerial Vehicle Access Alternative A (Preferred Alternative). The Air Force decision is to implement Fox 3 Military Operations Area (MOA) Expansion and New Paxon MOA Alternative E (Preferred Alternative), Realistic Live Ordnance Delivery (Alternative A), and Night Joint Training Alternative B (Preferred Alternative).

4.3.3.3 Other Environmental Considerations

4.3.3.3.1 Commercial and Recreational Fishing

Commercial and recreational fishing constitutes an important and widespread use of the ocean resources throughout the Study Area. Fishing can adversely affect fish populations, other species, and habitats. Potential impacts of fishing include overfishing of targeted species, bycatch, entanglement, and habitat destruction, all of which negatively affect fish stocks and other marine resources. Bycatch is the capture of fish, marine mammals, sea turtles, seabirds, and other nontargeted species that occur incidentally to normal fishing operations. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces habitat structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), habitat destruction, and the generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine animals.

Fishing can also have a profound influence on individual targeted species populations. In a study of retrospective data, Jackson et al. (2001) analyzed paleo-ecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer-term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. Fisheries bycatch has been identified as a primary driver of population declines in several marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al. 2010).

4.3.3.3.2 Maritime Traffic

In 2012, 28 cruise ships were scheduled to make 450 voyages through Southeast Alaska. Cruise ships comprise 19 percent of the vessel activity in Southeast Alaska. Ferries, passenger vessels with overnight accommodations, and cruise ships comprise 67 percent of the vessel activity, although cruise ships only operate during the 5-month period from May through September. Dry freight cargo barges, tank barges, and freight ships (log and ore carriers) comprise another 30 percent of the vessel activity (Alaska Department of Environmental Conservation 2012).

The Alaska Marine Highway is a ferry service operated by the State of Alaska, headquartered in Ketchikan, Alaska. The Highway is composed of 3,500 mi. of routes that go as far south as Bellingham, Washington and as far west as Unalaska/Dutch Harbor, Alaska. The highway system operates along the south-central coast of the state, the eastern Aleutian islands, and the inside passage of Alaska and British Columbia. There are 32 terminals located in Washington, British Columbia, and Alaska. Primary concerns for the cumulative impacts analysis include vessels striking marine mammals, introduction of non-native species through hull fouling and ballast water, and underwater sound from ships and other vessels.

Figure 4-1 depicts the commercial vessel density provided by the automated identification system data for the area from Alaska to the Pacific Northwest in 2011. As evident from the graphic, commercial vessel use is highest in the U.S. Exclusive Economic Zone, at straits and passages, and along least-distance line routes between ports. As is evident from the figure, some of those commercial vessel

routes pass through the TMAA. Navy vessels during a Carrier Strike Group exercise are a small, infrequent, and short duration component of overall vessel traffic in Gulf of Alaska.

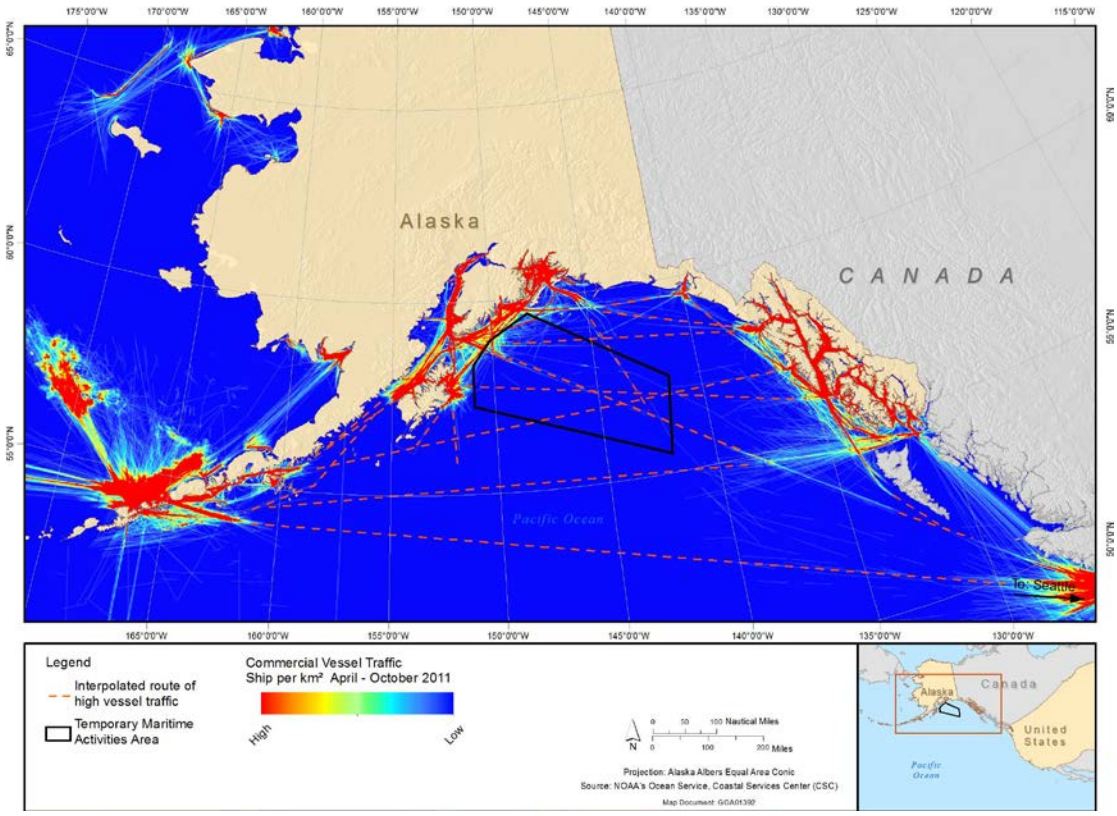

Figure 4-1: Commercial Vessel Density Involving the Study Area in 2011

4.3.3.3.3 Oceanographic Research

There are currently scientific research permits and General Authorizations for research issued by NMFS for cetacean work in the North Pacific. The most invasive research involves tagging or biopsy while the remainder focuses on vessel and aerial surveys and close approach for photo-identification. Species covered by these permits and authorizations include small odontocetes, sperm whales and large mysticetes. One permit issued to the Office of Protected Resources of NMFS allows for responses to strandings and entanglements of listed marine mammals. NMFS has also issued General Authorizations for commercial photography of non-listed marine mammals, provided that the activity does not rise to Level A Harassment of the animals. These authorizations are usually issued for no more than 1 or 2 years, depending on the project.

The Bureau of Ocean Energy Management (BOEM) awarded one seismic survey permit in 2013 to Norwegian geosciences company TGS. In October 2013, TSG completed an open water marine seismic survey to acquire 2D data, using an airgun array as the energy source, and collected magnetic and gravity data in the Chukchi Sea Outer Continental Shelf Planning Area (Bureau of Ocean Energy Management 2013). For 2014 SAExploration Inc. has submitted an application for a permit to conduct an on-ice seismic survey to acquire 3D seismic data, using vibrators as the energy source, in the Beaufort Sea Outer Continental Shelf Planning Area. The proposed program is planned to start on or after 1 January 2014.

A typical seismic survey lasts 2–3 weeks and covers a range of about 300–600 mi. The intensity of sound waves produced by the firing of seismic airguns can reach up to 250 decibels (dB) near the source and can be as high as 117 dB over 20 mi. away. Additionally, Russian and Canadian exploration permits on the Outer Continental Shelf are anticipated although there is no collaboration between governments. Since 1973, BOEM has spent $425 million studying the Outer Continental Shelf environment off Alaska and subsequently generated more than 500 technical reports. In the last decade, more than $15 million has been focused on marine acoustic studies. Based upon that data, BOEM has concluded that multiple seismic surveys could yield some likelihood of cumulative effects on marine life, but these effects are expected to be temporary and unlikely to cause population level effects (National Marine Fisheries Service and Bureau of Ocean Energy Management 2013; Heimbruch 2013).

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects, etc.). Data to assess population level effects from research are not currently available, and it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations in the Study Area.

4.3.3.3.4 Academic Research

The University of Alaska Fairbanks is ranked in the top 150 of nearly 700 institutions in the United States that conduct research, and is listed in the top 11 of more than 10,000 institutions worldwide for number of citations in climate change publications and fourth among United States universities. It is associated with research centers that include a wide array of interests (e.g., air and space, climate change, environmental and natural disasters, energy and mineral extraction, health and biomedical sciences, and national security sustainable management).

The University of Alaska Anchorage devotes sponsored programs and research to special concerns and opportunities associated with northern populations. Research areas include public decision making, ecosystem studies and conservation biology, earth and climate processes, human ecology and coupled human-environment interactions, health research, behavioral and physical health, biomedical programs, and rural health issues.

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects, etc.). Data to assess population-level effects from research are not currently available, and it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations in the Study Area.

4.3.3.3.5 Ocean Noise

Noise is generally described as unwanted sound—sound that clutters and masks other sounds of interest (Richardson et al. 1995). Anthropogenic sources of noise that are most likely to contribute to increases in ocean noise are vessel noise from commercial shipping and general vessel traffic, oceanographic research, oil and gas exploration, underwater construction, and naval and other use of sound navigation and ranging (sonar).

Any potential for cumulative impact should be put into the context of recent changes to ambient sound levels in the world's oceans as a result of anthropogenic activities. However, there is a large and variable natural component to the ambient noise level as a result of events such as earthquakes, rainfall, waves

breaking, and lightning hitting the ocean as well as biological noises such as those from snapping shrimp and the vocalizations of marine mammals.

Sound emitted from large vessels, such as shipping and cruise ships, is the principal source of low frequency noise in the ocean today (Hatch and Wright 2007; Hildebrand 2005; Richardson et al. 1995). Acoustic monitoring conducted under Navy funding in the TMAA has detected ship noise with some regularity at a recording site mid-shelf off of the Kenai Peninsula site and relatively infrequently at a site farther offshore near the shelf-break (for the locations of these passive acoustic monitoring buoys, see Baumann-Pickering et al. 2012).

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver approximately 25 mi. (40 kilometers [km]) west of Point Sur, California. The data showed an increase in ambient noise of approximately 10 dB in the frequency ranges of 20–80 Hertz (Hz) and 200–300 Hz, and about 3 dB at 100 Hz over a 33-year period. Each 3 dB increase is noticeable to the human ear as a doubling in sound level. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating 300 days per year, producing constant broadband noise at source levels of 198 dB (Hildebrand 2004). Navy vessels during a Carrier Strike Group exercise are a small, infrequent, and short duration component of overall vessel noise in Gulf of Alaska. In addition, Navy combatant vessels have been designed to generate minimal noise and use ship quieting technology to elude detection by enemy passive acoustic devices (Mintz and Filadelfo 2011; Southall et al. 2005).

Appendix D (Acoustic Primer) provides additional information about sources of anthropogenic sound in the ocean and other background information about underwater noise. This appendix describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for individual animals and populations. A variety of impacts may result from exposure to sound-producing activities. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal, to more severe impacts that may have lasting consequences. The major categories of potential impacts are: behavioral reactions, physiological stress, auditory fatigue, auditory masking, and direct trauma.

4.3.3.3.5.1 Ocean Acidification Affects on Noise in the Ocean

Since the Industrial Revolution in the mid-19th century, the world's oceans have become increasingly acidic as a result of anthropogenic emissions of carbon (e.g., carbon dioxide [CO2]) from the burning of fossil fuels (Reeder and Chiu 2010). Public comments received by the Navy on recently published Environmental Impact Statements (EISs) have expressed concerns that the increase in the acidity of ocean waters could potentially lead to an increase in the propagation of underwater sound associated with Navy activities (e.g., ship noise, sonar) and then have a greater potential to acoustically impact marine species (e.g., marine mammals, fish, turtles).

Although an increase in the acidity of seawater reduces the availability of boron ions that absorb sound (see Urick 1983), the effect that ionic absorption has on sound propagation is very small and overall transmission loss is dominated by other mechanisms (see Hester et al. 2008; Ilyina et al. 2010; Reeder and Chiu 2010). Reeder and Chiu (2010) demonstrated that even if there is a continual increase in ocean acidity over decades, there would still be no significant changes to average background noise levels in the ocean. Furthermore, they conclude that even with a large increase in acidity, there would be no change in ocean noise levels in shallow water and in near surface habitats frequented by marine mammals. The Navy's proposed actions in the GOA Study Area would not significantly contribute to

ocean acidification, and the potential cumulative effects of ocean acidification would not perceptively change ocean noise levels; therefore, the effect of ocean acidification need not be considered further in this analysis.

4.3.3.3.6 Ocean Pollution, Tsunami Debris, and Other Marine Debris in Alaska

Pollution is the introduction of harmful contaminants that are outside the norm for a given ecosystem. Ocean pollution has and will continue to have serious impacts on marine ecosystem. Common ocean pollutants include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from non-point sources (i.e., storm water runoff from watersheds), point sources (i.e., wastewater treatment plant discharges), other land-based sources (i.e., windblown debris), spills, dumping, vessels, and atmospheric deposition.

The Government of Japan estimates that 5 million tons of debris was swept into the Pacific Ocean after the March 2011 earthquake and tsunami that struck Japan. An estimated 70 percent sank right away and 1.5 million tons were left floating off the coast. While there are no estimates of how much is still floating, some debris has already reached the Alaskan coast. Marine debris is typically non-hazardous material; however, the tsunami debris is composed of materials found in urban areas (e.g., bottles, building fragments, boats, plastics, and docks). The National Oceanic and Atmospheric Administration works closely with state agencies and local authorities to systematically survey Alaska's coast. NOAA models predict an increase in debris in the next several years; however, very little is anticipated to be hazardous.

Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned in the marine environment. Common types of marine debris include various forms of plastic and abandoned fishing gear, as well as clothing, metal, glass, and other debris. Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service 2006).

Plastic marine debris is a major concern because it degrades slowly and many plastics float, allowing the debris to be transported by currents throughout the oceans. Currents in the oceanic convergence zone in the North Pacific Subtropical Gyre act to accumulate the floating plastic marine debris. These debris carrying currents include the south-flowing California Current, and the north-flowing Gulf of Alaska Current. These currents distribute debris throughout the Study Area.

Additionally, plastic waste in the ocean chemically attracts hydrocarbon pollutants such as PCB and DDT, which accumulate up to one million times more in plastic than in ocean water (Mato et al. 2001). Fish, marine animals, and birds can mistakenly consume these wastes containing elevated levels of toxins instead of their prey. In the North Pacific Subtropical Gyre, it is estimated that the fishes in this area are ingesting 12,000 to 24,000 U.S. tons (10,886,216 to 21,772,433 kilograms) of plastic debris a year (Davison and Asch 2011).

Marine mammals have been documented ingesting marine debris from commercial and recreation sources, sometimes with fatal effects (Barco et al. 2010, Good et al. 2010, Jacobsen et al. 2010, Allen et al. 2011, Cassoff et al. 2011, Denuncio et al. 2011, Williams et al. 2011, Baulch and Perry 2012, de Stephanis et al. 2013, Jauniaux et al. 2013).

Debris that sinks to the seafloor is also a concern for ingestion and entanglement by fish, invertebrates, sea turtles, marine mammals, and marine vegetation. In addition, sunken debris contributes to marine

habitat degradation. In the U.S. west coast Groundfish Bottom Trawl Surveys of 2007 and 2008, anthropogenic debris was observed at depths of 55 to 1,280 meters (180.5 to 4,199.5 feet). The density of debris increased with depth, and the majority of the debris was plastic and metallic, while the rest of it was fabric and glass (Keller et al. 2010).

4.3.3.3.7 Non-Point Sources, Point Sources, and Atmospheric Deposition

Storm water runoff, wastewater, and nonpoint source pollution, are considered major causes of impairment of ocean waters. Storm water runoff from coastal urban areas and beaches carries waste such as plastics and Styrofoam into coastal waters. Sewer outfalls also are a source of ocean pollution. Sewage can be treated to eliminate potentially harmful releases of contaminants; however, releases of untreated sewage occur due to malfunctions or overloads to the infrastructure, resulting in releases of bacteria usually associated with feces, such as *Escherichia coli* and *Enterococci spp*. Bacteria levels are used routinely to determine the quality of water at recreational beaches and as indicators of the possible presence of other harmful microorganisms. In the past, toxic chemicals have been released into sewer systems. While such dumping has long been forbidden by law, the practice left ocean outflow sites contaminated. Sewage treatment facilities generally do not treat or remove persistent organic pollutants, such as polychlorinated biphenyl (PCB) and dichlorodiphenyltrichloroethane (DDT), or other toxins.

Hypoxia (low dissolved oxygen concentration) is a major impact associated with point and non-point sources of pollution. Hypoxia occurs when waters become overloaded with nutrients from pesticides such as nitrogen and phosphorus, which enter oceans from non-point source runoff, wastewater treatment plants, and atmospheric deposition. Too many nutrients can stimulate algal blooms—the rapid expansion of microscopic algae (phytoplankton). When excess nutrients are consumed, the algae population dies off and the remains are consumed by bacteria. Bacterial consumption causes dissolved oxygen in the water to decline to the point where marine life that depends on oxygen can no longer survive (Boesch et al. 1997).

Almost 200 million tons of criteria pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, volatile organic compounds, and particulate matter) were emitted into the U.S. atmosphere in 1997 (U.S. Environmental Protection Agency 1998). Through the process of wet and dry atmospheric deposition, these and other pollutants can return to the earth and the waters. Wet deposition removes gases and particles from the atmosphere and deposits them on the surface of the earth through rain, sleet, snow, and fog. Dry deposition is a process through which particles and gases are deposited in the absence of precipitation, such as through dust (U.S. Geological Survey 2000). This atmospheric deposition also contributes to the buildup of pollutants in the Study Area. Non-point sources, point sources, and atmospheric deposition also contribute toxic pollutants such as metals, pesticides, and other organic compounds to the marine environment. Toxic pollutants may cause lethal or sublethal effects if present in high concentrations, and can build up in tissues over time and suppress immune system function, resulting in disease and death for marine organisms. The main causes of water pollution in the Study Area are predation by invasive species, discharges of oil products (refined oil products, crude oil, and hazardous substances), and industrial and agricultural contaminants (Encyclopedia of Earth 2013).

4.3.3.3.8 Marine Tourism

Tourism is Alaska's second biggest industry in terms of employment, and is the main industry of many small and isolated communities. The coast and some major rivers are the center of Alaska's tourism. Sport fishing is one of the biggest industries along with the growing number of ecotourists visiting the

state. In the summer of 2011 alone, there were a total of 1,556,800 visitors to the state. Cruise ship visitors make up a majority of 57 percent or 883,000 of those visitors. The second-most popular activity of tourists in Alaska is wildlife viewing (52 percent), much of which occurs on the coast. Between 2006 and 2011, the percentage of visitors from the United States fell by 2 percent, while Canada and the other international categories each increased by 1 percent.

4.4 Resource-Specific Cumulative Impacts

4.4.1 Resource Areas Dismissed from Cumulative Impacts Analysis

In accordance with CEQ guidance (Council on Environmental Quality 2010), the cumulative impacts analysis focused on impacts that are "truly meaningful." The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The analysis focused on marine mammals. Detailed analysis of cumulative impacts on the following resources was not necessary as the incremental contribution of the Proposed Action to cumulative impacts would be low and was assessed in the 2011 GOA Final EIS/OEIS. Further analysis of cumulative impacts is not warranted on the following resources:

- Air quality
- Expended materials
- Water resources
- Acoustic environment (airborne)
- Marine plants and invertebrates
- Fish
- Birds
- Cultural resources
- Transportation and circulation
- Socioeconomics
- Environmental justice and protection of children
- Public safety

4.4.2 Marine Mammals

4.4.2.1 Impacts of The Proposed Action That May Contribute to Cumulative Impacts

Based on the analysis presented in Section 3.8 (Marine Mammals), impacts of the Proposed Action that might contribute to cumulative impacts on marine mammals include injury (Level A harassment under the MMPA) and disturbance or behavioral modification (MMPA Level B harassment). Injury could be caused by underwater explosions, or in the form of Permanent Threshold Shift (PTS) could also be caused by sonar use. Underwater explosions and sonar use would result in disturbance that meets the definition of MMPA Level A and B harassment. Other relatively short-term activities that might inadvertently harass marine mammals meet the definition of MMPA Incidental Harassment Authorizations. The remaining stressors analyzed in Section 3.8 (Marine Mammals) are not expected to result in mortality or Level A or B harassment. The incremental contribution of these remaining stressors, discussed in Section 3.8.3 (Environmental Consequences), to cumulative impacts on marine mammals, would be negligible.

4.4.2.2 Impacts of Other Actions

4.4.2.2.1 Overview

The potential impacts of other actions that are relevant to the cumulative impact analysis for marine mammals include the following:

- Mortality associated with non-Navy vessel strikes, bycatch in fisheries, and entanglement in fishing and other gear
- Injury associated with non-Navy vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with water pollution

Most of the other actions and considerations retained for analysis in Table 4.3-1 would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and permitting. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in the maritime traffic and ocean noise subsections. Similarly, many of the actions would result in water pollution. The aggregate impacts of water pollution are addressed in the ocean pollution section (Section 4.4.2.2.5). Bycatch is associated with commercial fishing, and the primary cause of entanglement is commercial fishing. Therefore, these stressors are discussed in the commercial fishing section (Section 4.4.2.3.1).

4.4.2.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Although operation of SURTASS-LFA Sonar would not occur within or near the TMAA, marine mammals could be exposed to that sound source and migrate into the TMAA. Potential impacts on marine mammals from SURTASS-LFA Sonar operations include (1) nonauditory injury,[2] (2) permanent loss of hearing, (3) temporary loss of hearing, (4) behavioral change, and (5) masking. The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of marine mammals from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in marine mammals due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of SURTASS-LFA Sonar with monitoring and mitigation would result in no mortality. The likelihood of low-frequency active sonar transmissions causing marine mammals to strand is negligible (U.S. Department of the Navy 2012).

4.4.2.2.3 Maritime Traffic and Vessel Strikes

Vessel strikes have been and will continue to be a cause of marine mammal mortality and injury throughout the Study Area. A review of the impacts of ship strikes on marine mammals is presented in Section 3.8.2.4 (General Threats). In particular, certain large whales, such as the blue whale, are more prone to vessel strikes (Berman-Kowalewski et al. 2010; Betz et al. 2011). The most vulnerable marine

[2] Nonauditory injury can be defined as not relating to or functioning in hearing (Merriam-Webster 2012); this includes mortality, strike, and lung injury.

mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein 2002; Laist and Shaw 2006; Nowacek et al. 2004). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes. Most vessel strikes of marine mammals reported involve commercial vessels and occur over or near the continental shelf (Laist et al. 2001). The literature review by Laist et al. (2001) concluded that vessel strikes likely have a negligible impact on the status of most whale populations, but that for small populations, vessel strikes may have considerable population-level impacts. The conservation status and abundance of the species struck would determine in large part whether the injury would have population-level impacts on that species (Laist et al. 2001; Vanderlaan and Taggart 2009). There has never been a Navy vessel strike to a marine mammal in the Study Area during any previous training activities. In *Summary of Reported Whale-Vessel Collisions in Alaskan Waters* (Neilson et al. 2012), the research article reports 108 whale-vessel collisions occurred from 1978 to 2011. In 19 cases the vessel type is unknown, but of the 89 that the vessel type is known, 35 percent were private recreational, 35 percent were commercial recreational, 8 percent were cruise ships, 7 percent were commercial fishing vessels, 4 percent were USCG cutters, 3 percent were research, and 1 percent was the state ferry system.

Mysticetes

Virtually all of the rorqual whale species have been documented to have been hit by vessels. This includes blue whales (Berman-Kowalewski et al. 2010; Van Waerebeek et al. 2007; Calambokidis 2012), fin whales (as recently as November 2011 in San Diego) (Van Waerebeek et al. 2007; Douglas et al. 2008), sei whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), minke whales (Van Waerebeek et al. 2007), and humpback whales (Lammers et al. 2003; Van Waerebeek et al. 2007; Douglas et al. 2008).

Odontocetes

Sperm whales may be exceptionally vulnerable to vessel strikes as they spend extended periods of time "rafting" at the surface in order to restore oxygen levels within their tissues after deep dives (Jaquet and Whitehead 1996; Watkins et al. 1999). There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (Aguilar de Soto et al. 2006). In general, odontocetes move quickly and seem to be less vulnerable to vessel strikes than other cetaceans; however, most small whale and dolphin species have at least occasionally suffered from vessel strikes including: killer whales (Visser and Fertl 2000; Van Waerebeek et al. 2007) and short-finned pilot whales (Aguilar et al. 2000; Van Waerebeek et al. 2007).

Pinnipeds

Pinnipeds in general appear to suffer fewer impacts from ship strikes than do cetaceans. This may be due, at least in part, to the large amount of time they spend on land (especially when resting and breeding), and their high maneuverability in the water. However, California sea lions are often attracted to fishing vessels or when food is available onboard or nearby (Hanan et al. 1989), and this may make them somewhat more at risk of being hit by a vessel during these times. Ship strikes are not a major concern for pinnipeds in general (Antonelis et al. 2006; Marine Mammal Commission 2002; National Marine Fisheries Service 2007).

4.4.2.2.4 Ocean Noise

Noise is generally described as unwanted sound—sound that clutters and masks other sounds of interest (Richardson et al. 1995). Anthropogenic sources of noise that are most likely to contribute to increases in ocean noise are vessel noise from commercial shipping and general vessel traffic,

oceanographic research, oil and gas exploration, underwater construction, and naval and other use of sound navigation and ranging (sonar).

Any potential for cumulative impact should be put into the context of recent changes to ambient sound levels in the world's oceans as a result of anthropogenic activities. However, there is a large and variable natural component to the ambient noise level as a result of events such as earthquakes, rainfall, waves breaking, and lightning hitting the ocean as well as biological noises such as those from snapping shrimp and the vocalizations of marine mammals.

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver approximately 25 mi. (40 km) west of Point Sur, California. The data showed an increase in ambient noise of approximately 10 dB in the frequency ranges of 20–80 Hz and 200–300 Hz, and about 3 dB at 100 Hz over a 33-year period. Each 3 dB increase is noticeable to the human ear as a doubling in sound level. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating 300 days per year, producing constant broadband noise at source levels of 198 dB (Hildebrand 2004).

Appendix D (Acoustic Primer) provides additional information about sources of anthropogenic sound in the ocean and other background information about underwater noise. This appendix describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for individual animals and populations. A variety of impacts may result from exposure to sound-producing activities. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal, to more severe impacts that may have lasting consequences. The major categories of potential impacts are: behavioral reactions, physiological stress, auditory fatigue, auditory masking, and direct trauma.

4.4.2.2.5 Ocean Pollution

As discussed in Section 3.8.3 (Environmental Consequences), pollutants from multiple sources are present in, and continue to be released into, the oceans. Elevated concentrations of certain compounds have been measured in tissue samples from marine mammals. Long-term exposure to pollutants poses potential risks to the health of marine mammals, although for the most part, the impacts are just starting to be understood (Reijnders et al. 2008). Section 3.8.3 (Environmental Consequences) provides an overview of these potential impacts, which include organ anomalies and impaired reproduction and immune function (Reijnders et al. 2008).

If the health of an individual marine mammal were compromised by long-term exposure to pollutants, it is possible that this condition could alter the animal's expected response to stressors from training activities associated with the Proposed Action. The behavioral and physiological responses of any marine mammal to a specific stressor, such as underwater sound, could be influenced by a number of other factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, size, and social position. Synergistic impacts are also possible. For example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter 2005). While the response of a previously stressed animal might be different than the response of an unstressed animal, there are no data available at this time to accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to a particular stressor associated with the Proposed Action.

4.4.2.3 Coastal Development

Coastal development and increased human populations in coastal areas will continue to have impacts on marine mammals such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds (see Section 3.8, Marine Mammals, for more information on impacts on marine mammals).

4.4.2.3.1 Commercial Fishing

Several commercial fisheries operate in the Study Area. Potential impacts from these activities include marine mammal injury and mortality from bycatch and entanglement. Fisheries have also resulted in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals.

Numerous ports in or near the Study Area contain both commercial and commercial passenger fishing vessel (i.e., recreational) fishing fleets that use the ocean areas within the Study Area.

In 1994, the MMPA was amended to formally address bycatch. Estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer and Read 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period. However, fishery bycatch is likely the most impactful problem presently and may account for the deaths of more marine mammals than any other cause (Northridge 2008, Read 2008, Hamer et al. 2010; Geijer and Read 2013).

As discussed in Section 3.8.3.9 (Entanglement Stressors), entanglement in fishing gear is another major threat to marine mammals in the Study Area. In addition, overfishing of many fish stocks has resulted in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al. 2001; Myers and Worm 2003; Pauly et al. 1998). These ecological changes may have important and likely adverse consequences for populations of marine mammals (DeMaster et al. 2001).

In summary, future commercial fishing activities in the Study Area are expected to result in significant impacts on some marine mammal species based on the relatively high injury and mortality rates associated with bycatch and entanglement. This mortality could result in or contribute to population declines for some species. Ecological changes brought about by commercial fishing are also expected to adversely impact marine mammals in the Study Area.

Entanglement of humpback whales in Alaska occur mainly in Southeast Alaska and involve crab, shrimp, unidentified pot gear, and gillnet fisheries. Humpback whales have been identified in Hawaii entangled in gear from Alaska. The number of events of identified entanglement has increased from less than 5 in 1990 to almost 15 in 2011 (Jackson et al. n.d.). The Alaska Network is permitted by NOAA Fisheries to attempt animal disentanglement. Since the Network began in 1998, there have been over 130 reports of large whale entanglements in local fishing gear, marine debris, and mooring gear (National Marine Fisheries Service n.d.).

4.4.2.4 Cumulative Impacts on Marine Mammals

The aggregate impacts of past, present actions and reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. The impacts are considered significant because vessel strikes, bycatch, and entanglement associated with other actions are expected to result in relatively high rates of injury and mortality that could cause population

declines in some species. The Proposed Action could also result in injury to individuals of some marine mammal species from underwater explosions, sonar, and vessel strikes. Injury that might occur under the Proposed Action would be additive to injury and mortality associated with other actions. However, the relative contribution of the Proposed Action to the overall injury and mortality would be low compared to other actions. The Navy does not anticipate mortalities to marine mammals within the Study Area as a result of training activities under the Proposed Action. While quantitative estimates of marine mammal mortality from other actions are not available, the total bycatch estimate (lethal takes and serious injuries) for marine mammals for 39 fisheries and 54 marine mammal stocks throughout the United States was 1,887 individual animals in 2005 (National Oceanic and Atmospheric Administration 2011). Some of these mortalities likely occurred in the Study Area or affected individuals that used the Study Area seasonally.

Ocean noise associated with other actions (see Section 4.4.2.2.4, Ocean Noise), such as underwater explosions and sonar associated with the Proposed Action, could also result in additive behavioral impacts on marine mammals. However, in the Study Area, it is unlikely that these actions and underwater explosions or sonar use would overlap in time and space because these activities are dispersed and the sound sources are intermittent. The Navy takes appropriate coordination and scheduling steps (described in Section 3.12, Socioeconomic Resources) to avoid activities that interfere with or are not compatible with training.

It is likely that distant shipping noise, which is more universal and continuous, and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on marine mammals.

As discussed in Section 4.4.2.2.5 (Ocean Pollution), the potential also exists for the impacts of ocean pollution and acoustic stressors associated with the Proposed Action to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal.

4.5 Summary of Cumulative Impacts

Marine mammals are the primary resources of concern for cumulative impacts analysis:

- Past human activities have impacted these resources to the extent that several marine mammal species occurring in the Study Area are ESA-listed.
- These resources would be impacted by multiple ongoing and future actions.
- Explosive detonations and vessel strikes under the Proposed Action have the potential to disturb, injure, or kill marine mammals.

In summary, based on the analysis presented in Section 3.8 (Marine Mammals), the current aggregate impacts of past, present, and other reasonably foreseeable future actions are not significantly different than the assessment in the 2011 GOA Final EIS/OEIS. No new information or circumstances are significant enough to warrant further cumulative impact review.

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5 Standard Operating Procedures, Mitigation, and Monitoring

TABLE OF CONTENTS

5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING 5-1

5.1 STANDARD OPERATING PROCEDURES 5-1
5.1.1 GENERAL SAFETY 5-2
5.1.2 VESSEL SAFETY 5-2
5.1.3 AIRCRAFT SAFETY 5-3
5.1.4 LASER PROCEDURES 5-3
5.1.4.1 Laser Operators 5-3
5.1.4.2 Laser Activity Clearance 5-3
5.1.5 WEAPONS FIRING PROCEDURES 5-3
5.1.5.1 Notice to Mariners 5-3
5.1.5.2 Weapons Firing Range Clearance 5-3
5.1.6 UNMANNED AERIAL AND UNDERWATER VEHICLE PROCEDURES 5-4
5.1.7 TOWED IN-WATER DEVICE PROCEDURES 5-4
5.1.8 BEST MANAGEMENT PRACTICES 5-4
5.2 INTRODUCTION TO MITIGATION 5-5
5.2.1 REGULATORY REQUIREMENTS FOR MITIGATION 5-5
5.2.2 OVERVIEW OF MITIGATION APPROACH 5-6
5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements 5-6
5.2.2.2 Protective Measures Assessment Protocol 5-7
5.2.3 ASSESSMENT METHOD 5-7
5.2.3.1 Effectiveness Assessment 5-8
5.2.3.2 Operational Assessment 5-9
5.3 MITIGATION ASSESSMENT 5-10
5.3.1 LOOKOUT PROCEDURAL MEASURES 5-10
5.3.1.1 Specialized Training 5-11
5.3.1.2 Lookouts 5-12
5.3.2 MITIGATION ZONE PROCEDURAL MEASURES 5-20
5.3.2.1 Acoustic Stressors 5-23
5.3.2.2 Physical Disturbance and Strike 5-37
5.3.3 MITIGATION MEASURES CONSIDERED BUT ELIMINATED 5-41
5.3.3.1 Previously Considered But Eliminated 5-41
5.4 MITIGATION SUMMARY 5-50
5.5 MONITORING AND REPORTING 5-55
5.5.1 APPROACH TO MONITORING 5-55
5.5.1.1 Integrated Comprehensive Monitoring Program 5-55
5.5.1.2 Scientific Advisory Group Recommendations 5-56
5.5.2 REPORTING 5-57
5.5.2.1 Exercise and Monitoring Reporting 5-57
5.5.2.2 Additional Reporting Requirements 5-57
5.5.2.3 Stranding Response Plan 5-58
5.5.2.4 Bird Strikes 5-58

LIST OF TABLES

TABLE 5.3-1: SIGHTABILITY BASED ON G(0) VALUES FOR MARINE MAMMAL SPECIES IN THE STUDY AREA 5-18
TABLE 5.3-2: PREDICTED RANGE TO EFFECTS AND RECOMMENDED MITIGATION ZONES 5-22
TABLE 5.4-1: SUMMARY OF RECOMMENDED MITIGATION MEASURES 5-51
TABLE 5.4-2: MITIGATION IDENTIFICATION AND IMPLEMENTATION 5-53

LIST OF FIGURES

FIGURE 5.2-1: FLOWCHART OF PROCESS FOR DETERMINING RECOMMENDED MITIGATION MEASURES 5-8

5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING

This chapter describes the United States (U.S.) Department of the Navy (Navy) standard operating procedures (SOPs), mitigation measures, and marine species monitoring and reporting efforts. SOPs are essential to maintaining safety and mission success, and in many cases have the added benefit of reducing potential environmental impacts. Mitigation measures are designed to reduce or avoid potential impacts on marine resources. Marine species monitoring efforts are designed to track compliance with take authorizations, evaluate the effectiveness of mitigation measures, and improve understanding of the impacts of training activities on marine resources within the Gulf of Alaska (GOA) Temporary Maritime Activities Area (TMAA) Study Area (Study Area).

Consistent with the cooperating agency agreement with the National Marine Fisheries Service (NMFS), mitigation and monitoring measures presented in the Final Environmental Impact Statement (EIS)/Overseas EIS (OEIS) focused on the requirements for protection and management of marine resources. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Since completion of the 2011 GOA Final EIS/OEIS, on-going cooperation with NMFS and new modeling protocols have resulted in changes to mitigation, standard operating procedures, and monitoring procedures. As a result, this chapter presents the most up-to-date mitigations, standard operating procedures, and monitoring procedures that the Navy implements rather than a supplement to the information presented in Chapter 5 of the 2011 GOA Final EIS/OEIS.

5.1 STANDARD OPERATING PROCEDURES

Effective training (hereafter referred to as the Proposed Action) requires participants to utilize their sensors and weapon systems to their optimum capabilities as required by the activity objectives. The Navy currently employs standard practices to provide for the safety of personnel and equipment, including vessels and aircraft, as well as the success of the training activities. For the purpose of this document, standard practices are referred to as SOPs. Because of their importance for maintaining safety and mission success, SOPs have been considered as part of the Proposed Action and therefore are included in the Chapter 3 environmental analyses for resources that are being re-analyzed.

Navy SOPs have been developed and refined over years of experience, and are broadcast via numerous naval instructions and manuals, including the following sources:

- Ship, Submarine and Aircraft Safety Manuals
- Ship, Submarine and Aircraft Standard Operating Manuals
- Fleet Area Control and Surveillance Facility Range Operating Instructions
- Fleet Exercise Publications and Instructions
- Naval Gunfire Safety Instructions
- Navy Planned Maintenance System Instructions and Requirements
- Federal Aviation Administration Regulations

In many cases there are incidental environmental, socioeconomic, and cultural benefits resulting from SOPs. SOPs serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits. This is what distinguishes SOPs, which are a component of the Proposed Action, from mitigation measures, which are designed entirely for the purpose of reducing environmental impacts resulting from the Proposed Action. Because SOPs are crucial to safety and

mission success, the Navy will not modify them as a way to further reduce impacts on environmental resources. Rather, mitigation measures will be used as the tool for avoiding and reducing potential environmental impacts. SOPs are internal documents that are under the configuration management of the individual commands. SOPs that are recognized as providing a potential secondary benefit are provided below.

5.1.1 General Safety

In the development of SOPs and measures to protect the safety of its people, the Navy follows the guidance set forth in the Chief of Naval Operations Instructions (OPNAVINST) 5100.19 (Navy Safety and Occupational Health Program Manual for Forces Afloat) and 5100.23 (Navy Safety and Occupational Health Program Manual). These instructions provide minimum requirements under which organizations may develop procedures that delineate additional organizational specific requirements. These two instructions include policies for public safety; laser procedures; weapons firing procedures; and unmanned aircraft, surface, and underwater vehicle activities.

5.1.2 Vessel Safety

For the purposes of this chapter, the term “ship” is inclusive of surface ships and surfaced submarines. The term “vessel” is inclusive of ships and small boats (e.g., rigid-hull inflatable boats).

Ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when moving through the water (underway). Watch personnel undertake extensive training in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent, including on-the-job instruction and a formal Personal Qualification Standard Program (or equivalent program for supporting contractors or civilians), to certify that they have demonstrated all necessary skills (such as detection and reporting of floating or partially submerged objects). Watch personnel are composed of officers, enlisted men and women, and civilian equivalents. Their duties may be performed in conjunction with other job responsibilities, such as navigating the ship or supervising other personnel. While on watch, personnel employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. After sunset and prior to sunrise, watch personnel employ night visual search techniques, which could include the use of night vision devices.

A primary duty of watch personnel is to detect and report all objects and disturbances sighted in the water that may be indicative of a threat to the ship and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per safety requirements, watch personnel also report any marine mammals sighted that have the potential to be in the direct path of the ship as a standard collision avoidance procedure. Because watch personnel are primarily posted for safety of navigation, range clearance, and man-overboard precautions, they are not normally posted while ships are moored to a pier. When anchored or moored to a buoy, a watch team is still maintained but with fewer personnel than when underway. When moored or at anchor, watch personnel may maintain security and safety of the ship by scanning the water for any indications of a threat (as described above).

While underway, Navy ships (with the exception of submarines) greater than 65 feet (ft.) (20 meters [m]) in length have at least two personnel standing watch; Navy ships less than 65 ft. (20 m) in length, submarines, and contractor vessels have at least one person standing watch. While underway, personnel standing watch are alert at all times and have access to binoculars. Due to limited manning and space limitations, small boats do not have dedicated personnel standing watch, and the boat crew is responsible for maintaining the safety of the boat and surrounding environment.

All vessels use appropriate caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

5.1.3 AIRCRAFT SAFETY

Pilots of Navy aircraft make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike.

5.1.4 LASER PROCEDURES

Only low-energy lasers, some of which could be hazardous to human eyes, are proposed for use. The following procedures are applicable to lasers of sufficient intensity to cause human eye damage.

5.1.4.1 Laser Operators

Only properly trained and authorized personnel operate lasers.

5.1.4.2 Laser Activity Clearance

Prior to commencing activities involving lasers, the operator ensures that the area is clear of unprotected or unauthorized personnel in the laser impact area by performing a personnel inspection or a flyover. The operator also ensures that any personnel within the area are aware of laser activities and are properly protected.

5.1.5 WEAPONS FIRING PROCEDURES

When the Navy conducts any potentially hazardous training activity, such as weapons firing, personnel are assigned to fulfill critical safety functions. A Range Safety Officer is responsible for the safe conduct of all activities on the range on which activities are being conducted. For activities conducted off of designated ranges, an officer (or civilian equivalent) on a ship or aircraft engaged in the activity or within visual range of the activity may function as the Range Safety Officer. For larger exercises, the Officer Conducting the Exercise (or civilian equivalent) is ultimately responsible for the safe conduct of range training. Either the Officer Conducting the Exercise or the Range Safety Officer assigned to the event can terminate activities if unsafe conditions exist.

5.1.5.1 Notice to Mariners

A Notice to Mariners (NTM) is issued in advance of hazardous activities or activities in which navigational hazards are present, such as missile firing, gunnery exercises, and air-to-surface bombing. More information on NTMs is found in the 2011 GOA Final EIS/OEIS Chapter 3, Section 3.14 (Public Safety).

5.1.5.2 Weapons Firing Range Clearance

The weapons firing hazard range must be clear of non-participating vessels and aircraft before firing activities will commence. The size of the firing hazard range is based on the farthest firing range capability of the weapon being used. All missile and rocket firing activities are carefully planned in advance and conducted under strict procedures that place the ultimate responsibility for range safety on the officer conducting the exercise or civilian equivalent. All weapons firing is secured when cease fire orders are received from the Range Safety Officer or when the line of fire is endangering any object other than the designated target.

Pilots of Navy aircraft are not authorized to expend ordnance, fire missiles, or drop other airborne devices through any cloud cover where visual clearance of the air and surface area is not possible. The two exceptions to this requirement are: (1) when operating in the open ocean, air, and surface clearance through visual means or radar surveillance is acceptable; and (2) when the officer conducting the exercise accepts responsibility for the safeguarding of airborne and surface traffic.

During activities that involve recoverable targets (e.g., aerial drones), the Navy recovers the target and any associated parachutes to the maximum extent practical consistent with operational requirements and personnel safety.

5.1.6 Unmanned Aerial and Underwater Vehicle Procedures

For activities involving unmanned aerial and underwater vehicles, the Navy evaluates the need to publish a Notice to Airmen or NTM based on the scale, location, and timing of the activity. Unmanned aerial vehicles and unmanned aircraft systems are operated in accordance with Federal Aviation Administration air traffic organization policy as issued in Office of the OPNAVINST 3710, 3750, and 4790.

5.1.7 Towed In-Water Device Procedures

Prior to deploying a towed device from a manned platform, there is a SOP to search the intended path of the device for any floating debris (e.g., driftwood) or other potential obstructions (e.g., animals), as they have the potential to cause damage to the device.

5.1.8 Best Management Practices

Best management practices include measures that regulate operations to ensure compliance with pollution emission requirements and general resource conservation goals. In the development of best management practices, the Navy will utilize and implement all applicable sections of OPNAVINST 5090.1D (Environmental Readiness Program Manual). This instruction provides minimum requirements, under which organizations may develop procedures that delineate additional organizational-specific requirements. Some SOPs also provide best management practices value.

In Chapter 3 of this Draft Supplemental EIS/OEIS, the Navy analyzed environmental resources for potential impacts resulting from the Navy's Proposed Action. All of the Navy's best management practices provide protection to environmental resources. For example, Navy policies and procedures identified in Navy instructions such as the Environmental Readiness Program Manual include directives regarding waste management, pollution prevention, and recycling, all of which benefit sediments and water quality in the ocean. Any procedures or practices that benefit ocean sediments and water quality in turn benefit all marine life in the ocean, from plants and invertebrates, to fish and marine mammals.

Some examples of SOPs that also contribute to best management practices are pollution control programs. The Navy's compliance with the Clean Air Act and its implementing regulations has resulted in comprehensive air quality management programs that help to ensure minimum impacts to air quality.

Many of the Navy's SOPs are directed at enhancing safety, both for the Sailors involved in the activities as well as non-participant members of the public. One program initially focused on safety has the added benefit of reducing bird injuries and fatalities: the Navy's Bird/Animal Aircraft Strike Hazard Program. This program has resulted in reduced incidents of aircraft striking birds.

These examples illustrate common Navy procedures and practices that can often reduce impacts to environmental and human resources. The following section will describe procedures implemented specifically to mitigate environmental impacts.

5.2 INTRODUCTION TO MITIGATION

The Navy recognizes that the Proposed Action has the potential to impact the environment. Mitigation measures are modifications to the Proposed Action that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. The procedures discussed in this chapter, most of which are currently or were previously implemented as a result of past environmental compliance documents, Endangered Species Act (ESA) biological opinions, Marine Mammal Protection Act (MMPA) Letters of Authorization, or other formal or informal consultations with regulatory agencies, are being coordinated with NMFS and the U.S. Fish and Wildlife Service (USFWS) through the consultation and permitting process.

In order to make the findings necessary to issue an MMPA letter of authorization, it may be necessary for NMFS to require additional mitigation measures or monitoring beyond those contained in this Draft Supplemental EIS/OEIS. These could include measures considered, but eliminated in this Supplemental EIS/OEIS, or as yet undeveloped measures. The public will have an opportunity to provide information to NMFS through the MMPA process, both during the comment period following NMFS' notice of receipt of the application for a letter of authorization, and during the comment period following publication of the proposed rule. NMFS may propose additional mitigation measures or monitoring in the proposed rule.

Additionally, the Navy is engaging in consultation processes under the ESA with regard to listed species that may be affected by the Proposed Action described in this Supplemental EIS/OEIS. For the purposes of the ESA section 7 consultation, the mitigation measures proposed here may be considered by NMFS or USFWS as beneficial actions taken by the Federal agency or applicant (50 Code of Federal Regulations [C.F.R.] 402.14(g)(8)). If required to satisfy requirements of the ESA, NMFS or USFWS may develop an additional set of measures contained in terms and conditions, reasonable and prudent measures, or conservation recommendations in any biological opinion issued for the Proposed Action. The Navy will also consider public comments on proposed mitigation measures described in this Draft Supplemental EIS/OEIS.

5.2.1 REGULATORY REQUIREMENTS FOR MITIGATION

An EIS must analyze the affected environment, discuss the environmental impacts of the Proposed Action and each alternative, and assess the significance of the impacts on the environment. Mitigation measures are designed to help reduce the severity or intensity of impacts of the Proposed Action and can occur early in the planning process. An agency may choose not to take the action or to move the location of the action. Mitigation measure development also occurs throughout the analysis process whenever an impact is minimized by limiting the degree or magnitude of the action or its implementation. Mitigation measures can also include actions that repair, rehabilitate, or restore the affected environment or reduce impacts over time through constant monitoring and corrective adjustments.

In accordance with the National Environmental Policy Act (NEPA) requirement, the environmental benefit of all Navy recommended proposed mitigation measures will apply to the Proposed Action analyzed in this Draft Supplemental EIS, and according to Navy policy, will also apply to the Draft Supplemental OEIS where applicable and appropriate. Additionally, the White House Council on

Environmental Quality (CEQ) issued guidance for mitigation and monitoring on 14 January 2011. This guidance affirms that federal agencies, including the Navy, should:

- commit to mitigation in decision documents when they have based environmental analysis upon such mitigation (by including appropriate conditions on grants, permits, or other agency approvals, and making funding or approvals for implementing the Proposed Action contingent on implementation of the mitigation commitments);
- monitor the implementation and effectiveness of mitigation commitments;
- make information on mitigation and monitoring available to the public, preferably through agency web sites; and
- remedy ineffective mitigation when the federal action is not yet complete.

The CEQ guidance encourages federal agencies to develop internal processes for post-decision monitoring to ensure the implementation and effectiveness of the mitigation. It also states that federal agencies may use adaptive management as part of an agency's action. Adaptive management, when included in the NEPA analysis, allows for the agency to take alternate mitigation actions if mitigation commitments originally made in the planning and decision documents fail to achieve projected environmental outcomes. Adaptive management generally involves four phases: plan, act, monitor, and evaluate. This process allows the use of the results to update knowledge and adjust future management actions accordingly. Through implementing mitigation measures from the Navy's previous planning, consultations, permits, and monitoring of those efforts, the Navy has collected data to further refine proposed mitigation measures.

Through the planning, consultation, and permitting processes, federal regulatory agencies may also suggest that the Navy analyze additional mitigation measures for inclusion in the Final Supplemental EIS/OEIS and associated consultation and permitting documents. Any proposals for additional mitigation measures should be based on the federal agency's assessment of the likelihood that such measures will contribute to a notable reduction of the environmental impact. If additional measures are identified, the Navy will apply the effectiveness and operational assessment protocol discussed in Section 5.3 (Mitigation Assessment) to determine whether the additional measure will be proposed for implementation. This additional analysis will be presented in the Final Supplemental EIS/OEIS, and, the final suite of mitigations resulting from the ongoing planning, consultation, and permitting processes will be documented in the Record of Decision (ROD).

5.2.2 Overview of Mitigation Approach

This section describes the approach that the Navy took to develop its recommended mitigation measures. The Navy's overall approach to assessing potential mitigation measures was based on two principles: (1) mitigations will be effective at reducing potential impacts on the resource; and (2) from a military perspective, the mitigations are practical to implement, executable, and personnel safety and readiness will not be impacted. The assessment process involved using information directly from Chapter 3 (Affected Environment and Environmental Consequences) and assessing all existing mitigation and proposals for new or modified mitigation in order to determine if recommending a mitigation measure for implementation would be appropriate.

5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements

In an effort to improve upon past processes, the Navy considered all mitigations previously implemented and adapted its mitigation assessment approach based on lessons learned from previous

EISs, ESA biological opinions, MMPA Letters of Authorization, and other formal or informal consultations with regulatory agencies. For example, during the development of the GOA EIS/OEIS the Navy determined that relocation of activities to another range was not possible due to a number of factors. The Navy considered reduction or elimination of training in the GOA, but determined that a reduction would not fulfill its Title 10 training requirements or meet joint training requirements.

Navy planners, scientists, and the operational community assessed the effectiveness of a full suite of potential mitigation measures (a portion of which were specific mitigation areas) on a case-by-case basis, using information and lessons learned from the Navy's internal adaptive management process. The resulting assemblage of recommended measures is comprised of currently implemented measures, modifications of currently implemented measures, and newly proposed measures. Details on the assessment methods are provided in Section 5.2.3 (Assessment Method). The rationale for recommending, modifying, adding, or discontinuing each measure is provided in Section 5.3 (Mitigation Assessment).

5.2.2.2 Protective Measures Assessment Protocol

The Protective Measures Assessment Protocol (PMAP), which was used in the 2011 GOA Final EIS/OEIS, is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with mitigation measures during the conduct of certain training activities at sea. The Navy runs the PMAP program during the event planning process to ensure that personnel involved in the activity are aware of the mitigation requirements and to help ensure that all mitigations are implemented appropriately. In addition to providing notification of the required mitigation, the tool also provides a visual display of the exercise area, unit's position in relation to the target area, and any relevant environmental data. The final suite of mitigation measures contained in the ROD will be integrated into the PMAP.

Section 5.3.1.1.1.1 (United States Navy Afloat Environmental Compliance Training Series) contains information about the newly developed PMAP training module.

5.2.3 Assessment Method

As shown in Figure 5.2-1, the Navy undertook an effectiveness assessment and operational assessment for each potential mitigation measure to ensure its compatibility with Section 5.2.2 (Overview of Mitigation Approach). The Navy used information from published and readily available sources, as well as Navy after-action and monitoring reports. When available, these data were used when they represented the best available science and if they were generally accepted by the scientific community to ensure that they were applicable and contributed to the analysis.

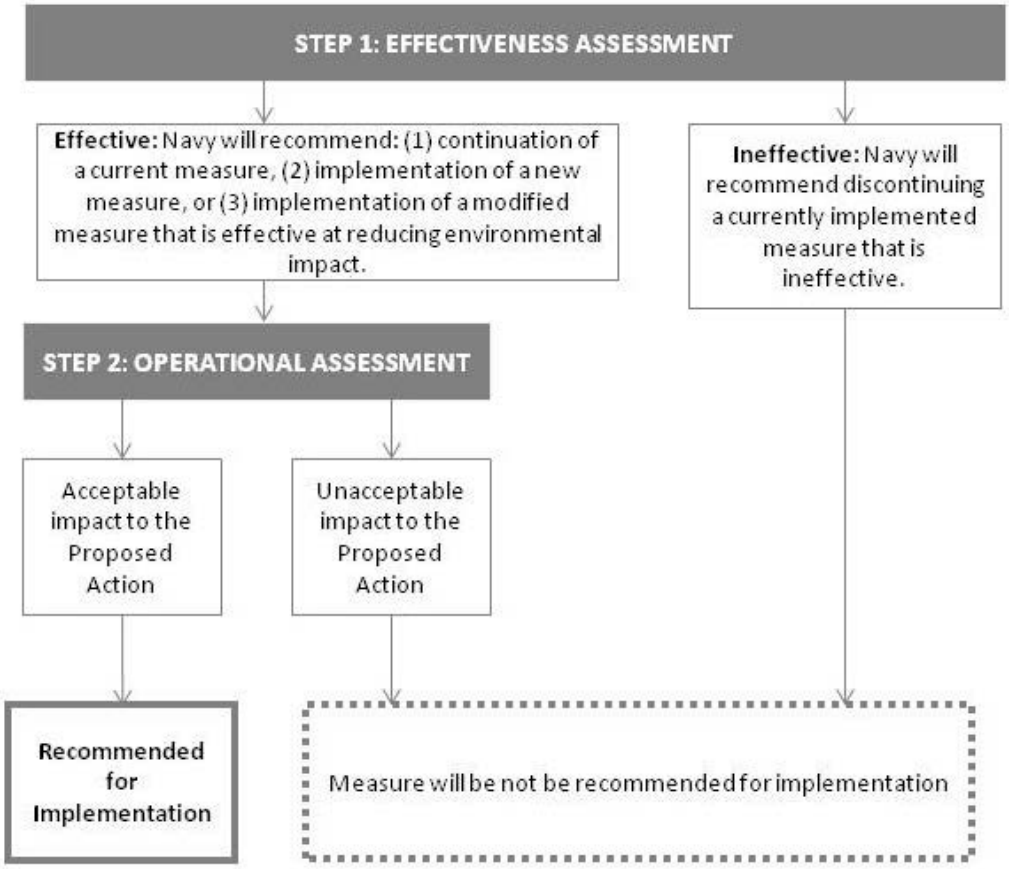

Figure 5.2-1: Flowchart of Process for Determining Recommended Mitigation Measures

5.2.3.1 Effectiveness Assessment

5.2.3.1.1 Procedural Measures

Procedural measures could involve employing techniques or technology to modify an activity in order to avoid or reduce a potential impact on a particular resource. For the purposes of organization, procedural measures are discussed within two subcategories: Lookouts and mitigation zones.

A procedural measure was deemed effective if implementing the measure was likely to result in avoidance or reduction of an impact on a resource. The level of avoidance or reduction of the impact gained from implementing a procedural measure was weighed against the potential for a shift in impacts resulting from the activity modification. For example, if predictive modeling results indicate that the use of underwater explosives could cause unacceptable impacts on a particular resource; those impacts could possibly be reduced by substituting non-explosive activities for explosive activities. However, if the increased use of non-explosive activities would consequently produce an unacceptable impact on habitats due to an associated physical disturbance or strike risk from military expended materials, the measure would not necessarily be justifiable.

A procedural measure was deemed ineffective if its implementation would not result in avoidance or reduction of an impact on a resource, or if an unacceptable impact will simply be shifted from one resource to another. For ineffective procedural measures that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.1.2 Proposed Mitigation Areas

In order to avoid or reduce a potential impact on a particular resource, the Navy would either limit the time of day or duration in which a particular activity could take place, or move or relocate a particular activity outside of a specific geographic area, yet still remain within the Study Area. Within mitigation areas, the measures would only apply to the specific activity that resulted in the requirement for mitigation, and would not prevent or restrict other activities from occurring during that time or in that area.

A proposed mitigation area was deemed effective if implementing the measure would likely result in avoidance or reduction of the impact on the resource. The specific season, time of day, or geographic area must be important to the resource. In determining importance, special consideration was given to time periods or geographic areas having characteristics such as especially high overall density or percent population use, seasonal bottlenecks for a migration corridor, and identifiable key foraging and reproduction areas.

Avoidance or reduction of the impact in the specific time period or geographic area was weighed against the potential for causing new impacts in alternative time periods or geographic areas. For example, if the proposed training event predicted to cause unacceptable impacts on a particular resource in a known foraging location, those impacts could possibly be reduced by relocating those activities to a new location. However, if the proposed training event at the new location would consequently produce an unacceptable impact on the same or a different resource at the new location, the measure would not necessarily be justifiable.

A proposed mitigation area was deemed ineffective if implementing the measure would not result in avoidance or reduction of an impact on a resource, or if an unacceptable impact would simply be shifted from one time period or location to another. For ineffective mitigation areas that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.2 Operational Assessment

The Navy conducted the operational assessment for procedural measures and proposed mitigation areas using the criteria described below. The Navy deemed procedural and mitigation area measures to have acceptable operational impacts on a particular proposed activity if the following four conclusions were reached:

1. Implementation of the measure will not increase safety risks to Navy personnel and equipment.
2. Implementation of the measure is practical. Practicality was defined by the following factors:
    - The measure does not result in an unacceptable increase in resource requirements (e.g., wear and tear on equipment, additional fuel, additional personnel, increased training requirements, or additional reporting requirements).
    - The measure does not result in an unacceptable increase in time away from homeport for Navy personnel.
    - The measure does not result in national security concerns. Should national security require conducting more than the designated number of activities, or a change in how the Navy conducts those activities, the Navy reserves the right to provide the regulatory federal agency with prior notification and include the information in any associated exercise or monitoring reports.

- The measure is consistent with Navy policy.

3. Implementation of the measure will not result in an unacceptable impact on readiness. A primary factor that was considered for all mitigation measures is that the measure must not modify the activity in a way that no longer allows the activity to meet the intended objectives, and ultimately must not interfere with the Navy meeting all of its military readiness requirements. Specifically, for mitigation area measures, the following additional factors were considered:
   - The activity is not dependent on a specific range or range support structure within the mitigation area, and there are alternate areas with the necessary environmental conditions (e.g., oceanographic conditions).
   - The mitigation area does not hold any current or foreseeable future readiness value. This assessment will be revisited if Navy operations or national security interests conclude that training needs to occur within the mitigation area.
   - Implementation of the measure will not prohibit conducting shipboard maintenance, repair, and testing pierside prior to at-sea operations.
4. The Navy has legal authority to implement the measure.

If all four of the above conditions were not able to be reached, the Navy deemed the procedural or proposed mitigation area measure to have unacceptable impacts on the Proposed Action, and did not recommend those unacceptable measures for implementation.

5.3 Mitigation Assessment

The effectiveness and operational assessments resulted in potential mitigation measures being organized into the following four sections:

- Section 5.3.1 (Lookout Procedural Measures) includes recommended measures specific to the use of Lookouts or trained marine species observers.
- Section 5.3.2 (Mitigation Zone Procedural Measures) includes recommended measures specific to visual observations with a mitigation zone.
- Section 5.3.3 (Mitigation Measures Considered but Eliminated) includes measures that the Navy does not recommend for implementation due to the measure being ineffective at reducing environmental impacts, having an unacceptable operational impact, or being incompatible with Section 5.2.2 (Overview of Mitigation Approach).

A summary of the Navy recommended measures is provided in Table 5.4-1.

5.3.1 Lookout Procedural Measures

As described in Section 5.1 (Standard Operating Procedures), ships have personnel assigned to stand watch at all times while underway. Standard watch personnel may perform watch duties in conjunction with job responsibilities that extend beyond looking at the water or air (such as supervision of other personnel). This section will introduce Lookouts, who perform similar duties to standard personnel standing watch and whose duties satisfy safety of navigation and mitigation requirements.

The Navy will have two types of Lookouts for the purposes of conducting visual observations: those positioned on ships; and those positioned ashore, in aircraft, or on small boats. Lookouts positioned on ships will diligently observe the air and surface of the water. They will have multiple observation objectives, which include but are not limited to detecting the presence of biological resources and

recreational or fishing boats, observing the mitigation zones described in Section 5.3.1.2 (Lookouts), and monitoring for vessel and personnel safety concerns.

Due to manning and space restrictions on aircraft, small boats, and some Navy Ships, Lookouts for these platforms may be supplemented by the aircraft crew or pilot, boat crew, range site personnel, or shore-side personnel. Lookouts positioned in minimally manned platforms may be responsible for tasks in addition to observing the air or surface of the water (e.g., navigation of a helicopter or small boat). However, all Lookouts will, considering personnel safety, practicality of implementation, and impact on the effectiveness of the activity, comply with the observation objectives described above for Lookouts positioned on ships.

The procedural measures described below primarily consist of having Lookouts during specific training activities.

5.3.1.1 Specialized Training

5.3.1.1.1 Training for Navy Personnel and Civilian Equivalents

5.3.1.1.1.1 United States Navy Afloat Environmental Compliance Training Series

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to continue implementing the Marine Species Awareness Training for watch personnel and Lookouts, and as further described below, to add the requirement for additional Navy personnel and civilian equivalents to complete one or more environmental training modules.

The Navy has developed the U.S. Navy Afloat Environmental Compliance Training Series to help ensure Navy-wide compliance with environmental requirements, and to help Navy personnel gain a better understanding of their personal roles and responsibilities. The training series contains four interactive multimedia training modules. Personnel will be required to complete all modules identified in their career path training plan.

The first module is the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series. The introduction module provides information on environmental laws (e.g., ESA and MMPA) and responsibilities relevant to Navy training and testing activities. The material is put into context of why environmental compliance is important to the Navy, from the most junior sailor to Commanding Officers.

The second module is the U.S. Navy Marine Species Awareness Training. Consistent with current requirements, all personnel standing watch on the bridge, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare helicopter crews, civilian equivalents, and Lookouts will successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The module contained within the U.S. Navy Environmental Compliance Training Series is an update to the current Marine Species Awareness Training version 3.1. The updated training is designed to improve the effectiveness of visual observations for marine resources, including marine mammals and sea turtles. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures.

The third module is the U.S. Navy PMAP. PMAP is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with worldwide mitigation measures during the conduct of training and testing activities at sea. The module provides instruction for generating and reviewing

PMAP reports. Section 5.2.2.2 (Protective Measures Assessment Protocol) contains additional information on the benefits of the software tool.

The fourth module is the U.S. Navy Sonar Positional Reporting System and marine mammal incident reporting. The Navy developed the Sonar Positional Reporting System as its official record of underwater sound sources used under its MMPA permits. Marine mammal incidents include vessel strikes and animal strandings. The module provides instruction on the reporting requirements and procedures.

Effectiveness and Operational Assessment

Navy personnel undergo extensive training in order to stand watch on the bridge. Standard training includes on-the-job instruction under the supervision of experienced personnel, followed by completion of the Personal Qualification Standard program. The Personal Qualification Standard program certifies that personnel have demonstrated the skills needed to stand watch, such as detecting and reporting floating or partially submerged objects.

The U.S. Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is a specialized multimedia training program designed to help Navy operational and test communities best avoid potentially harmful interactions with marine species. The program provides training on how to sight marine species, focusing on marine mammals. The training also includes instruction for visually identifying sea turtles, concentrations of floating vegetation (kelp paddies), jellyfish aggregations, and flocks of seabirds, which are often indicators of marine mammal or sea turtle presence. The Marine Species Awareness Training also addresses the role that watchstanders and Lookouts play in helping the Navy maintain compliance with environmental protection requirements, as well as supporting Navy stewardship commitments.

In summary, the Navy believes that the U.S. Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is the best and most appropriate forum for teaching watch personnel and Lookouts about their responsibilities for helping reduce impacts on the marine environment. The Marine Species Awareness Training provides the Navy with invaluable training for a relatively large number of personnel. Constantly shifting personnel assignments presents a real challenge; however, the format and structure of the U.S. Navy Afloat Environmental Compliance Training Series will help the Navy reduces costs during fiscally constrained periods and provide constant access to training. Overall, the Marine Species Awareness Training is an effective tool for improving the potential for Lookouts to detect marine species while on duty.

Implementation of the Marine Species Awareness Training has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on the effectiveness of the military readiness activity, and Navy policy.

5.3.1.2 Lookouts

The Navy proposes to use one or more Lookouts during the training activities described below, which are organized by stressor category. A comparison of the currently implemented mitigation measures and recommended mitigation measures are provided where applicable. The effectiveness and operational assessments are discussed for all Lookout measures collectively in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts) and Section 5.3.1.2.5 (Operational Assessment for Lookouts).

5.3.1.2.1 Acoustic Stressors – Non-Impulse Sound

5.3.1.2.1.1 Hull Mounted Mid-Frequency Active Sonar

The Navy's current Lookout mitigation measures during training activities involving hull-mounted mid-frequency active sonar include requirements such as the number of personnel on watch and the manner in which personnel are to visually search the area in the vicinity of the ongoing activity.

The Navy is proposing to modify the number of Lookouts currently implemented for ships using hull mounted mid-frequency active sonar. The recommended measure is provided below.

Ships using hull mounted mid-frequency active sonar sources associated with anti-submarine warfare (ASW) activities at sea (with the exception of ships less than 65 ft. [20 m] in length, which are minimally manned) will have two Lookouts at the forward position.

While using hull-mounted mid-frequency active sonar sources underway, vessels less than 65 ft. (20 m) in length, and ships that are minimally manned will have one Lookout at the forward position due to space and manning restrictions.

5.3.1.2.1.2 High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar

The Navy currently conducts high-frequency and non-hull-mounted mid-frequency active sonar training in the Study Area. Non-hull mounted mid-frequency active sonar training activities include the use of aircraft deployed sonobuoys and helicopter dipping sonar. During those activities, the Navy employs the following mitigation measure regarding Lookout procedures:

- Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.
- Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes (min.) before the first deployment of active (dipping) sonar in the water.

The Navy is proposing to continue using the number of Lookouts currently implemented for aircraft conducting non-hull mounted mid-frequency active sonar activities.

Mitigation measures do not currently exist for other high-frequency active sonar activities associated with ASW, or for new platforms; therefore, the Navy is proposing to add a new measure for these activities and on these platforms when conducted in the Study Area. The recommended measure is provided below.

The Navy will have one Lookout on ships or aircraft conducting high-frequency or non-hull mounted mid-frequency active sonar activities associated with ASW activities at sea.

5.3.1.2.2 Acoustic Stressors – Explosives and Impulse Sound

5.3.1.2.2.1 Improved Extended Echo Ranging Sonobuoys

The Navy is proposing to continue the Lookout procedural measures currently implemented for this activity, and to clarify that one Lookout is required:

- Crews shall conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search shall be conducted at an altitude below 1,500 ft. (460 m) at a

slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct area clearances utilizing more than one aircraft.

- Crews shall conduct a minimum of 30 min. of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30 min. observation period may include pattern deployment time.
- When operationally feasible, Navy crews shall conduct continuous visual and aural monitoring of marine mammal activity. This shall include monitoring of aircraft sensors from the time of the first sensor placement until the aircraft have left the area and are out of range of these sensors.
- Aural Detection – If the presence of marine mammals is detected aurally, then that shall cue the Navy aircrew to increase the vigilance of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.
- Mammal monitoring shall continue until out of own-aircraft sensor range.

5.3.1.2.2.2 Explosive Signal Underwater Sound Buoys Using 0.6–2.5 Pound Net Explosive Weight

Lookout measures do not currently exist for explosive Signal Underwater Sound (SUS) buoy activities using 0.6–2.5 pound (lb.) net explosive weight (NEW).

The Navy is proposing to add this measure. Aircraft conducting explosive sonobuoy activities using 0.6–2.5 lb. NEW will have one Lookout.

5.3.1.2.2.3 Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target

Currently, the Navy employs the following Lookout procedures during gunnery exercises:

- From the intended firing position, trained Lookouts shall survey the mitigation zone for marine mammals prior to commencement and during the exercise as long as practicable.
- If applicable, target towing vessels shall maintain a Lookout. If a marine mammal is sighted in the vicinity of the exercise, the tow vessel shall immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

The Navy is proposing to continue using the Lookout procedures currently implemented for this activity. The Navy will have one Lookout on the vessel or aircraft conducting small-, medium-, or large-caliber gunnery exercises against a surface target. Towing vessels, if applicable, shall also maintain one Lookout.

5.3.1.2.2.4 Missile Exercises Using a Surface Target

Currently, the Navy employs the following Lookout procedures during missile exercises:

- Aircraft shall visually survey the target area for marine mammals. Visual inspection of the target area shall be made by flying at 1,500 ft. (457 m) or lower, if safe to do so, and at slowest safe speed.
- Firing or range clearance aircraft must be able to actually see ordnance impact areas.

The Navy is proposing to continue using the Lookout procedures currently implemented for this activity. When aircraft are conducting missile exercises against a surface target, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.2.5 Bombing Exercises

Currently, the Navy employs the following Lookout procedures during bombing exercises:

- If surface vessels are involved, Lookouts shall survey for floating kelp and marine mammals.
- Aircraft shall visually survey the target and buffer zone for marine mammals prior to and during the exercise. The survey of the impact area shall be made by flying at 1,500 ft. (457 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

The Navy is proposing to (1) continue implementing the current measures for bombing exercises, and (2) clarify the number of Lookouts currently implemented for this activity. The Navy will have one Lookout positioned in an aircraft conducting bombing exercises, and trained Lookouts in any surface vessels involved.

5.3.1.2.2.6 Weapons Firing Noise During Gunnery Exercises

The Navy is proposing to continue using the number of Lookouts currently implemented for gunnery exercises. The Navy will have one Lookout on the ship conducting explosive and non-explosive gunnery exercises. This may be the same Lookout described in Section 5.3.1.2.2.3 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target) when that activity is conducted from a ship against a surface target.

5.3.1.2.2.7 Sinking Exercises

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have two Lookouts (one positioned in an aircraft and one on a vessel) during sinking exercises.

5.3.1.2.3 Physical Disturbance and Strike

5.3.1.2.3.1 Vessels

Currently, the Navy employs the following Lookout procedures to avoid physical disturbance and strike of marine mammals during at-sea training:

- While underway, surface vessels shall have at least two Lookouts with binoculars; surfaced submarines shall have at least one Lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, Lookouts will watch for and report to the Officer of the Deck the presence of marine mammals.
- On surface vessels equipped with a mid-frequency active sonar, pedestal-mounted “Big Eye” (20x110) binoculars shall be properly installed and in good working order to assist in the detection of marine mammals in the vicinity of the vessel.
- Personnel on Lookout shall employ visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).
- After sunset and prior to sunrise, Lookouts shall employ Night Lookout Techniques in accordance with the Lookout Training Handbook. (NAVEDTRA 12968-D).

The Navy is proposing to revise the mitigation measures for this activity as follows: while underway, vessels will have a minimum of one Lookout.

5.3.1.2.3.2 Towed In-Water Devices

The Navy is proposing to clarify the number of Lookouts currently implemented for activities using towed in-water devices. The Navy will have one Lookout during activities using towed in-water devices when towed from a manned platform.

5.3.1.2.3.3 Non-Explosive Practice Munitions – Small-, Medium-, and Large-Caliber Gunnery Exercises Using a Surface Target

Currently, the Navy employs the same mitigation measures for non-explosive practice munitions—small-, medium-, and large-caliber gunnery exercises using a surface target as described above in 5.3.1.2.2.3 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target).

The Navy is proposing to continue using the number of Lookouts currently implemented for these activities. The Navy will have one Lookout during activities involving non-explosive practice munitions (e.g., small-, medium-, and large-caliber gunnery exercises) against a surface target.

5.3.1.2.3.4 Non-Explosive Practice Munitions – Bombing Exercises

Currently, the Navy employs the same mitigation measures for non-explosive bombing exercises as described above in 5.3.1.2.2.5 (Bombing Exercises).

The Navy is proposing to continue using the same Lookout procedures currently implemented for these activities. The Navy will have one Lookout positioned in an aircraft during non-explosive bombing exercises, and trained Lookouts in any surface vessels involved.

5.3.1.2.3.5 Non-Explosive Practice Munitions – Missile Exercises (Including Rockets) Using a Surface Target

Currently, the Navy employs the same mitigation measures for non-explosive missile exercises (including rockets) using a surface target as described above in 5.3.1.2.2.4 (Missile Exercises Using a Surface Target).

The Navy is proposing to continue using the number of Lookouts currently implemented for these activities. When aircraft are conducting non-explosive missile exercises (including exercises using rockets) against a surface target, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.4 Effectiveness Assessment for Lookouts

Personnel standing watch in accordance with Navy standard operating procedures have multiple job responsibilities. While on duty, these standard watch personnel often conduct marine species observation in addition to their primary job duties (e.g., aiding in the navigation of the vessel). By having one or more Lookouts observing the air and surface of the water during certain training activities, the Navy increases the likelihood that marine species will be detected. It is also important to note that a number of training activities involve multiple vessels and aircraft, thereby increasing the cumulative number of Lookouts or watch personnel that could potentially be present during a given activity.

Although using Lookouts is expected to increase the likelihood that marine species will be detected at the surface of the water, it is unlikely that using Lookouts will be able to help avoid impacts to all species entirely due to the inherent limitations of visually detecting marine mammals. The probability of visually detecting a marine animal is dependent upon two things. First, an animal must be present in an area to be seen (known as the availability bias), and an animal that is present in the area of observation must be positioned or behaving in a way that will allow for a visual detection. For example, an animal may not be

visually detectable if it is swimming entirely under the water at a relatively far distance from a boat. Second, the observer must perceive the animal when the animal is in a position to be detected (Marsh and Sinclair 1989).

In cooperation with NMFS, the Navy has undertaken monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the impacts of the Navy activities on marine resources. In 2010, the Navy initiated a study designed to evaluate the effectiveness of the Navy Lookout team. The University of St. Andrews, Scotland, under contract to the U.S. Navy, developed an initial data collection protocol for use during the study. Between 2010 and 2012, trained Navy marine mammal observers collected data during nine field trials as part of a "proof of concept" phase. The goal of the proof of concept phase was to develop a statistically valid protocol for quantitatively analyzing the effectiveness of Lookouts during Navy training exercises. Field trials were conducted in the Hawaii Range Complex, Southern California Range Complex, and Jacksonville Range Complex onboard one frigate, one cruiser, and seven destroyers. A preliminary analysis of the proof of concept data is ongoing. The Navy is also working to finalize the data collection process for use during the next phase of the study. While data were collected as part of this proof of concept phase, those data are not fairly comparable as protocols were being changed and assessed, nor are those data statistically significant. Therefore, it is improper to use these data to draw any conclusions on the effectiveness of Navy Lookouts.

5.3.1.2.4.1 Detection Probabilities of Marine Mammals in the Study Area

Until the results of the Navy's Lookout effectiveness study are available, the Navy must rely on the best available science to determine detection probabilities of marine mammals by Navy Lookouts. To do so, the Navy has compiled the results of available literature on line-transect analyses, which are typically used to estimate cetacean abundance. In line-transect analyses, the factors affecting the detection of an animal or group of animals directly on the transect line may be probabilistically quantified as g(0). As a reference, a g(0) value of 1 indicates that animals on the transect line are always detected. Table 5.3-1 provides detection probabilities for cetacean species based largely on g(0) values derived from shipboard and aerial surveys in the Study Area, which vary widely based on g(0) derivation factors (e.g., species, sighting platforms, group size, and sea state conditions). Refer to Section 3.8.3.1.8 (Implementing Mitigation to Reduce Sound Exposures) for additional background on g(0) and a discussion of how the Navy used g(0) to quantitatively assess the effectiveness of Lookouts during sound-producing activities.

Several variables that play into how easily a marine mammal may be detected by a dedicated observer are directly related to the animal, including its external appearance and size; surface, diving and social behavior; and life history. The following is a generalized discussion of the behavior and external appearance of the marine mammals with the potential to occur in the Study Area as these characters relate to the detectability of each species. The species are grouped loosely based on either taxonomic relatedness or commonalities in size and behavior, and include large whales, cryptic species, delphinids, and pinnipeds. Not all statements may hold true for all species in a grouping and exceptions are mentioned where applicable. The information presented in this section may be found in Jefferson et al. (2008) and sources within unless otherwise noted.

Table 5.3-1: Sightability Based on g(0) Values for Marine Mammal Species in the Study Area

Species/Stocks	Family	Vessel Sightability	Aircraft Sightability
Baird's Beaked Whale	*Ziphiidae*	0.96	0.18
Blue Whale, Fin Whale	*Balaenopteridae*	0.921	0.407
California Sea Lion, Northern Fur Seal, Steller Sea Lion	*Zalophus, Callorhinus, Eumetopias*	0.299	0.299
Cuvier's Beaked Whale	*Ziphiidae*	0.23	0.074
Dall's Porpoise	*Phocoenidae*	0.822	0.221
Gray Whale	*Eschichtiidae*	0.921	0.482
Harbor Porpoise	*Phocoenidae*	0.769	0.292
Harbor Seal	*Phoca vitulina*	0.281	0.281
Humpback Whale	*Megaptera*	0.921	0.495
Killer Whale	*Orcinus orca*	0.921	0.95
Minke Whale	*Balaenopteridae*	0.856	0.386
North Pacific Right Whale	*Eubalaena*	0.645	0.41
Northern Elephant Seal	*Mirounga*	0.105	0.105
Pacific White-Sided Dolphin	*Lagenorhynchus*	0.856	0.67
Ribbon Seal	*Histriophoca*	0.281	0.281
Sei Whale	*Balaenopteridae*	0.921	0.407
Sperm Whale	*Physeter*	0.87	0.32
Stejneger's Beaked Whale	*Mesoplodon*	0.23	0.074

Notes: When there was no value available for vessels, the g(0) for aircraft was used as a conservative underestimate of sightability following the assumption that the availability bias from a slower moving vessel should result in a higher g(0). The g(0) for Cuvier's beaked whale was used for Stejneger's beaked whale given there is no data available for Stejneger's. The published California Sea Lion aircraft g(0) is used for Steller Sea Lion and Northern Fur Seal because all are in the otariidae family and there is no g(0) data for these other species. The published Harbor Seal aircraft g(0) is used for Ribbon Seal because they are in the phocid family and there is no g(0) data for ribbon seal. North Atlantic right whale data (Palka 2005) has been used for North Pacific right whale.

Sources: Barlow 2006; Barlow et al. 2006; Barlow and Forney 2007; Carretta et al. 2000; Forney and Barlow 1998; Laake et al. 1997; Palka 2005

Large Whales

Species of large whales found in the Study Area include all the baleen whales and the sperm whale. Baleen whales are generally large, with adults ranging in size from 30 to 89 ft. (9 to 27 m), often making them immediately detectable. Many species of baleen whales have a prominent blow ranging from 10 ft. (3 m) to as much as 39 ft. (12 m) above the surface. However, there are at least two species (Bryde's whale and common minke whale) often have no visible blow. Baleen whales tend to travel singly or in small groups ranging from pairs to groups of five. The exception to this is the fin whale, which is known to travel in pods of seven or more individuals. All species of baleen whales are known to form larger-scale aggregations in areas of high localized productivity or on breeding grounds. Baleen whales may or may not fluke at the surface before they dive; some species fluke regularly (e.g., the humpback whale), some fluke variably (e.g., the blue whale and fin whale) and some rarely fluke (e.g., the sei whale and common minke whale). Baleen whales may remain at the surface for extended periods of time as they forage or socialize. Humpback whales are known to corral prey at the surface. Dive behavior varies amongst species, as well. Many species will dive and remain at depth for as long as 30 min. Some will adjust their diving behavior according to the presence of vessels (e.g., the humpback

whale and fin whale). Sei whales are known to sink just below the surface and remain there between breaths.

Adult gray whales, included among the large whales, range in size from 38 to 46 ft. (11 to 14 m). When viewed in windless conditions, their blow is heart-shaped, up to 15 ft. (5 m) in height. They typically breathe 3–5 times in a row, about 10–20 seconds apart, then dive for 3–7 min. Gray whales occur within a narrow coastal band, and their populations are generally assessed using focused (single-species) count data made from shore stations; g(0) values from vessels are not available for this species and thus estimates from other large baleen whales were used.

Sperm whales are also considered large whales, with adult males reaching as much as 50 ft. (18 m) in total length. Sperm whales at the surface would likely be easy to detect. They have a prominent, 16 ft. (5 m) blow, and may remain at the surface for long periods of time. They are known to raft (i.e., loll at the surface) and to form surface-active groups when socializing. Sperm whales may travel or congregate in large groups of as many as 50 individuals. Although sperm whales engage in conspicuous surface behavior such as fluking, breaching and tail-slapping, they are long, deep divers and may remain submerged for over 1 hour.

Cryptic Species

Cryptic and deep-diving species are those that do not surface for long periods of time and are often difficult to see when they surface, which ultimately limits the ability of Lookouts to detect them even in good sighting conditions (Barlow et al. 2006). Cryptic species include beaked whales (family Ziphiidae), dwarf and pygmy sperm whales (*Kogia* species), and harbor porpoises, although dwarf and pygmy sperm whales are not in the Study Area. Beaked whales are notoriously difficult to detect at sea. In the Study Area, there is currently no reliable abundance estimate for the Alaska stock of Cuvier's beaked whale (Allen and Angliss 2013). Beaked whale diving behavior in general consists of long, deep dives that may last for nearly 90 min. followed by a series of shallower dives and intermittent surfacings (Tyack et al. 2006, Baird et al. 2008). Some individuals remain at the surface for an extended period of time (perhaps 1 hour or more) or make shorter dives (MacLeod and D'Amico, 2006). Detection of beaked whales is further complicated because beaked whales often dive and surface in a synchronous pattern and they travel below the surface of the water (MacLeod and D'Amico 2006).

Harbor porpoises are difficult to detect in all but the best of conditions (i.e., no swell, no whitecaps). Harbor porpoises travel singly or in small groups of less than six individuals, but may aggregate into groups of several hundred. They are inconspicuous at the surface, rarely lifting their heads above the surface and often lying motionless. They are small and may actively avoid vessels.

Delphinids

Delphinids are some of the most likely species to be detected at sea by observers. Many species of delphinids engage in very conspicuous surface behavior, including leaping, spinning, bow riding, and traveling along the surface in large groups. Delphinid group sizes may range from 10 to 10,000 individuals, depending upon the species and the geographic region. Species such as pilot whales, rough-toothed dolphins, white-beaked dolphins, white-sided dolphins, bottlenose dolphins, stenellid dolphins, common dolphins, and Fraser's dolphins are known to either actively approach and investigate vessels, or bow ride along moving vessels. Common dolphins form huge groups that travel quickly along the surface, churning up the water and making them visible from a great distance. Delphinids may dive for as little as 1 min. to more than 30 min., depending upon the species.

Pinnipeds

Pinnipeds (seals and sea lions) are more difficult to detect at sea than cetaceans. Pinnipeds are much smaller, often solitary and generally do not engage in conspicuous surface behavior. There is not a lot of information regarding pinniped behavior at sea. Pinnipeds have a low profile, no dorsal appendage and small body size in comparison with most cetaceans, which limits accurate visual detection to sea states of less than 2 on the Beaufort scale (Carretta et al. 2000) at sea. Some species, such as harbor seals, are known to approach and observe human activities on land or on stationary vessels.

5.3.1.2.4.2 Summary of Lookout Effectiveness

Due to the various detection probabilities, levels of experience and dependence on sighting conditions, Lookouts will not always be effective at avoiding impacts on all species. However, Lookouts are expected to increase the overall likelihood that certain marine mammal species will be detected at the surface of the water, when compared to the likelihood that these same species would be detected if Lookouts are not used. The Navy believes the continued use of Lookouts contributes to helping reduce potential impacts on these marine mammal species from training activities.

5.3.1.2.5 Operational Assessment for Lookouts

As written, implementation of the mitigation measures recommended in Section 5.3.1.2 (Lookouts) has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activities, and Navy policy. The number of Lookouts recommended for each measure often represents the maximum Lookout capacity based on limited resources (e.g., space and manning restrictions).

5.3.2 Mitigation Zone Procedural Measures

Safety zones described in Section 5.1 (Standard Operating Procedures) are zones designed for human safety, whereas this section will introduce mitigation zones. A mitigation zone is designed solely for the purpose of reducing potential impacts on marine species from training activities. Mitigation zones are measured as the radius from a source. Unique to each activity category, each radius represents a distance that the Navy will visually observe to help reduce injury to marine species. Visual detections of applicable marine species will be communicated immediately to the appropriate watch station for information dissemination and appropriate action. If the presence of marine mammals is detected acoustically, Lookouts posted in aircraft and on surface vessels will increase the vigilance of their visual surveillance. As a reference, aerial surveys are typically made by flying at 1,500 ft. (457 m) altitude or lower at the slowest safe speed.

Many of the proposed activities have mitigation measures that are currently being implemented, as required by previous environmental documents or consultations. Most of the current 2011 EIS/OEIS mitigation zones for activities that involve the use of impulsive and non-impulsive sources were originally designed to reduce the potential for onset of temporary threshold shift (TTS). For this Supplemental EIS/OEIS, the Navy updated the acoustic propagation modeling to incorporate updated hearing threshold metrics (i.e., upper and lower frequency limits), updated density data for marine mammals, and factors such as an animal's likely presence at various depths. An explanation of the acoustic propagation modeling process can be found in the *Determination of Acoustic Effects on Marine Mammals for the Gulf of Alaska Navy Training Activities Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement* technical report (Marine Species Modeling Team 2014, in progress).

As a result of the updates to the acoustic propagation modeling, in some cases the ranges to onset of TTS effects are much larger than those output by previous Phase I models. Due to the ineffectiveness and unacceptable operational impacts associated with mitigating these large areas, the Navy is unable to mitigate for onset of TTS for every activity. In this GOA analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, permanent threshold shift (PTS), out to the predicted maximum range. In some cases where the ranges to effects are smaller than previous models estimated, the mitigation zones were adjusted accordingly to provide consistency across the measures. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also consequently covers the predicted average range to TTS. Table 5.3-2 summarizes the predicted average range to TTS, average range to PTS, maximum range to PTS, and recommended mitigation zone for each activity category, based on the Navy's acoustic propagation modeling results. The predicted ranges are based on local environmental conditions and are unique to the GOA Study Area.

The activity-specific mitigation zones are based on the longest range for all the functional hearing groups (based on the hearing threshold metrics described in Section 3.8, Marine Mammals). The mitigation zone for a majority of activities is driven by either the high-frequency cetaceans or the sea turtles functional hearing groups. Therefore, the mitigation zones are even more protective for the remaining functional hearing groups (i.e., low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds), and likely cover a larger portion of the potential range to onset of TTS.

In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted maximum range to PTS based on the effectiveness and operational assessments. The recommended mitigation zones and their associated assessments are provided throughout the remainder of this section. The recommended measures are either currently implemented, modifications of current measures, or new measures.

For some activities specified throughout the remainder of this section, Lookouts may be required to observe for concentrations of detached floating vegetation (*Sargassum* or kelp paddies), which are indicators of potential marine mammal and sea turtle presence, within the mitigation zone. Those specified activities will not commence if the floating vegetation (*Sargassum* or kelp paddies) is observed within the mitigation zone prior to the initial start of the activity. If floating vegetation is observed prior to the initial start of the activity, the activity will be relocated to an area where no floating vegetation is observed. Training will not cease as a result of indicators entering the mitigation zone after activities have commenced. This measure is intended only for floating vegetation detached from the seafloor.

Table 5.3-2: Predicted Range to Effects and Recommended Mitigation Zones

Activity Category	Representative Source (Bin)[1]	Predicted (Longest) Average Range to TTS	Predicted (Longest) Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
Non-Impulse Sound					
Hull-Mounted Mid-Frequency Active Sonar	SQS-53 ASW hull-mounted sonar (MF1)	3,821 yd. (3.5 km) for one ping	100 yd. (91 m) for one ping	Not Applicable	6 dB power down at 1,000 yd. (914 m); 4 dB power down at 500 yd. (457 m); and shutdown at 200 yd. (183 m)
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar	AQS-22 ASW dipping sonar (MF4)	230 yd. (210 m) for one ping	20 yd. (18 m) for one ping	Not applicable	200 yd. (183 m)
Explosive and Impulse Sound					
Improved Extended Echo Ranging Sonobuoys	Explosive sonobuoy (E4)	434 yd. (397 m)	156 yd. (143 m)	563 yd. (515 m)	600 yd. (549 m)
Signal Underwater Sound (SUS) buoys using 0.6–2.5 lb. NEW	Explosive sonobuoy (E3)	290 yd. (265 m)	113 yd. (103 m)	309 yd. (283 m)	350 yd. (320 m)
Gunnery Exercises – Small- and Medium-Caliber (Surface Target)	40 mm projectile (E2)	190 yd. (174 m)	83 yd. (76 m)	182 yd. (167 m)	200 yd. (183 m)
Gunnery Exercises – Large-Caliber (Surface Target)	5 in. projectiles (E5 at the surface[3])	453 yd. (414 m)	186 yd. (170 m)	526 yd. (481 m)	600 yd. (549 m)
Missile Exercises (Including Rockets) up to 250 lb. NEW Using a Surface Target	Maverick missile (E9)	949 yd. (868 m)	398 yd. (364 m)	699 yd. (639 m)	900 yd. (823 m)
Missile Exercises up to 500 lb. NEW (Surface Target)	Harpoon missile (E10)	1,832 yd. (1.7 km)	731 yd. (668 m)	1,883 yd. (1.7 km)	2,000 yd. (1.8 km)
Bombing Exercises	MK-84 2,000 lb. bomb (E12)	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2,500 yd. (2.3 km)[2]
Sinking Exercises	Various up to MK-84 2,000 lb. bomb (E12)	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2.5 nm[(2)]

[1] This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.

[2] Recommended mitigation zones are larger than the modeled injury zones to account for multiple types of sources or charges being used.

[3] The representative source bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).

Notes: ASW = Anti-submarine Warfare, dB = decibels, km = Kilometers, lb. = Pounds, m = Meters, mm = millimeters, NEW = Net Explosive Weight, PTS = Permanent Threshold Shift, TTS = Temporary Threshold Shift, yd. = yards

5.3.2.1 Acoustic Stressors

5.3.2.1.1 Non-Impulsive Sound

5.3.2.1.1.1 Hull Mounted Mid-Frequency Active Sonar

The Navy is proposing to (1) continue implementing the current measures for mid-frequency active sonar, and (2) clarify the conditions needed to recommence an activity after a sighting.

Activities that involve the use of hull mounted mid-frequency active sonar will use Lookouts for visual observation from a ship immediately before and during the exercise. Mitigation zones for these activities involve powering down the sonar by six decibels (dB) when a marine mammal is sighted within 1,000 yards (yd.) (914 m) of the sonar dome, and by an additional 4 dB when sighted within 500 yd. (457 m) from the source, for a total reduction of 10 dB. Active transmissions will cease if a marine mammal or sea turtle is sighted within 200 yd. (183 m). Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., (4) the ship has transited more than 2,000 yd. (1.8 kilometer [km]) beyond the location of the last sighting, or (5) the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave (and there are no other marine mammal sightings within the mitigation zone). Active transmission may resume when dolphins are bow riding because they are out of the main transmission axis of the active sonar while in the shallow-wave area of the ship bow.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for hull-mounted mid-frequency active sonar sources is approximately 100 yd. (91 m) for one ping. This range was determined by the high-frequency cetacean functional hearing group. The distance for all other marine mammal functional hearing groups is less than 80 yd. (73 m) for one ping, so the mitigation zone will provide further protection from injury (PTS) for these species. Therefore, implementation of the 200 yd. (183 m) shutdown zone will reduce the potential for exposure to higher levels of energy that would result in injury (PTS) and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. Implementation of the 500 yd. (457 m) and 1,000 yd. (914 m) sonar power reductions will further reduce the potential for injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) to occur when individual marine mammals are sighted within these zones, especially in cases where the ship and animal are approaching each other.

The mitigation zones the Navy has developed are within a range for which Lookouts can reasonably be expected to maintain situational awareness and visually observe during most conditions. Since the average range to onset of TTS is 3,821 yd. (3.5 km), the entire range to TTS is not reasonably observable. By establishing mitigation zones that can be realistically maintained from ships, Lookouts will be more effective at sighting individual animals. By keeping Lookouts focused within the ranges where exposure to higher levels of energy is possible, the effectiveness at reducing potential impacts to marine mammals and sea turtles will increase. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 min. would result in an unacceptable operational impact on readiness. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.1.2 High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar

Recommended Mitigation and Comparison to Current Mitigation

Non-hull-mounted mid-frequency active sonar training activities include the use of aircraft deployed sonobuoys and helicopter dipping sonar. The Navy is proposing to: (1) continue implementing the current mitigation measures for activities currently being executed, such as dipping sonar activities; (2) extend the implementation of its current mitigation to all other activities in this category; and (3) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft (with the exception of platforms operating at high altitudes) immediately before and during active transmission within a mitigation zone of 200 yd. (183 m) from the active sonar source. For activities involving helicopter deployed dipping sonar, visual observation will commence 10 min. before the first deployment of active dipping sonar. If the source can be turned off during the activity, active transmission will cease if a marine mammal (for MF8, MF9, MF10, and MF12 only) is sighted within the mitigation zone. Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for an aircraft-deployed source, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a vessel-deployed source, (5) the vessel or aircraft has repositioned itself more than 400 yd. (370 m) away from the location of the last sighting, or (6) the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted average range to onset of PTS for high-frequency and non-hull mounted mid-frequency active sonar sources is 20 yd. (18 m) for one ping. This range was determined by the high-frequency cetacean functional hearing group. The predicted average range to onset of TTS across all functional hearing groups is 230 yd. (210 m) for one ping. Implementation of the 200 yd. (183 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would

result in injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Lookouts often visually observe either close aboard a vessel or from directly above the source by aircraft (i.e., helicopters). Exceptions include when sonobuoys are deployed and when sources are deployed from high altitude aircraft. When sonobuoys are used, the sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly small or cryptic marine mammals, decreases at long distances. This measure should be effective at reducing risks to all marine mammals that are available to be observed within the mitigation zone.

The post-sighting wait periods are designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30 min. wait period for vessel-deployed sources more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving species. However, the analysis in Section 3.8.3.3.1 (Impacts from Sonar and Other Active Acoustic Sources) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur, with the exception of *Kogia* species (which are not found in the Study Area). Furthermore, any wait period greater than 30 min. for vessel-deployed sources would result in an unacceptable operational impact on readiness. Any wait period greater than 10 min. for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2 Explosives and Impulsive Sound

5.3.2.1.2.1 Improved Extended Echo Ranging Sonobuoys

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the marine mammal and sea turtle mitigation zone from 1,000 yd. (914 m) to 600 yd. (549 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation. The recommended measures are provided below.

Mitigation will include pre-exercise aerial observation and passive acoustic monitoring, which will begin 30 min. before the first source/receiver pair detonation and continue throughout the duration of the exercise. The pre-exercise aerial observation will include the time it takes to deploy the sonobuoy pattern (deployment is conducted by aircraft dropping sonobuoys in the water). Improved Extended Echo Ranging sonobuoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone around the intended deployment location. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Passive acoustic monitoring would be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would provide only limited range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual surveillance.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for Improved Extended Echo Ranging sonobuoys is approximately 563 yd. (515 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The predicted average range to onset of TTS across all functional hearing groups is 434 yd. (397 m). Implementation of the 600 yd. (549 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.3 3 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 min. would result in an unacceptable operational impact on readiness. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.2 Explosive Signal Underwater Sound Buoys Using 0.6–2.5 Pound Net Explosive Weight

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for activities using SUS buoys.

The Navy is proposing to add the following recommended measures. Mitigation will include pre-exercise aerial monitoring during deployment within a mitigation zone of 350 yd. (320 m) around an explosive

SUS sonobuoy. Explosive SUS buoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone (around the intended deployment location). SUS deployment will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Passive acoustic monitoring will also be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft in order to increase vigilance of their visual surveillance.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for explosive sonobuoys using 0.6–2.5 lb. NEW is approximately 309 yd. (283 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. The predicted average range to onset of TTS across all functional hearing groups is 290 yd. (265 m). Implementation of the 350 yd. (320 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10 min. wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 min. for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.3 Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue implementing the current mitigation measures for this activity, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (183 m) around the intended impact location. Vessels will observe the mitigation zone from the firing position. When aircraft are firing, the aircrew will maintain visual watch of the mitigation zone during the activity. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (366 m) away from the location of the last sighting.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for small and medium caliber gunnery is approximately 182 yd. (167 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 190 yd. (174 m). Implementation of the 200 yd. (183 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Small-, and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location that may be up to 4,000 yd. (3.7 km) away, although typically much closer than this. Therefore, it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Large vessel or aircraft platforms would provide a more effective observation platform for Lookouts than small boats. However, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 4,000 yd. (3.7 km). However, this measure is likely effective at reducing the risk of injury to marine mammals that may be observed from the typical target distances. This measure may be ineffective at reducing the risk of injury to sea turtles at large target distances; however, it does reduce the risk for those individuals that may be observed at closer distances. In addition, it is more likely that sea turtles will be observed when exercises involve aircraft versus vessels.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.3.3 (Impacts from Explosives) shows that injury to

deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 min. when vessels are firing would result in an unacceptable operational impact on readiness. The 10 min. wait period when aircraft are firing is based on fuel restrictions. Any wait period greater than 10 min. when aircraft are firing would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.4 Gunnery Exercises – Large-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue using the currently implemented mitigation zone for this activity, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for kelp paddies. The recommended measures are provided below.

Mitigation will include visual observation from a ship immediately before and during the exercise within a mitigation zone of 600 yd. (549 m) around the intended impact location. Ships will observe the mitigation zone from the firing position. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for large caliber gunnery is 526 yd. (481 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. The average predicted range to onset of TTS across all functional hearing groups is 453 yd. (414 m). Implementation of the 600 yd. (549 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Per the Navy's current reporting requirements, any injured or dead marine mammals or sea turtles will be reported as appropriate.

Large caliber gunnery exercises involve the participating ship firing munitions at a target location from ranges up to 6 nautical miles (nm) away. Therefore it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen.

Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.3.3 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation, and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.5 Missile Exercises (Including Rockets) up to 250 Pound Net Explosive Weight Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Currently, the Navy employs a mitigation zone of 1,800 yd. (1.6 km) for all missile exercises. Because missiles have a wide range of warhead strength, the Navy recommends two mitigation zones: one for missiles with warheads 250 lb. NEW and less, and a larger mitigation zone for missiles with larger warheads. The Navy is proposing to (1) modify the mitigation measures currently implemented for missile exercises involving missiles with 250 lb. NEW and smaller warheads by reducing the mitigation zone from 1,800 yd. (1.6 km) to 900 yd. (823 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation. The recommended measures are provided below.

When aircraft are firing, mitigation will include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 900 yd. (823 m) around the deployed target. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a missile exercise (including rockets) up to 250 lb. NEW (Bin E9) is 699 yd. (639 m). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter predicted range

to onset of PTS, so the mitigation zone will provide further protection for these species. The average predicted range to onset of TTS across all functional hearing groups is 949 yd. (868 m). Implementation of the 900 yd. (823 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

Missile exercises involve the participating aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. There is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Therefore, this measure is not effective at reducing the risk of injury to animals once the firing activity has begun; but it does reduce the risk for those individuals that may be observed prior to commencement of the activity when aircraft are firing. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10 min. wait period is for aircraft that have fuel restrictions (e.g., helicopters). Any wait period greater than 10 min. for these types of aircraft would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. The 30 min. wait period is for aircraft that are less restricted by fuel capacities (e.g., maritime patrol aircraft). The 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. Any wait period greater than 30 min. would result in an unacceptable operational impact on readiness for this type of aircraft.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.6 Missile Exercises 251 – 500 Pound Net Explosive Weight Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Current mitigation measures apply to all missile exercises, regardless of the warhead size. The Navy proposes to add a mitigation zone that applies only to missiles with a NEW of 251–500 lb. The recommended measures are provided below.

When aircraft are involved in the missile firing, mitigation will include visual observation by the aircrew prior to commencement of the activity within a mitigation zone of 2,000 yd. (1.8 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the

mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a missile exercise (up to 500 lb. NEW [Bin E10]) is 1,882 yd. (1.7 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. The predicted average range to onset of TTS across all functional hearing groups is 1,832 yd. (1.7 km). Implementation of the 2,000 yd. (1.8 km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Missile exercises involve the aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. There is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Therefore, this measure is not effective at reducing the risk of injury to animals once the activity has begun; however, it does reduce the risk for those individuals that may be observed prior to commencement of the activity when aircraft are firing. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10 min. wait period is for aircraft that have fuel restrictions (e.g., helicopters). Any wait period greater than 10 min. for these types of aircraft would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. The 30 min. wait period is for aircraft that are less restricted by fuel capacities (e.g., maritime patrol aircraft). The 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. Any wait period greater than 30 min. would result in an unacceptable operational impact on readiness for this type of aircraft.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.7 Bombing Exercises

Recommended Mitigation and Comparison to Current Mitigation

Currently, the Navy employs the following mitigation zone procedures during bombing exercises:

- Ordnance shall not be targeted to impact within 1,000 yd. (914 m) of known or observed floating kelp or marine mammals.

- A 1,000 yd. (914 m) radius mitigation zone shall be established around the intended target.
- The exercise will be conducted only if marine mammals are not visible within the mitigation zone.

The Navy is proposing to (1) maintain the existing mitigation zone to be used for non-explosive bombing activities, (2) revise the mitigation zone procedures to account for predicted ranges to impacts to marine species when high explosive bombs are used, (3) clarify the conditions needed to recommence an activity after a sighting, and (4) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 2,500 yd. (2.3 km) around the intended impact location for explosive bombs and 1,000 yd. (914 m) for non-explosive bombs. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for bombing exercises is 2,474 yd. (2.3 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. For example, the predicted maximum range to onset of PTS to mid-frequency of cetaceans is less than 500 yd. (457 m). The predicted average range to onset of TTS across all functional hearing groups is 2,513 yd. (2.3 km). Implementation of the 2,500 yd. (2.3 km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to effects on mortality across all functional hearing groups is less than 250 yd. (229 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,500 yd. (2.3 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Similarly, Lookouts posted in aircraft during bombing activities will, by necessity, focus their attention on the water surface below and surrounding the location of bomb deployment. Due to the nature of this activity (e.g., aircraft maintaining a relatively steady altitude of approximately 1,500 ft. [460 m] and approaching the intended impact location), Lookouts will be able to observe a

larger area during bombing activities than other proposed activities that involve the use of Lookouts positioned in aircraft (e.g., Improved Extended Echo Ranging sonobuoy activities). However, observation of an area beyond what the Navy is proposing to implement for bombing activities is not practicable and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal.

The decrease in mitigation zone size will result in no mitigation for exposures to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will likely consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10 min. wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 min. for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.8 Sinking Exercises

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by increasing the mitigation zone from 2.0 nm to 2.5 nm, (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, and (4) adopt the marine mammal and sea turtle mitigation zone size for aggregations of jellyfish for ease of implementation. The recommended measures are provided below.

Mitigation will include visual observation within a mitigation zone of 2.5 nm around the target ship hulk. Sinking exercises will include aerial observation beginning 90 min. before the first firing, visual observations from vessels throughout the duration of the exercise, and both aerial and vessel observation immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours. Prior to conducting the exercise, the Navy will review remotely sensed sea surface temperature and sea surface height maps to aid in deciding where to release the target ship hulk.

The Navy will also monitor using passive acoustics during the exercise. Passive acoustic monitoring would be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual surveillance. Lookouts will also increase observation vigilance before the use of torpedoes or unguided ordnance with a NEW of 500 lb. or greater, or if the Beaufort sea state is a 4 or above.

The exercise will cease if a marine mammal, sea turtle, or aggregation of jellyfish is sighted within the mitigation zone. The exercise will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min. Upon sinking the vessel, the Navy will conduct post-exercise visual surveillance of the mitigation zone for 2 hours (or until sunset, whichever comes first).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. During a sinking exercise, multiple weapons sources may be used (projectiles, missiles, bombs, torpedoes), the largest of which is the 2,000 lb. bomb. The recommended mitigation zone is approximately double the predicted maximum range to onset of PTS of the largest weapon source, and is designed to account for multiple detonations during the activity. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a bombing exercise is approximately 2,474 yd. (2.3 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter predicted range to onset of PTS, so the mitigation zone will provide further protection for these species. For example, the predicted maximum range to onset of PTS to mid-frequency of cetaceans is less than 500 yd. (457 m). The predicted average range to onset of TTS across all functional hearing groups is 2,513 yd. (2.3 km). Implementation of the 2.5 nm mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is less than 250 yd. (229 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,100 yd. (1.9 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft or vessels may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement for sinking exercises is not practicable and would not likely result in avoidance or reduction of injury to marine mammals because the effort spent observing those more distant areas would inevitably be minimal. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals. The amount of time it takes for an aircraft to conduct line transects around a detonation point within the currently implemented 4.5 nm mitigation zone could result in animals entering the mitigation zone at one end while the aircraft completes the survey at the other end of the mitigation zone. Observation for indicators of marine mammal presence (e.g., jellyfish aggregations) will further help avoid impacts to marine mammals.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.1.1 (Non-Impulsive and Impulsive Sound Sources) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the ship and aircrews' abilities to coordinate attack tactics on a seaborne target as would be required in a real world combat situation, and would therefore have an unacceptable impact on the realism and effectiveness of the exercise. Although activities involving certain types of aircraft (e.g., helicopters) typically employ a 10 min. wait period due to fuel restrictions, the Navy is able to make an exception for this particular activity due to the large variation and rotation of assets that could participate in this type of exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.9 Weapons Firing Noise During Gunnery Exercises – Large-Caliber

Recommended Mitigation and Comparison to Current Mitigation

The Navy currently has no mitigation zone procedures for this activity in the Study Area.

The Navy is proposing to adopt measures currently used during Navy gunnery exercises in other ranges outside of the Study Area. For all explosive and non-explosive large-caliber gunnery exercises conducted from a ship, mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 70 yd. (64 m) within 30 degrees on either side of the gun target line on the firing side. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., or (4) the ship has repositioned itself more than 140 yd. (128 m) away from the location of the last sighting.

Effectiveness Assessment

The mitigation zone is designed to reduce the potential for injury from weapons firing noise during large-caliber gunnery exercises conducted from a ship. The majority of the energy that an animal could be exposed to would occur on the firing side of the vessel and would follow in the direction of fire. It is not operationally feasible to have Lookouts stationed on all sides of the vessel to visually observe for marine mammals and sea turtles due to limited resources (e.g., manning restrictions). Since the Lookout is positioned aboard the firing ship and is visually observing nearby the ship (70 yd. [64 m]), this measure should be effective at reducing the risk to all marine mammals and sea turtles that are available to be observed.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine

mammal species but may not be sufficient for some deep-diving marine mammal species or sea turtles. However, the analysis in Section 3.8.3.3.3 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 min. would result in an unacceptable operational impact on readiness.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2 Physical Disturbance and Strike

5.3.2.2.1 Vessels and In-Water Devices

5.3.2.2.1.1 Vessels

Recommended Mitigation and Comparison to Current Mitigation

The Navy's current measures to mitigate potential impacts to marine mammals from vessel and in-water device strikes during training activities are provided below:

- Naval vessels shall maneuver to keep at least 500 yd. (460 m) away from any observed whale in the vessel's path and avoid approaching whales head-on. These requirements do not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged activities, launching and recovering aircraft or landing craft, minesweeping activities, replenishment while underway and towing activities that severely restrict a vessel's ability to deviate course.
- Vessels will take reasonable steps to alert other vessels in the vicinity of the whale. Given rapid swimming speeds and maneuverability of many dolphin species, naval vessels would maintain normal course and speed on sighting dolphins unless some condition indicated a need for the vessel to maneuver.

The Navy is proposing to continue to use the 500 yd. (457 m) mitigation zone currently established for whales, and to implement a 200 yd. (183 m) mitigation zone for all other marine mammals. Vessels will avoid approaching marine mammals head on and will maneuver to maintain a mitigation zone of 500 yd. (457 m) around observed whales and 200 yd. (183 m) around all other marine mammals (except bow-riding dolphins), providing it is safe to do so.

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (within 500 yd. [457 m]), this measure should be effective at reducing the risk to marine mammals that are available to be observed. However, as discussed above in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species, such as beaked whales.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on the effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.1.2 Towed In-Water Devices

Recommended Mitigation and Comparison to Current Mitigation

The Navy currently has no mitigation zone procedures for this activity in the Study Area.

The Navy is proposing to adopt measures currently used in other ranges outside of the Study Area during activities involving towed in-water devices. The Navy will ensure that towed in-water devices being towed from manned platforms avoid coming within a mitigation zone of 250 yd. (229 m) around any observed marine mammal, providing it is safe to do so.

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (250 yd. [229 m]), this measure should be effective at reducing the risk to marine mammals that are observable. However, as discussed above in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species such as beaked whales.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2 Non-Explosive Practice Munitions

5.3.2.2.2.1 Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Currently, the Navy employs the same mitigation measures for non-explosive gunnery exercises as described above in Sections 5.3.1.2.2.3 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target).

The Navy is proposing to (1) continue using the mitigation measures currently implemented for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation by a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (183 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (366 m) away from the location of the last sighting.

Effectiveness and Operational Assessments

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive projectile. Large caliber gunnery exercises involve the participating ship or aircraft firing munitions at a target location from ranges up to 6 nm away. Small- and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location from up to 2 nm away, although typically closer. Therefore, it is necessary for the Lookout to be able to visually observe the mitigation

zone from these distances. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen. Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.1.1 (Non-Impulsive and Impulsive Sound Sources) shows that injury to marine mammals and sea turtles is not expected to occur. Furthermore, any wait period greater than 30 min. would result in an unacceptable operational impact on readiness. The 10 min. wait period when aircraft are firing is based on fuel restrictions. Any wait period greater than 10 min. when aircraft are firing would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to some species of marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2.2 Bombing Exercise

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to continue using the mitigation measures currently implemented for this activity. The recommended measure includes clarification of a post-sighting activity recommencement criterion.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 1,000 yd. (914 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Effectiveness and Operational Assessments

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10 min. wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 min. for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10 min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal

and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive bomb. The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals or sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2.3 Missile Exercises (Including Rockets) Using a Surface Target

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 1,800 yd. (1.6 km) to 900 yd. (823 m), (2) clarify the conditions needed to recommence an activity after a sighting, (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation**,** and (4) modify the platform of observation to eliminate the requirement to observe when ships are firing. The recommended measures are provided below.

When aircraft are firing, mitigation will include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 900 yd. (823 m) around the deployed target. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

Effectiveness and Operational Assessments

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive projectile. Activities using non-explosive missiles (including rockets) involve the participating ship or aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. Because that type of observation is not possible for a ship, visual observation is not suitable for activities that involve a ship-fired missile. Even with aircraft firing, there is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30 min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.8.3.1.1 (Non-Impulsive and Impulsive Sound Sources) shows that injury to marine mammals and sea turtles is not expected to occur. Furthermore, any wait period greater than 30 min. would result in an unacceptable operational impact on readiness. The 10 min. wait period when aircraft are firing is based on fuel restrictions. Any wait period greater than 10 min. when aircraft are firing would result in an unacceptable operational impact on readiness and safety of

personnel. The 10 min. wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3 MITIGATION MEASURES CONSIDERED BUT ELIMINATED

A number of mitigation measures were suggested during the public comment periods of previous Navy environmental documents. As a result of the assessment process identified in Section 5.2 (Introduction to Mitigation), the Navy determined that some of the suggested measures would likely be ineffective at reducing environmental impacts, have an unacceptable operational impact based on the operational assessment, or be incompatible with Section 5.2.2 (Overview of Mitigation Approach). The measures that the Navy does not recommend for implementation are discussed in Section 5.3.3.1 (Previously Considered but Eliminated) and Section 5.3.3.2 (Previously Accepted but Now Eliminated).

There is a distinction between effective and feasible observation procedures for data collection and measures employed to prevent impacts or otherwise serve as mitigation. The discussion below is in reference to those procedures meant to serve as mitigation measures.

5.3.3.1 Previously Considered But Eliminated

5.3.3.1.1 Reducing Amount of Training Activities

Reducing training for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The requirements to train are designed to provide the experience needed to ensure Sailors are properly prepared for operational success. These requirements have been developed through many years of iteration and are designed to ensure Sailors achieve the levels of readiness needed to properly respond to the many contingencies that may occur during an actual mission. The Proposed Action does not include training beyond levels required for maintaining satisfactory levels of readiness due to the need to efficiently use limited resources (e.g. fuel, personnel, and time). Therefore, any reduction of training would not allow Sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

5.3.3.1.2 Replacing Training with Simulated Activities

Replacing training activities with simulated activities for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

As described in Chapter 2, Section 2.3.2.4 (Simulated Training) of the 2011 GOA Final EIS/OEIS, the Navy currently uses computer simulation for training whenever possible. Computer simulation can provide familiarity and complement live training; however, it cannot provide the fidelity and level of training necessary to prepare naval forces for deployment.

The Navy is required by law to operationally test major platforms, systems, and components of these platforms and systems in realistic combat conditions before full-scale production can occur. Substituting

simulation for live training fails to meet the purpose of and need for the Proposed Action and therefore was eliminated from consideration as a mitigation measure.

5.3.3.1.3 Reducing Sonar Source Levels and Total Number of Hours

Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission. Reducing active sonar source levels and the total number of active sonar hours used during training activities for the purpose of mitigation would adversely impact the effectiveness of military readiness activities and increase safety risks to personnel for the following reasons:

Sonar operators need to train as they would operate during real combat situations. Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, sonar equipment power levels are set consistent with mission requirements. Reducing sonar source levels for the purpose of mitigation precludes sonar operators from learning to operate the sonar systems with their entire range of capabilities throughout the extremely diverse range of environmental conditions they may encounter. Failure to train with the entire range of capabilities will reduce the effectiveness of the sonar operators should their skills be required during real world events. Not only would they not develop the skills necessary to identify and track submarines at the maximum distances of their systems capabilities, they would not learn how to use their systems' capabilities during the entire range of environmental conditions they may encounter. Likewise, they would not develop the knowledge of how to fully integrate multiple ASW capabilities, including other ships and aircraft into an integrated ASW team.

Failure to train with the entire range of capabilities also compromises training by reducing the ability for a sonar operator to detect, track, and hold an enemy target, mine, or other object, and by reducing the realism of other training scenarios (e.g., navigation training). Particularly during a strike group exercise, sonar operators need to learn to handle real world combat situations (e.g., the ability to manage sonar operations during periods of mutual interference, which can occur when more than one sonar system is operating simultaneously). Training with reduced sonar source levels would ultimately condition Sailors to expect conditions that they would not experience in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the strike group's ability to achieve mission success. Ultimately, reducing sonar source levels would reduce training realism. Reducing the total number of sonar hours used during training would prevent the Navy from meeting its military readiness qualification standards.

5.3.3.1.4 Implementing Active Sonar Ramp-Up Procedures during Training

Implementing active sonar ramp-up procedures (slowly increasing the sound in the water to necessary levels) in an attempt to clear the range prior to conducting activities for the purpose of mitigation during training activities would result in an unacceptable impact on readiness and would not necessarily be effective at reducing potential impacts on marine species for the following reason:

Ramp-up procedures would alert opponents to the participants' presence. This would consequently negatively affect the realism of training because the target submarine could detect the searching unit before the searching unit could detect the target submarine, enabling the target submarine to take evasive measures. This is not representative of a real-world situation and thereby would impact training realism and effectiveness. Training with reduced realism would alter Sailors' abilities to effectively

operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the sonar operator's ability to achieve mission success.

5.3.3.1.5 Reducing Vessel Speed

As described in Section 5.1.2 (Vessel Safety), as a SOP, Navy personnel are required to use appropriate caution and operate at a safe speed consistent with mission and safety. These SOPs are designed to allow a vessel to take proper and effective action to avoid a collision with any sighted object or disturbance (which may include a marine mammal), and to stop within a distance appropriate to the prevailing circumstances and conditions. Implementing widespread reductions in vessel speed throughout the Study Area for the purpose of mitigation would be impractical with regard to military readiness activities, and result in an unacceptable impact on readiness for the following reasons:

Vessel operators need to be able to react to changing tactical situations and evaluate system capabilities in training as they would in actual combat. Widespread speed restrictions would not allow the Navy to properly test vessel capabilities or train to react to these situations. Speed restrictions during some activities (e.g., flight operations, underway replenishment, etc.) would also add unacceptable risk and decrease safety of personnel and vessels. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the vessel operator's ability to achieve mission success.

5.3.3.1.6 Limiting Access to Training Locations

The Joint Pacific Alaska Range Complex provides a venue in which a large USAF contingent of aircraft can train jointly with and around a complete Navy Carrier Strike Group (CSG), comprised of an aircraft carrier and several other combatant surface ships. When the Navy conducts Joint training with Air Force assets, the training is often limited to Navy and Air Force aircraft conducting air training on Navy or Air Force ranges. In some cases, Air Force aircraft train with CSGs in other Pacific ranges; however, the size and mix of Air Force forces are significantly limited by the availability of local Air Force assets or by the cost of transporting and sustaining the aircraft and crews for the duration of an exercise. More importantly, very few airfields can meet the parking requirements of the large number of Air Force aircraft that are involved in a robust Joint training exercise. However, the Navy's CSGs are mobile and capable of carrying out sustained operations over a long period of time. Having Navy CSGs transit to the TMAA for training not only adds realism, but is economically prudent, as CSGs routinely transit to training areas as part of their normal training and deployment cycles. When operating in the TMAA, Navy CSG aircraft can reach established Air Force and Army instrumented ranges where they conduct air-to-air and air-to-ground training with Air Force and Army assets. Likewise, Alaska-based Air Force aircraft can reach the TMAA without refueling to conduct training with the CSG.

Subsequently, limiting training activities to specific locations for the purpose of mitigation would be impractical with regard to implementation, would adversely impact the effectiveness of military readiness activities, and would increase safety risks to personnel for the following reasons:

The ability to use the diverse and multidimensional capabilities of each range complex and training area results in the Navy's ability to develop and maintain high levels of readiness. Major exercises using integrated warfare components require large areas of the littorals, open ocean, and certain nearshore areas for realistic and safe training. Limiting training (including the use of sonar and other active acoustic sources or explosives) to specific locations (e.g., abyssal waters and surveyed offshore waters) and avoiding areas (e.g., embayments or large areas of the littorals and open ocean) would be impractical to implement with regard to the need to conduct activities in proximity to certain facilities and range

complexes. These restrictions would also adversely impact the safety of the training activities by requiring activities to take place in more remote areas where safety support may be limited.

Training activities require continuous access to large areas consisting potentially of thousands of square miles of ocean and air space to provide naval personnel the ability to train with and develop competence and confidence in their capabilities and their entire suite of weapons and sensors. Exercises may change mid-stream based on evaluators' assessments of performance and other conditions including weather or mechanical issues. These may preclude use of a permission scheme for access to water space. Threats to national security are constantly evolving and the Navy requires the ability to adapt training to meet these emerging threats as well as develop and test systems to effectively operate in these environments. Restricting access to limited locations would impact the ability of Navy training to evolve as the threat evolves. Operational units already incorporate requirements for safety of personnel including air space and shipping routes. Safety restrictions may include limits on distance from military air fields during carrier flight operations and air traffic corridors for safety of military and civilian aviation. These types of limitations shape how exercise planners develop and implement training scenarios including those involving defense of aircraft carriers from submarines.

Therefore, limiting access to training locations would reduce realism of activities by restricting access to important real world combat situations, such as bathymetric features and varying oceanographic features. As described in Section 5.3.3.1.7 (Avoiding Locations Based on Bathymetry and Environmental Conditions), Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or salinity. Training in a few specific locations would alter Sailors' abilities to effectively operate in varying real world combat situations, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

5.3.3.1.7 Avoiding Locations Based on Bathymetry and Environmental Conditions

The unique and complex bathymetric and oceanographic environment in the TMAA presents a challenging ASW training opportunity. The complexity of the sea bottom, the input of freshwater into the sea, and the areas of upwelling and ocean currents combine in the TMAA like in no other training area in the Pacific Ocean. Numerous air, surface, and subsurface assets within a Navy CSG gain valuable experience by conducting ASW training in this environment.

Subsequently, avoiding locations for training activities based on bathymetry and environmental conditions for the purpose of mitigation would increase safety risks to personnel and result in an unacceptable impact on readiness for the following reasons:

Areas where training activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. The varying environmental conditions of the Study Area (e.g., bathymetry and topography) maximize the training realism and effectiveness. Limiting training, including the use of sonar and other active acoustic sources or explosives, to avoid steep or complex bathymetric features (e.g., submarine canyons and large seamounts) and oceanographic features (e.g., surface fronts and variations in sea surface temperatures) would reduce the realism of the military readiness activity. Systems must be operated in a variety of bathymetric and environmental conditions to ensure functionality and accuracy in a variety of environments. Sonar operators need to train as they would operate during real world combat situations. Because real world combat situations include diverse bathymetric and environmental conditions, Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or

salinity. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the sonar operator's ability to achieve mission success.

5.3.3.1.8 Avoiding or Reducing Active Sonar at Night and During Periods of Low Visibility

Avoiding or reducing active sonar at night and during periods of low visibility for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The Navy must train in the same manner as it will fight. ASW can require a significant amount of time to develop the "tactical picture," or an understanding of the battle space (e.g., area searched or unsearched, identifying false contacts, and understanding the water conditions). Reducing or securing power in low-visibility conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Training differently from what would be needed in an actual combat scenario would decrease training effectiveness, reduce the crew's abilities, and introduce an increased safety risk to personnel.

Mid-frequency active sonar training is required year-round in all environments, including night and low-visibility conditions. Training occurs over many hours or days, which requires large teams of personnel working together in shifts around the clock to work through a scenario. Training at night is vital because environmental differences between day and night affect the detection capabilities of sonar. Temperature layers that move up and down in the water column and ambient noise levels can vary significantly between night and day, which affects sound propagation and could affect how sonar systems are operated. Consequently, personnel must train during all hours of the day to ensure they identify and respond to changing environmental conditions, and not doing so would unacceptably decrease training effectiveness and reduce the crews' abilities. Therefore, the Navy cannot operate only in daylight hours or wait for the weather to clear before training.

5.3.3.1.9 Avoiding or Reducing Active Sonar during Strong Surface Ducts

Avoiding or reducing active sonar during strong surface ducts for the purpose of mitigation would increase safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in an unacceptable impact on readiness for the following reasons:

The Navy must train in the same manner as it will fight. ASW can require a significant amount of time to develop the "tactical picture," or an understanding of the battle space such as area searched or unsearched, identifying false contacts, understanding the water conditions, etc. Surface ducting is a condition when water conditions (e.g., temperature layers, lack of wave action) result in little sound energy penetrating beyond a narrow layer near the surface of the water. Submarines have long been known to exploit the phenomena associated with surface ducting. Therefore, training in surface ducting conditions is a critical component to military readiness because sonar operators need to learn how sonar transmissions are altered due to surface ducting, how submarines may take advantage of them, and how to operate sonar effectively in this environment. Avoiding or reducing active sonar during surface ducting conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Diminished realism would reduce a sonar operator's ability to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

Furthermore, avoiding surface ducting would be impractical to implement because ocean conditions contributing to surface ducting change frequently, and surface ducts can be of varying duration. Surface

ducting can also lack uniformity and may or may not extend over a large geographic area, making it difficult to determine where to reduce power and for what periods.

5.3.3.1.10 Avoiding Locations Based on Distances from Isobaths or Shorelines

The littoral waterspace (i.e., 25 nm from 200 m isobaths) is where potential enemies will operate and is also the most challenging area to operate due to a diverse acoustic environment. In real world situations, it is highly likely the Navy would be working in these types of areas. It is not realistic to refrain from training in the areas that are the most challenging and operationally important. Placing coastal restrictions, such as limiting operations in the littoral waterspace, would hamper Navy training. Areas where ASW events are scheduled to occur are carefully chosen to provide for the safety of events and to allow for the realistic development of the training scenario including the ability of the exercise participants to develop, maintain, and demonstrate proficiency in all areas of warfare simultaneously. Limiting the training event to a few areas would have an adverse impact on the effectiveness of the training by limiting the ability to conduct other critical warfare areas including, but not limited to, the ability of the CSG to defend itself from threats on the surface and in the air while carrying out air strikes. Furthermore, training activities using integrated warfare components require large areas of the littorals and open ocean for realistic and safe training.

Subsequently, avoiding locations for training activities within the Study Area based on wide-scale distances from isobaths or the shoreline for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, result in unacceptable impact on readiness, and would not be an effective means of mitigation, and would increase safety risks to personnel for the following reasons:

A measure requiring avoidance of mid-frequency active sonar within 13 nm of the 656 ft. (200 m) isobaths was part of the Rim of the Pacific 2006 exercise authorization by NMFS. This measure, as well as similar measures of like distances, lacks any scientific basis when applied to the context of the Study Area (e.g., bathymetry, sound propagation, and width of channels). There is no scientific analysis indicating this measure is protective and no known basis for these specific metrics. The Rim of the Pacific 2006 exercise mitigation measure precluded active anti-submarine training in the littoral region, which significantly impacted realism and training effectiveness (e.g., protecting ships from submarine threats during amphibious landings). This mitigation procedure had no observable effect on the protection of marine mammals during Rim of the Pacific 2006 exercises, and its value is unclear; however, its adverse effect on realistic training, as with all arbitrary distance from land restrictions, is significant.

Training in shallower water is an essential component to maintaining military readiness. Sound propagates differently in shallower water and operators must learn to train in this environment. Additionally, submarines have become quieter through the use of improved technology and have learned to hide in the higher ambient noise levels of the shallow waters of coastal environments. In real world events, it is highly likely Sailors would be working in, and therefore must train in, these types of areas.

Areas where training activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. The proximity to facilities and range complexes is essential to the training realism and effectiveness required to train and certify naval forces ready for combat operations. Limiting access to nearshore areas would restrict access to certain training locations and would increase transit time for

these activities, which would result in an increased risk to personnel safety, particularly for platforms with fuel restrictions (e.g., aircraft) or for certain activities.

The ability to use the diverse and multi-dimensional capabilities of each range complex and training area results in the Navy's ability to develop and maintain high levels of readiness. Otherwise limiting training (including the use of sonar and other active acoustic sources or explosives) to avoid arbitrary distances from isobaths or the shoreline would adversely impact the effectiveness of the training. This includes avoiding conducting activities within 12 nm from shore, 25 nm from shore, between shore and the 20 m isobath, and 13 nm out from the 656 ft. (200 m) isobath. Operating in shallow water is essential in order to provide realistic training on real world combat conditions with regard to shallow water sound propagation.

5.3.3.1.11 Increasing Visual and Passive Acoustic Observations

Increasing visual and passive acoustic observations for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in an unacceptable impact on readiness for the following reasons:

The Navy recommended mitigation measures already represent the maximum level of effort (e.g., numbers of Lookouts and passive sonobuoys) that the Navy can commit to observing mitigation zones given the number of personnel that will be involved and the number and type of assets and resources available. The number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, vessels are minimally manned and are therefore physically unable to accommodate more than one Lookout. Furthermore, training activities are carefully planned with regard to personnel duties. Requiring additional Lookouts would either require adding personnel, for which there would be no additional space, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives.

The Navy will conduct passive acoustic monitoring during several activities with Navy assets, such as sonobuoys, already participating in the activity (e.g., sinking exercises, and improved extended echo ranging sonobuoys). Refer to Section 5.3.2 (Mitigation Zone Procedural Measures) for additional information on the use of passive acoustics during training activities. The Navy does not have the resources to construct and maintain additional passive acoustic monitoring systems for each training activity.

5.3.3.1.12 Increasing the Size of Observed Mitigation Zones

Increasing the size of observed mitigation zones for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in an unacceptable impact on readiness for the following reasons:

The Navy developed activity-specific mitigation zones based on the Navy's acoustic propagation model. In this GOA analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, PTS, out to the predicted maximum range. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also covers the predicted average range to TTS. In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted

maximum range to PTS based on the associated effectiveness and operational assessments presented in Section 5.3.2 (Mitigation Zone Procedural Measures).

The Navy recommended mitigation zones represent the maximum area the Navy can effectively observe based on the platform of observation, number of personnel that will be involved, and the number and type of assets and resources available. As mitigation zone sizes increase, the potential for reducing impacts decreases. For instance, if a mitigation zone increases from 1,000 to 4,000 yd. (914 to 3,658 m), the area that must be observed increases sixteen-fold. The Navy recommended mitigation measures balance the need to reduce potential impacts with the ability to provide effective observations throughout a given mitigation zone. Implementation of mitigation zones is most effective when the zone is appropriately sized to be realistically observed. The Navy does not have the resources to maintain additional Lookouts or observer platforms that would be needed to effectively observe mitigation zones of increased size. Further, as explained above, the number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, some vessels are minimally manned and are therefore physically unable to accommodate more than one Lookout. Training activities are carefully planned with regard to personnel duties. Requiring observation of mitigation zones of increased size would either require adding personnel, for which there would be no additional space or resources, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives. For most activities, Lookouts are required to observe for concentrations of detached floating vegetation (kelp paddies), which are indicators of potential marine mammal and sea turtle presence, within the mitigation zone to further help reduce the potential for injury to occur.

5.3.3.1.13 Conducting Visual Observations Using Third-Party Observers

With limited exceptions, use of third-party observers (e.g., trained marine species observers) in air or on surface platforms in addition to existing Navy Lookouts for the purposes of mitigation would be impractical with regard to implementation of military readiness activities and result in an unacceptable impact on readiness for the following reasons:

Use of third-party observers is not necessary because Navy personnel are extensively trained in spotting items on or near the water surface. Use of Navy Lookouts ensures immediate implementation of mitigation if marine species are sighted. A critical skill set of effective Navy training is communication. Navy Lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken. Additionally, multiple training events can occur simultaneously and in various regions throughout the Study Area, and can last for days or weeks at a time. The Navy does not have the resources to maintain third-party observers to accomplish the task for every event.

The use of third-party observers would compromise security for some activities involving active sonar due to the requirement to provide advance notification of specific times and locations of Navy platforms. Reliance on the availability of third-party personnel would impact training flexibility. The presence of other aircraft in the vicinity of naval activities would raise safety concerns for both the commercial observers and naval aircraft. Furthermore, vessels have limited passenger capacity. Training event planning includes careful consideration of this limited capacity in the placement of personnel on ships involved in the event. Inclusion of non-Navy observers onboard these vessels would require that in some cases there would be no additional space for essential Navy personnel required to meet the exercise objectives.

The areas where training events will most likely occur in the Study Area cover more than 42,146 square nautical miles. Contiguous ASW events may cover many hundreds or even thousands of square miles. The number of civilian vessels or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise area in the time required. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an event took place. Given that there are no adequate controls to account for these or other possibilities, there is little utility to performing extensive before or after event surveys of large exercise areas as a mitigation measure.

Surveying during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, many of the training events take place far from land, limiting both the time available for civilian aircraft to be in the event area and presenting a concern should aircraft mechanical problems arise. Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the progress of the exercise and impact the effectiveness of the military readiness activity.

5.3.3.1.14 Adopting Mitigation Measures of Foreign Navies

Adopting mitigation measures of foreign navies generally for the purpose of mitigation, such as expanding the mitigation zones to match those used by a particular foreign navy, would be impractical with regard to implementation of military readiness activities and result in an unacceptable impact on readiness for the following reasons:

Mitigation measures are carefully customized for and agreed upon by each individual navy based on potential impacts of the activities on marine species and the impacts of the mitigation measures on military readiness. The mitigation measures developed for one navy would not necessarily be effective at reducing potential impacts on marine species by all navies. Similarly, mitigation measures that do not cause an unacceptable impact to one navy may cause an unacceptable impact on another. For example, most other navies do not possess an integrated strike group and do not have integrated training requirements. The Navy's training is built around the integrated warfare concept and is based on the Navy's capabilities, the threats faced, the operating environment, and the overall mission. Implementing other navies' mitigation would be incompatible with U.S. Navy requirements. The U.S. Navy's recommended mitigation measures have been carefully designed to reduce potential impacts on marine species while not causing an unacceptable impact on readiness.

5.3.3.1.15 Increasing Reporting Requirements

The Navy has extensive reporting requirements, including exercise and monitoring reporting designed to verify implementation of mitigation, comply with current permits, and improve future environmental assessments (Section 5.5, Monitoring and Reporting). Increasing the requirement to report marine species sightings to augment scientific data collection and to further verify the implementation of mitigation measures is unnecessary and would increase safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in an unacceptable impact on readiness for the following reasons:

Vessels, aircraft, and personnel engaged in training events are intensively employed throughout the duration of training activities. Any additional workload assigned that is unrelated to their primary duty would adversely impact personnel safety and the effectiveness of the military readiness activity they are

undertaking. Lookouts are not trained to make accurate species-specific identification and would not be able to provide the detailed information that the scientific community would use. Alternatively, the Navy has an integrated comprehensive monitoring program (Section 5.5, Monitoring and Reporting) that does provide information that is available and useful to the scientific community in annual monitoring reports.

5.4 MITIGATION SUMMARY

Table 5.4-1 provides a summary of the Navy's recommended mitigation measures and compares the current and recommended (proposed) mitigations measures for acoustic (non-impulse and impulse) stressors and for physical disturbance and strike stressors. For reference, currently implemented mitigation measures for each activity category are also summarized in the table. The process for developing each of these measures is detailed in Section 5.2.3 (Assessment Method) and involved: (1) an effectiveness assessment to determine if implementation of the measure will likely result in avoidance or reduction of an impact on a resource; and (2) an operational assessment to determine if implementation of the measures will have acceptable operational impacts on the Proposed Action with regard to personnel safety, practicality of implementation, readiness, and Navy policy. Measures are intended to meet applicable regulatory compliance requirements for NEPA, Executive Order 12114, and CEQ guidance. The Navy recommended mitigation measures were also developed consistent with resource-specific environmental requirements, as follows:

- Measures specifying marine mammals and indicators of marine mammal presence (e.g. floating vegetation [kelp paddies], large schools of fish, or flocks of seabirds) as the protection focus are intended to meet MMPA requirements.
- Measures specifying marine mammals, sea turtles, flocks of seabirds, floating vegetation (kelp paddies), large schools of fish, jellyfish aggregations, or shallow coral reefs as the protection focus are intended to meet ESA requirements.
- Measures specifying shallow coral reefs, live hardbottom, artificial reefs, or shipwrecks as the protection focus are intended to meet Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act.
- Measures specifying shipwrecks is an additional protection focus intended to meet Abandoned Shipwreck Act and National Historic Preservation Act requirements.

The measures presented in Table 5.4-1 are discussed in greater detail in Section 5.3.1 (Lookout Procedural Measures), and Section 5.3.2 (Mitigation Zone Procedural Measures). As discussed in Section 5.2.2.2 (Protective Measures Assessment Protocol), the final suite of mitigations resulting from the ongoing planning for this Supplemental EIS/OEIS, as well as the regulatory consultation and permitting processes will be integrated into the PMAP for implementation purposes. Section 5.5 (Monitoring and Reporting) describes the monitoring and reporting efforts the Navy will undertake to investigate the effectiveness of implemented mitigation measures and to better understand the impacts of the Proposed Action on marine resources.

Table 5.4-2 examines the mitigation measures, describing their implementation, benefits, and how successful implementation is evaluated.

Table 5.4-1: Summary of Recommended Mitigation Measures

Activity Category or Mitigation Area	2011 GOA Final EIS/OEIS Measures and Protection Focus	Proposed Lookout Procedural Measure	Proposed Mitigation Zone and Protection Focus
Specialized Training			
Marine Species Awareness Training (Modules 1 through 4)	Applicable personnel will complete the U.S. Navy Marine Species Awareness Training prior to standing watch or serving as a Lookout.	Applicable personnel will complete the U.S. Navy Marine Species Awareness Training prior to standing watch or serving as a Lookout.	The mitigation zones observed by Lookouts are specified for each Mitigation Zone Procedural Measure below.
Acoustic Stressors – Sonar and Other Active Acoustic Sources			
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare	1,000 yd. (914 m) and 500 yd. (457 m) power downs and 200 yd. (183 m) shutdown for marine mammals and sea turtles	2 Lookouts (general) 1 Lookout (minimally manned, moored, or anchored)	1,000 yd. (914 m) and 500 yd. (457 m) power downs and 200 yd. (183 m) shutdown for cetaceans and sea turtles (excludes bow-riding dolphins)
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar	Non-hull mounted mid-frequency: 200 yd. (183 m) for marine mammals, floating vegetation, and kelp paddies. High-frequency: None	2 Lookouts (general) 1 Lookout (minimally manned, moored, or anchored)	200 yd. (183 m) for marine mammals and concentrations of floating vegetation.
Acoustic Stressors – Sonar and Other Active Acoustic Sources			
Improved Extended Echo Ranging Sonobuoys	1,000 yd. (914 m) for marine mammals and sea turtles.	1 Lookout	600 yd. (549 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Explosive Signal Underwater Sound buoys using 0.6–2.5 lb. NEW	None	1 Lookout	350 yd. (320 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target	200 yd. (183 m) for marine mammals, sea turtles, floating vegetation.	1 Lookout	200 yd. (183 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Gunnery Exercises – Large-Caliber Explosive Rounds using a Surface Target	None. (Current mitigation measures were for all gunnery exercises and included only a 200 yd. [180 m] mitigation zone, which the Navy feels is too small for high-explosive gunnery.).	1 Lookout	600 yd. (549 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Missile Exercises (Including Rockets) up to 250 lb. NEW Using a Surface Target	1,800 yd. (1.6 km) for marine mammals, sea turtles, floating vegetation and kelp paddies.	1 Lookout	900 yd. (823 m) for marine mammals, sea turtles, and concentrations of floating vegetation.

Table 5.4-1: Summary of Recommended Mitigation Measures (continued)

Activity Category or Mitigation Area	2011 GOA Final EIS/OEIS Measures and Protection Focus	Proposed Lookout Procedural Measure	Proposed Mitigation Zone and Protection Focus
Acoustic Stressors – Sonar and Other Active Acoustic Sources (continued)			
Missile Exercises Using 251–500 lb. NEW Using a Surface Target	1,800 yd. (1.6 km) for marine mammals, sea turtles, floating vegetation, and kelp paddies.	1 Lookout	2,000 yd. (1.8 km) for marine mammals, sea turtles, and concentrations of floating vegetation (kelp paddies).
Explosive and Non-Explosive Bombing Exercises	Explosive: 1,000 yd. (914 m) for marine mammals, sea turtles, and floating vegetation.	1 Lookout	Explosive: 2,500 yd. (2.3 km) for marine mammals, sea turtles, and concentrations of floating vegetation. Non-Explosive: 1,000 yd. (914 m) for marine mammals, sea turtles, and concentrations of floating vegetation.
Sinking Exercises	2.0 nm for marine mammals, sea turtles, floating vegetation and jellyfish aggregations.	2 Lookouts	2.5 nm for marine mammals, sea turtles, concentrations of floating vegetation (kelp paddies), and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.
Weapons Firing Noise During Gunnery Exercises – Large-Caliber	None	1 Lookout	70 yd. (60 m) within 30 degrees on either side of the gun target line on the firing side for marine mammals, sea turtles, and concentrations of floating vegetation.
Physical disturbance and Strike			
Vessel Movements	500 yd. (457 m) for whales.	1 Lookout	500 yd. (457 m) for whales. 200 yd. (183 m) for all other marine mammals (except bow riding dolphins).
Towed In-Water Device Use	250 yd. (229 m) for marine mammals.	1 Lookout	250 yd. (229 m) for marine mammals

Notes: EIS = Environmental Impact Statement, km = kilometer, lb.= pound, m = meter, NEW = net explosive weight, nm = nautical mile, OEIS = Overseas Environmental Impact Statement, yd.= yard

Table 5.4-2: Mitigation Identification and Implementation

Mitigation Measure	Benefit	Evaluation Criteria	Implementation	Responsible Command	Date Implemented
Marine Species Awareness Training All personnel standing watch on the bridge and Lookouts will successfully complete the training before standing watch or serving as a Lookout.	To learn the procedures for searching for and recognizing the presence of marine species, including detection cues (e.g., congregating seabirds) so that potentially harmful interactions can be avoided.	Successful completion of training by all personnel standing watch and all personnel serving as Lookouts. Personnel successfully applying skills learned during training.	The multimedia training program has been made available to personnel required to take the training. Personnel have been and will continue to be required to take the training prior to standing watch and serving as Lookouts.	Officer Conducting the Exercise or Test or civilian equivalent	Ongoing
Lookouts					
Use of Four Lookouts for Underwater Detonations[1] Mine countermeasure and neutralization activities using time delay or positive control firing devices will include the use of two to four Lookouts, depending on the size of the charge. If applicable, aircrew and divers will report sightings of marine mammals or sea turtles.	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from explosives use can be avoided. Lookouts can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they are involved in the activity, will increase the probability of sightings, reducing the potential for impacts.	Annual report documenting the number of marine mammals and sea turtles sighted, including trend analysis after 3 years. Annual report documenting the number of incidents when a Navy activity was halted or delayed as a direct result of a marine mammal or sea turtle sighting.	All Lookouts will receive marine species awareness training and will be positioned on vessels, boats, and aircraft as described in Section 5.3.1.1.1 (Training for Navy Personnel and Civilian Equivalents).	Officer Conducting the Exercise or Test	Ongoing
Use of One or Two Lookouts Vessels using low-frequency active sonar or hull-mounted mid-frequency active sonar associated with ASW activities will have either one or two Lookouts, depending on the activity and size of the vessel. Mine countermeasure and neutralization activities with positive control will use two Lookouts, with one on each support vessel. If applicable, aircrew and divers will also report the presence of marine mammals or sea turtles. One Lookout may be used under certain circumstances specific in Section 5.3.1.2 (Lookouts).	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from Navy sonar and explosives use can be avoided. Lookouts can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they are involved in the activity, will increase the probability of sightings, reducing the potential for impacts.				
Use of One Lookout Surface ships and aircraft conducting ASW, ASUW, or MIW activities using HFAS, non-hull-mounted mid-frequency active sonar, helicopter dipping mid-frequency active sonar, anti-swimmer grenades, explosive buoys, surface gunnery activities, surface missile activities, bombing activities, explosive torpedo testing, and activities using non-explosive practice munitions, will have one Lookout.	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from Navy sonar, explosives, sonobuoys, gunnery rounds, missiles, explosive torpedoes, pile driving, towed systems, surface vessel propulsion, and non-explosive munitions can be avoided. Lookouts will quickly and effectively relay sighting information so that corrective action(s) can be taken.				

Table 5.4-2: Mitigation Identification and Implementation (continued)

Mitigation Measure	Benefit	Evaluation Criteria	Implementation	Responsible Command	Date Implemented
Mitigation Zones					
Use of a Mitigation Zone A mitigation zone is an area defined by a radius and centered on the location of a sound source or activity. The size of each mitigation zone is specific to a particular training activity (e.g., sonar use or explosive use).	A mitigation zone defines the area in which Lookouts survey for marine mammals and sea turtles. Mitigation zones reduce the potential for injury to marine species.	For those activities where monitoring is required, record observations of marine mammals and sea turtles located outside of the mitigation zone and note any apparent reactions to on-going Navy activities. Observation of acute reactions may be used as an indicator that the radius of the mitigation zone needs to be increased.	Mitigation zones have been and will continue to be implemented as described in Section 5.3.2 (Mitigation Zone Procedural Measures). Lookouts are trained to conduct observations within mitigation zones of different sizes.	Officer Conducting the Exercise or Test	Ongoing
Recognize the Importance of Marine Protected Areas In general, most Armed Forces activities are exempt from the prohibitions of marine protected areas Nevertheless, the Navy would carry out its training activities in a manner that will avoid, to the maximum extent practical and consistent with training requirements, adverse impacts to National Marine Sanctuary resources.	Avoiding or minimizing impacts while operating in or near marine protected areas could result in improved health of the resources in the areas.	The Navy shall submit an annual report to the National Marine Fisheries Service.	The Navy includes charts in the Protective Measures Assessment Protocol to define marine protected areas. To the greatest extent practical, adverse impacts to these areas will be avoided.	Officer Conducting the Exercise or Test	Ongoing

[1] Mine countermeasure and neutralization activities are not conducted in the Study Area and are not part of the Proposed Action. However, these activities are show in the table for completeness
Notes: ASW = Anti-submarine Warfare, ASUW = Anti-surface Warfare, HFAS = High-Frequency Active Sonar, IEER = Improved Extended Echo Ranging, MIW = Mine Warfare, NAVSEA = Naval Sea Systems Command

5.5 MONITORING AND REPORTING

5.5.1 APPROACH TO MONITORING

The Navy is committed to demonstrating environmental stewardship while executing its National Defense Mission and complying with the suite of Federal environmental laws and regulations. As a complement to the Navy's commitment to avoiding and reducing impacts of the Proposed Action through mitigation, the Navy will undertake monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the effects of the Proposed Action on marine resources. Taken together, mitigation and monitoring comprise the Navy's integrated approach for reducing environmental impacts from the Proposed Action. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

Consistent with the cooperating agency agreement with NMFS, mitigation and monitoring measures presented in this EIS/OEIS focus on the requirements for protection and management of marine resources. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Since monitoring will be required for compliance with the Letters of Authorization issued for the Proposed Action under the MMPA, details of the monitoring program will be developed in coordination with NMFS through the regulatory process. Discussions with resource agencies during the consultation and permitting processes may result in changes to the mitigation as described in this document. Such changes will be reflected in the Records of Decision and consultation documents such as the ESA Biological Opinion.

5.5.1.1 Integrated Comprehensive Monitoring Program

The Integrated Comprehensive Monitoring Program is intended to coordinate monitoring efforts across all regions where the Navy trains and tests and to allocate the most appropriate level and type of effort for each range complex (U.S. Department of the Navy 2010). The current Navy monitoring program is composed of a collection of "range-specific" monitoring plans, each developed individually as part of MMPA and ESA compliance processes as environmental documentation was completed. These individual plans establish specific monitoring requirements for each range complex, training area, or activity and are collectively intended to address the Integrated Comprehensive Monitoring Program top-level goals.

A 2010 Navy-sponsored monitoring meeting in Arlington, Virginia, initiated a process to critically evaluate the current Navy monitoring plans and begin development of revisions and updates to both existing region-specific plans as well as the Integrated Comprehensive Monitoring Plan. Discussions at that meeting as well as the following Navy and NMFS annual adaptive management meeting established a way ahead for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group of leading marine mammal scientists with the initial task of developing recommendations that would serve as the basis for a Strategic Plan for Navy monitoring. The Strategic Plan is intended to be a primary component of the Integrated Comprehensive Monitoring Program, provide a "vision" for Navy monitoring across geographic regions—serving as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address Integrated Comprehensive Monitoring Program top-level goals, and satisfy MMPA Letter of Authorization regulatory requirements.

The objective of the Strategic Plan is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating Scientific Advisory Group recommendations, and establishing a more transparent framework for soliciting, evaluating, and implementing monitoring work across the range complexes and training areas. The Strategic Plan must consider a range of factors in addition to the scientific recommendations including logistic, operational, and funding considerations and will be revised regularly as part of the annual adaptive management process.

The Integrated Comprehensive Monitoring Plan establishes top-level goals that have been developed in coordination with NMFS (U.S. Department of the Navy 2010). The following top-level goals will become more specific with regard to identifying potential projects and monitoring field work through the Strategic Plan process as projects are evaluated and initiated in the Study Area.

- An increase in our understanding of the likely occurrence of marine mammals or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and density of species);
- An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and ESA-listed species to any of the potential stressor(s) associated with the action (e.g., tonal and impulse sound), through better understanding of one or more of the following: (1) the action and the environment in which it occurs (e.g., sound source characterization, propagation, and ambient noise levels), (2) the affected species (e.g., life history or dive patterns), (3) the likely co-occurrence of marine mammals and ESA-listed marine species with the action (in whole or part) associated with specific adverse effects, or (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving or feeding areas);
- An increase in our understanding of how individual marine mammals or ESA-listed marine species respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level);
- An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) the long-term fitness and survival of an individual; or (2) the population, species, or stock (e.g., through impacts on annual rates of recruitment or survival);
- An increase in our understanding of the effectiveness of mitigation and monitoring measures;
- A better understanding and record of the manner in which the authorized entity complies with the Incidental Take Authorization and Incidental Take Statement;
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
- A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

5.5.1.2 Scientific Advisory Group Recommendations

Navy established the Scientific Advisory Group in 2011 with the initial task of evaluating current Navy monitoring approaches under the Integrated Comprehensive Monitoring Plan and existing MMPA Letters of Authorization and developing objective scientific recommendations that would form the basis for the Strategic Plan. While recommendations were fairly broad and not prescriptive from a range complex perspective, the Scientific Advisory Group did provide specific programmatic recommendations

that serve as guiding principles for the continued evolution of the Navy Marine Species Monitoring Program and provide a direction for the Strategic Plan to move this development. Key recommendations include:

- Working within a conceptual framework of knowledge, from basic information on the occurrence of species within each range complex, to more specific matters of exposure, response, and consequences.
- Facilitating collaboration among researchers in each region, with the intent to develop a coherent and synergistic regional monitoring and research effort.
- Striving to move away from a "box-checking" mentality. Monitoring studies should be designed and conducted according to scientific objectives, rather than on merely cataloging effort expended.
- Approach the monitoring program holistically and select projects that offer the best opportunity to advance understanding of the issues, as opposed to establishing range-specific requirements.

5.5.2 REPORTING

The Navy is committed to documenting and reporting relevant aspects of training activities to verify implementation of mitigation, comply with current permits, and improve future environmental assessments. Navy reporting initiatives are described below.

5.5.2.1 Exercise and Monitoring Reporting

The Navy will submit annual exercise and monitoring reports to the Office of Protected Resources at NMFS. The exercise report will describe the level of training conducted during the reporting period, and the monitoring report will describe both the nature of the monitoring that has been conducted and the actual results of the monitoring. If during a given year, no Navy training or monitoring occurs, then NMFS will be informed with a memorandum stating that fact vice publication of a formal report. All of the details regarding the content of the annual reports will be coordinated with NMFS through the permitting process. All unclassified reports submitted to date can be found on the NMFS Office of Protected Resources webpage.

5.5.2.2 Additional Reporting Requirements

5.5.2.2.1 Marine Mammal or Sea Turtle

If there is evidence that a marine mammal or sea turtle may have been stranded, injured, or killed by the action, Navy training activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise, who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Northwest, Environmental Director, and the chain-of-command. The situation will also be reported to NMFS.

Navy personnel shall ensure that NMFS is notified immediately (or as soon as clearance procedures allow) if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing mid-frequency active sonar, high-frequency active sonar, or underwater explosive detonations. The Navy will provide NMFS with the name of species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). In the event that an injured, stranded, or dead marine mammal is found by the Navy that is not in the vicinity of, or during or shortly after, mid-frequency active sonar, high-frequency active sonar, or

underwater explosive detonations, the Navy will report the same information as listed above as soon as operationally feasible and clearance procedures allow.

General Notification of Ship Strike

In the event of a ship strike by any Navy vessel, at any time or place, the Navy shall do the following:

- Immediately report to NMFS the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown).
- Report to NMFS as soon as operationally feasible the size and length of animal, an estimate of the injury status (e.g., dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status.
- Report to NMFS the vessel length, speed, and heading as soon as feasible.
- Provide NMFS a photo or video, if equipment is available.

5.5.2.3 Stranding Response Plan

In consultation with NMFS, there will be a NMFS-Navy stranding response plan applicable to periods in which Navy training events occur within the TMAA. All of the details regarding the content of the stranding response plan will be coordinated with NMFS through the permitting process.

5.5.2.4 Bird Strikes

The Navy will report all damaging and non-damaging bird strikes to the Naval Safety Center.

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6 Additional Regulatory Considerations

TABLE OF CONTENTS

6 ADDITIONAL REGULATORY CONSIDERATIONS 6-1

6.1 CONSISTENCY WITH OTHER APPLICABLE FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS 6-1
6.1.1 NATIONAL SYSTEM OF MARINE PROTECTED AREAS 6-8
6.2 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 6-12
6.3 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES 6-13
6.4 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF THE PROPOSED ACTION AND MITIGATION MEASURES 6-13

LIST OF TABLES

TABLE 6.1-1: SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION 6-2
TABLE 6.1-2: MARINE PROTECTED AREAS NEAR THE GULF OF ALASKA SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT STUDY AREA 6-12

LIST OF FIGURES

FIGURE 6.1-1: MAP OF MARINE PROTECTED AREAS NEAR THE STUDY AREA 6-11

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6 ADDITIONAL REGULATORY CONSIDERATIONS

In accordance with the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA), federal agencies shall, to the fullest extent possible, integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively. This chapter summarizes environmental compliance for the Proposed Action; consistency with other federal, state, and local plans, policies, and regulations not considered in Chapter 3 (Affected Environment and Environmental Consequences); the relationship between short-term impacts; the maintenance and enhancement of long-term productivity in the affected environment; irreversible or irretrievable commitments of resources; and energy conservation.

6.1 CONSISTENCY WITH OTHER APPLICABLE FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS

Implementation of the Proposed Action addressed in the Gulf of Alaska (GOA) Navy Training Activities Supplemental Environmental Impact Statement (EIS)/Overseas EIS (OEIS) would comply with applicable federal, state, and local laws, regulations, and executive orders. The United States (U.S.) Department of the Navy (Navy) is consulting with and will continue to consult with regulatory agencies, as appropriate, during the NEPA process and prior to implementation of the Proposed Action to ensure that requirements are met. Table 6.1-1 summarizes environmental compliance requirements that were considered in preparing this Supplemental EIS/OEIS (including those that may be secondary considerations in the resource evaluations). Section 3.0.2 (Regulatory Framework) provides brief excerpts of the primary federal statutes, executive orders, international standards, and guidance that form the regulatory framework for the resource evaluations. Documentation of consultation and coordination with regulatory agencies is provided in Appendix B (Agency Correspondence). Formal consultation under the Endangered Species Act will start following the release of the Draft Supplemental EIS/OEIS. However, the Navy has been coordinating with regulatory offices prior to initiating the formal consultation. Likewise, the Navy submitted applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act authorizations supported by this Supplemental EIS/OEIS. Consultation with NMFS is currently underway. Therefore, not all consultation documentation is included in Appendix B (Agency Correspondence) or on the website (www.goaeis.com) at this time, but all compliance will be completed prior to the signing of the Record of Decision for the Proposed Action.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws	
Abandoned Shipwreck Act (43 United States Code [U.S.C.] §§2101–2106)	The 1987 Abandoned Shipwreck Act establishes requirements for educational and recreational access to abandoned shipwrecks, the protection of such resources through the establishment of underwater parks and protected areas, the development of specific guidelines for management and protection in consultation with various stakeholders, defines the jurisdiction and responsibility of federal and state agencies, and explicitly states that the law of salvage and the law of finds do not apply. Under the Act, the Department of the Interior and National Park Service issued guidelines in 2007 to help states manage shipwrecks in their waters. The Act defines the federal government's title to any abandoned shipwreck that meets criteria for inclusion in the National Register of Historic Places within state submerged lands, with the stipulation that title to these shipwrecks will be transferred to the appropriate state. For abandoned shipwrecks in U.S. Territorial Waters, the federal government asserts title to the resource. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.10 (Cultural Resources) for the assessment and conclusion that the Proposed Action is consistent with the Act. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS. (See Section 3.10.2.2, Regulatory Framework, of the 2011 GOA Final EIS/OEIS)
Act to Prevent Pollution from Ships (33 U.S.C. §1901 et seq.)	Requirements associated with the Act to Prevent Pollution from Ships are implemented by the Navy Environmental Readiness Program Manual and related Navy guidance documents governing waste management, pollution prevention, and recycling. At sea, the Navy complies with these regulations and operates in a manner that minimizes or eliminates any adverse effects on the marine environment (U.S. Department of the Navy 2007).
Antiquities Act (16 U.S.C. §431)	The Antiquities Act states that any person who shall appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall, upon conviction, be fined or be imprisoned for a period of not more than 90 days, or shall suffer both fine and imprisonment. The Proposed Action is consistent with the Act's objectives for protection of archaeological and historical sites and objects, preservation of cultural resources, and the public's access to them. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.10 (Cultural Resources) for the assessment. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS. (See Section 3.10.2.2, Regulatory Framework, of the 2011 GOA Final EIS/OEIS)
Bald and Golden Eagle Protection Act (16 U.S.C. 668–668c)	This Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. Implementation of the Proposed Action would not affect Bald and Golden Eagles as their protection is defined in the Bald and Golden Eagle Protection Act. The conclusion presented in Chapter 3, Section 3.9 (Birds) of the 2011 GOA Final EIS/OEIS indicated that there is little indication that military activities will result in the take of bald eagles and, therefore, a permit is not needed. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
Coastal Zone Management Act (16 Code of Federal Regulations [C.F.R.] §1451 et seq.)	This Act established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. The Alaska Coastal Management Program (ACMP) ended on 1 July 2011 per state legislative action (Alaska Statute 44.66.030). The Legislature adjourned the special legislative session on 14 May 2011 without passing legislation required to extend the ACMP. Therefore, Alaska currently does not have an approved Coastal Management Plan, and the Navy has no requirements to prepare and submit a consistency determination for the Proposed Action analyzed in this Supplemental EIS/OEIS. See the 2011 GOA Final EIS/OEIS, Chapter 1, Section 1.5.5 (Coastal Zone Management Act) and Sections 3.3.2.2 (Regulatory Framework) and 3.5.2.1 (Regulatory Framework) for a discussion of Navy activities and compliance with the Coastal Zone Management Act under the previously approved Coastal Management Plan before it expired in 2011.
Clean Air Act (CAA) (42 U.S.C. §§7401 et seq.) CAA General Conformity Rule (40 C.F.R. §93[B]) State Implementation Plan (SIP)	The CAA is the comprehensive federal law that regulates air emissions from stationary and mobile sources. The Proposed Action would not conflict with attainment and maintenance goals established in SIPs. As determined previously, a CAA conformity determination will not be required because emissions attributable to the alternatives including the Proposed Action would be below *de minimis* thresholds. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.1 (Air Quality) for discussion of military service activities and compliance with the CAA. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS. (See Section 3.1.2.2, Regulatory Framework, of the 2011 GOA Final EIS/OEIS)
Clean Water Act (CWA) (33 U.S.C. 1251 et seq.)	The CWA is an act to provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes. The Act's objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The Proposed Action would not conflict with goals established in SIPs. No permits are required under the CWA Sections 401, 402, or 404 (b)(1). (See Section 3.3.2.2, Regulatory Framework; Section 3.5.2.1, Regulatory Framework; Section 3.5.2.2, Approach to Analysis; and Section 5.1.3, Water Resources, of the 2011 GOA Final EIS/OEIS)
Historic Sites Act (16 U.S.C. §§461–467)	The Historic Sites Act established a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States. The Proposed Action is consistent with the national policy for the preservation of historic sites, buildings, and objects of national significance. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.10 (Cultural Resources) for the complete assessment. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§1801–1802)	The Magnuson-Stevens Fishery Conservation and Management Act was established to conserve and manage U.S. fishery resources. The Navy prepared an Essential Fish Habitat Assessment (EFHA) as a separate document for the 2011 GOA Final EIS/OEIS. The Proposed Action would not adversely affect fish populations or EFH as defined under the Magnuson-Stevens Fishery Conservation and Management Act. The Proposed Action may affect ESA-listed fish species. The Proposed Action has no effect to designated critical habitat. The Navy has no existing protective measures in place specifically for fish; however, habitats associated with fish communities benefit from measures in place to protect marine mammals and sea turtles. See the 2011 GOA Final EIS/OEIS, Chapter 5 (Mitigation Measures), and Sections 3.6.1.2 (Essential Fish Habitat), 3.6.2.1 (Regulatory Framework), and 3.12.1.1 (Existing Conditions), for the full discussion of mitigation measures. The Navy is not preparing an updated EFHA, because the EFHA and associated consultation with NMFS conducted for the 2011 GOA Final EIS/OEIS is still valid.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
Endangered Species Act (ESA) (16 U.S.C. §§1531 et seq.) (Continued)	The ESA established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. The Supplemental EIS/OEIS analyzes potential effects to species listed under the ESA and is administered by both the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). In accordance with Section 7 of the ESA (50 C.F.R. §402), during the preparation of the 2011 GOA Final EIS/OEIS, the Navy prepared a biological evaluation and submitted it to the USFWS. The Navy received a concurrence letter from USFWS (March 2010), which agreed that the Navy's actions may affect, but were unlikely to adversely affect, the short-tailed albatross. As provided in 50 C.F.R. §402.16, re-initiation of formal consultation is normally required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. As there are no changes in the amount or extent of incidental take, no new information that would change the affected environment or analysis, no new Navy training activities, or no new or modified ESA status of ESA-listed short-tailed albatross in the Temporary Maritime Activities Area (TMAA), the criteria for re-initiation of formal consultation with USFWS for short-tailed albatross, as set forth in 50 C.F.R. §402.16, are not triggered. Therefore, the existing consultation continues to address the proposed action with regards to the short-tailed albatross, and the Navy will adhere to the terms of the informal USWFS consultation conducted under the 2011 GOA Final EIS/OEIS. Additionally, during the preparation of the 2011 GOA Final EIS/OEIS, the Navy formally consulted with NMFS regarding the Proposed Action. The Navy received a Biological Opinion (April 2011) that indicated that the Navy's actions were not likely to jeopardize the continued existence of leatherback sea turtles. Similar to short-tailed albatross, since there are no changes in the amount or extent of incidental take, no new information that would change the affected environment or analysis, no new Navy training activities, or no new or modified ESA status of ESA-listed leatherback sea turtles in the TMAA, the criteria for re-initiation of formal consultation with NMFS for leatherback sea turtles, as set forth in 50 C.F.R. §402.16, are not triggered. Therefore, therefore the existing consultation continues to address the proposed action with regards to leatherback sea turtles and the Navy will adhere to the terms of the formal NMFS consultation conducted under the 2011 GOA Final EIS/OEIS. However, the Supplemental EIS/OEIS presents new modeling information that reveals additional potential effects to marine mammals not previously covered in the previous consultation. Therefore, re-initiation of formal consultation, as set forth in 50 C.F.R. §402.16, is triggered. The Navy is currently preparing a Biological Evaluation that will be submitted to NMFS as part of the new formal consultation. A Biological Opinion (BO) will be issued by NMFS and the Navy will adhere to any BO terms and conditions listed therein. In addition, the Navy has applied for a Letter of Authorization (LOA) (see discussion below on the Marine Mammal Protection Act), which is expected to impose terms and conditions that, when implemented, would make ESA Section 9 prohibitions inapplicable to covered Navy activities. The new MMPA LOA permit will be issued by NMFS prior to the issuance of the Record of Decision (ROD) on this Supplemental EIS/OEIS

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
Marine Mammal Protection Act (MMPA) (16 U.S.C. §§1431 et seq.)	The MMPA governs activities with the potential to harm, disturb, or otherwise "harass" marine mammals. As a result of acoustic effects associated with active sonar use, acoustic sources, and underwater detonations of explosives, implementation of the Proposed Action may result in potential Level A (harm) or Level B (disturbance) harassment to marine mammals. Therefore, the Navy engaged in the NMFS regulatory process by conducting the analysis in Chapter 3 to determine whether incidental "takes" of marine mammals are likely, and will seek to obtain an LOA from NMFS. This Supplemental EIS/OEIS updates the marine analysis and will be the basis for a request for a new LOA 5-year permit for the 2016–2021 timeframe.
Migratory Bird Treaty Act (16 U.S.C. §§703–712)	The Migratory Bird Treaty Act prohibits the taking, killing, or possessing of migratory birds or the parts, nests, or eggs of such birds, unless permitted by regulation. The 2003 National Defense Authorization Act provides that the Armed Forces may take migratory birds incidental to military readiness activities provided that, for those ongoing or proposed activities that the Armed Forces determine may result in a significant adverse effect on a population of a migratory bird species, the Armed Forces confer and cooperate with the Service to develop and implement appropriate conservation measures to minimize or mitigate such significant adverse effects. Implementation of the Proposed Action would cause no significant adverse effect on a population of migratory bird species. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.9 (Birds), Sections 3.9.2.2 (Regulatory Framework), 3.9.2.4 (No Action Alternative), 3.9.2.5 (Alternative 1), 3.9.2.6, (Alternative 2), and the ROD for the assessment. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.
Military Munitions Rule	The Military Munitions Rule identifies when conventional and chemical military munitions are considered solid waste under the Resource Conservation and Recovery Act (42 U.S.C. §6901 et seq.). Military munitions are not considered solid waste if they are (1) used for their intended purpose, which includes training military personnel and testing of munitions, weapons, or weapon systems; or (2) subjected to materials recovery activities (40 C.F.R. §266.202(a)(1) and (2)). These two conditions cover the uses of munitions included in the Proposed Action; therefore, the Resource Conservation and Recovery Act does not apply.
Marine Protection, Research, and Sanctuaries Act (16 U.S.C. §1431 et seq. and 33 U.S.C. §1401 et seq.)	The Marine Protection, Research, and Sanctuaries Act generally prohibits (1) transportation of material from the United States for the purpose of ocean dumping, (2) transportation of material from anywhere for the purpose of ocean dumping by U.S. agencies or U.S.-flagged vessels, or (3) dumping of material transported from outside the United States into the U.S. territorial sea. A permit is required to deviate from these prohibitions. For the Navy SINKEX activities, the general permit is captioned "Transport of Target Vessels" and is published at 40 C.F.R. 229.2 (Permit). In a January 2014 agreement letter from the EPA to the Navy, the EPA determined that the activity authorized under the Permit for the SINKEX program conducted by Navy does not pose an unreasonable risk of injury to human health or the environment. SINKEX operations may continue in accordance with the requirements of the Permit, including the clarifications discussed in the January 2014 agreement letter. For additional information, see Sections 3.2.2.2 (Regulatory Framework), 3.2.2.6 (Alternative 2), 3.3.2.2 (Regulatory Framework), 3.3.2.6 (Alternative 2), and 5.2.1.2 (Measures for Specific Training Events) of the 2011 GOA Final EIS/OEIS.
National Historic Preservation Act (16 U.S.C. §§470 et seq.)	The Proposed Action would be implemented in consultation with and under programmatic agreement with the State Historic Preservation Office. For additional information, see Sections 3.10.2.2 (Regulatory Framework), 3.10.2.3 (Approach to Analysis), and 4.2.10 (Cultural Resources) of the 2011 GOA Final EIS/OEIS.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
National Marine Sanctuaries Act (16 U.S.C. §1431 et seq.)	This Act authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities as National Marine Sanctuaries. The Study Area does not include any National Marine Sanctuaries; therefore the National Marine Sanctuaries Act does not apply.
Rivers and Harbors Act (33 U.S.C. §401 et seq.)	The Rivers and Harbors Act addresses projects and activities in navigable waters and harbor and river improvements. In accordance with U.S. Army Corps of Engineers regulations, no permit is required under the Rivers and Harbors Act because no construction in navigable waterways is proposed. See Table 6-1 of the 2011 GOA Final EIS/OEIS.
Submerged Lands Act of 1953 (43 U.S.C. §§1301–1315)	The Submerged Lands Act returns the title to submerged lands to the states and promotes the exploration and development of petroleum deposits in coastal waters. The Proposed Action is consistent with regulations concerning the Submerged Lands Act.
Sunken Military Craft Act (Public Law 108–375, 10 U.S.C. §113 Note and 118 Stat. 2094–2098)	Under this Act, no person shall engage in or attempt to engage in any activity directed at a sunken military craft that disturbs, removes, or injures any sunken military craft. The Proposed Action would have no adverse effects on sunken U.S. military ships and aircraft within the Study Area. If a site is determined to be eligible for the National Register of Historic Places, the State Historic Preservation Officer would be consulted to address potential effects. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.10 (Cultural Resources) and Chapter 3, Section 3.10 (Cultural Resources) of this Supplemental EIS/OEIS for the assessment.
Executive Orders	
Executive Order 11990, *Protection of Wetlands*	This EO was issued to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands. There are no wetlands within the Study Area; therefore, the EO does not apply to the Proposed Action.
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*	This EO is responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. Training activities in the TMAA (open ocean) should not have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.13 (Environmental Justice and Protection of Children) Sections 3.13.2.2 (Regulatory Framework), and 3.13.4 (Summary of Effects) of the 2011 GOA Final EIS/OEIS for the full discussion and analysis. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.
Executive Order 12962, *Recreational Fisheries*	This EO orders Federal agencies, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing. The Proposed Action would not affect federal agencies' ability to fulfill certain duties with regard to promoting the health and access of the public to recreational fishing areas. See the 2011 GOA Final EIS/OEIS, Chapter 3 (Affected Environment and Environmental Consequences), Section 3.12 (Socioeconomics), and Section 3.6.2.1 (Regulatory Framework) for the full discussion and analysis. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Executive Orders (continued)	
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*	This EO considers the risks that arise because children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults; children's size and weight may diminish their protection from standard safety features; and children's behavior patterns may make them more susceptible to accidents because they are less able to protect themselves. Although children could be present in vessels on the water, there are no sensitive receptors as defined by the EO present in the GOA Supplemental EIS/OEIS Study Area and, therefore, the Proposed Action would not result in disproportionate environmental health risks or safety risks to children. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.13 (Environmental Justice and Protection of Children) Sections 3.13.2.2 (Regulatory Framework), and 3.13.4 (Summary of Effects) for the full discussion and assessment. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.
Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*	EO 13175 was created in order to establish regular and meaningful consultation and collaboration with Indian tribal governments in the development of regulatory practices on Federal matters that significantly or uniquely affect their communities; to reduce the imposition of unfunded mandates upon Indian tribal governments; and to streamline the application process for and increase the availability of waivers to Indian tribal governments. The Navy prepared this Supplemental EIS/OEIS in accordance with EO 13175 and is in the process of consulting and coordinating with Indian tribal governments in the Study Area regarding the Proposed Action and mitigation measures. There are 229 federally recognized tribes in Alaska. Government-to-government consultation was offered to the 12 Alaska Native tribes in the Study Area for both the 2011 GOA Final EIS/OEIS and this Supplemental EIS/OEIS. See Chapter 1 (Purpose and Need of the Proposed Action) of both documents for a full discussion. See Appendix C, Section C.2.1 (Tribal Notification Letters) of this Supplemental EIS/OEIS for additional information on Tribal consultation and coordination.
Executive Order 13089, *Coral Reef Protection*	EO 13089 was enacted to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment. The Navy has prepared this Supplemental EIS/OEIS in accordance with requirements that federal agencies whose actions affect U.S. coral reef ecosystems shall provide for implementation of measures needed to research, monitor, manage, and restore them, including reducing impacts from pollution and sedimentation. See the 2011 GOA Final EIS/OEIS, Chapter 3, Section 3.5 (Marine Plants and Invertebrates) for the full discussion and assessment. Additionally, because the Proposed Action is not changing, the conclusions from the 2011 GOA Final EIS/OEIS are still applicable and no additional analysis is required in this Supplemental EIS/OEIS.
Executive Order 13112, *Invasive Species*	This EO is to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts that invasive species cause. The Proposed Action would not increase the number of or introduce new invasive species nor require the Navy to take measures to avoid introduction and spread of those species. Naval vessels are exempt from 33 C.F.R. 151 Subpart D, Ballast Water Management for Control of Nonindigenous Species in Waters of the United States.
Executive Order 13158, *Marine Protected Areas*	This EO is intended to provide for the protection of significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of Marine Protected Areas. The Navy has prepared this Supplemental EIS/OEIS in accordance with the requirements to avoid harm to the natural and cultural resources of existing national system MPAs. See Section 6.1.1 (Marine Protected Areas) of this Supplemental EIS/OEIS for more information.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Executive Orders (continued)	
Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*	This EO is to establish an integrated strategy toward sustainability in the Federal Government and to make reduction of greenhouse gas emissions a priority for Federal agencies. The Proposed Action is consistent with the integrated strategy toward sustainability in the federal government and to making reduction of greenhouse gas emissions a priority for federal agencies.
Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*	This order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. The Proposed Action is consistent with the comprehensive national policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes.
International Standards	
International Convention for the Prevention of Pollution from Ships	This standard prohibits certain discharges of oil, garbage, and other substances from vessels. The convention and its annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (33 U.S.C. §§1901–1915) and the Federal Water Pollution Control Act (33 U.S.C. §§1321–1322). The Proposed Action does not include vessel operation and discharge from ships; however, the Navy vessels operating in the Study Area would comply with the discharge requirements established in this program, minimizing or eliminating potential impacts from discharges from ships.

Notes: BO = Biological Opinion, CAA = Clean Air Act, C.F.R. = Code of Federal Regulations, CWA = Clean Water Act, EFH = Essential Fish Habitat, EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, EO = Executive Order, EPA = Environmental Protection Agency, ESA = Endangered Species Act, GOA = Gulf of Alaska, LOA = Letter of Authorization, MMPA = Marine Mammal Protection Act, MPA = Marine Protected Area, Navy = United States Department of the Navy, NMFS = National Marine Fisheries Service, ROD = Record of Decision, SINKEX = Sinking Exercise, SIP = State Implementation Plan, TMAA = Temporary Maritime Activities Area, U.S. = United States, U.S.C. = United States Code, USFWS = United States Fish and Wildlife Service

6.1.1 National System of Marine Protected Areas

Many areas of the marine environment have some level of federal, state, or local management or protection. The National System of Marine Protected Areas (MPAs) has conservation or management purposes, defined boundaries, and some legal authority to protect resources. Marine protected areas vary widely in purpose, managing agency, management approaches, level of protection, and restrictions on human uses. They have been designated to achieve objectives ranging from conservation of biodiversity, to preservation of sunken historic vessels, to protection of spawning habitats important to commercial and recreational fisheries. Executive Order (EO) 13158*, Marine Protected Areas,* was created to "strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded marine protected areas; develop a scientifically based, comprehensive national system of marine protected areas representing diverse U.S. marine ecosystems, and the nation's natural and cultural resources; and avoid causing harm to marine protected areas through federally conducted, approved, or funded activities."

Executive Order 13158 requires each Federal agency whose actions affect the natural or cultural resources that are protected by a national system of MPAs to identify such actions, and in taking such actions, avoid harm to those natural and cultural resources. Pursuant to Section 5 of EO 13158, agency requirements apply only to the natural or cultural resources specifically afforded protection by the site as described by the List of MPAs. For sites that have both a terrestrial and marine area, only the marine portion and its associated protected resources are included on the List of MPAs and subject to Section 5 of EO 13158. A full list and map of areas accepted in the National System of MPAs is available from the National Marine Protected Areas Center.

The National Marine Protected Areas Center, which is federally managed through the National Oceanic and Atmospheric Administration (NOAA), is tasked with implementing EO 13158. In order to meet the qualifications for the various terms within EO 13158, the National Marine Protected Areas Center developed a Marine Protected Areas Classification system. This system uses six criteria to describe the key features of most MPAs, as follows:

1. Primary conservation focus, such as natural heritage, cultural heritage, or sustainable production
2. Level of protection (e.g., no access, no impact, no take, zoned with no-take areas, zoned multiple use, or uniform multiple use)
3. Permanence of protection
4. Constancy of protection
5. Ecological scale of protection
6. Restrictions on extraction

The National Marine Protected Areas Center utilizes these criteria to evaluate MPAs for inclusion in the National System of MPAs. Implementation of the National System of MPAs is managed by the Department of Commerce (DOC) and the Department of the Interior (DOI). Executive Order 13158 requires the DOC and the DOI to consult with other federal agencies about the inclusion of sites into the National System of MPAs, including the Department of Defense (DoD). The National System of MPAs includes MPAs managed under the following six systems:

National Marine Sanctuary System. Under the National Marine Sanctuaries Act, NOAA established national marine sanctuaries for marine areas with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. There are no National Marine Sanctuaries sites located within the TMAA (Study Area).

Marine National Monuments. Marine national monuments are designated through Presidential Proclamation under the authority of the Antiquities Act of 1906 (16 United States Code [U.S.C.] §431). Marine national monuments are often co-managed by state, federal, and local governments, in order to preserve diverse habitats and ecosystem functions. There are no Marine National Monuments within the Study Area.

National Wildlife Refuge System. The U.S. Fish and Wildlife Service manages ocean and Great Lakes refuges for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats. Three National Wildlife Refuges (Alaska Maritime, Becharof, and Kenai) that contain a marine component are located near, but outside the Study Area. These National Wildlife Refuges provide over 3 million hectares of refuge for seabirds, shorebirds, migratory waterfowl, and a diverse array of marine mammals and flora.

Together with federal agencies and legislation, the operation and management of Alaska National Wildlife Refuges is also influenced by policy documents such as the Alaska National Interest Lands Conservation Act of 1980 (Public Law 96–487). The Alaska Maritime National Wildlife Refuge Comprehensive Conservation Plan was completed in 1988. A revision of the plan was anticipated to begin in 2011. A land protection plan for the Alaska Maritime National Wildlife Refuge was released in August 2011 (U.S. Fish and Wildlife Service 2011). The interagency Kenai River Comprehensive Management Plan was developed in 1986 and revised in 1997 (Alaska Department of Natural Resources and Alaska Department of Fish and Game 1998). The Becharof (and Alaska Peninsula) National Wildlife Refuges Comprehensive Conservation Plan was completed in 1985 and revised in 2005 (U.S. Fish and Wildlife Service 2005), and then further revised in 2006 (U.S. Fish and Wildlife Service 2006). A land protection plan for the Becharof (and Alaska Peninsula) National Wildlife Refuges was released in December 2002 (U.S. Fish and Wildlife Service 2002).

State and Local Marine Protected Areas. State and local governments have established MPAs for the management of fisheries, nursery grounds, shellfish beds, recreation, tourism, and other uses; these areas have a diverse array of conservation focuses, from protecting ecological functions, to preserving shipwrecks, to maintaining traditional or cultural interaction with the marine environment. Seven sites are located within the TMAA and vicinity. Examples include the Alaska Maritime National Wildlife Refuge, Steller Sea Lion Protection Areas, Kachemak Bay Research Reserve, Katmai National Park and Preserve, and the Kodiak Island Wildlife Refuge (Figure 6.1-1).

National Park System. The National Park System contains ocean and Great Lakes parks, including some national monuments, administered by the DOI, National Park Service to conserve the scenery and the natural and historic objects and wildlife contained within. There is one National Park System site, the Kenai Fjords National Park, within the Study Area.

National Estuarine Research Reserve System. The National Estuarine Research Reserve System sites protect estuarine land and water and provides essential habitat for wildlife; educational opportunities for students, teachers, and the public; and living laboratories for scientists. There are no National Estuarine Research Reserve System sites within the Study Area.

This Supplemental EIS/OEIS has been prepared in accordance with requirements for natural or cultural resources protected under the National System of MPAs. While several MPAs are located within the Study Area and are included in the National System of MPAs, it is important to note that the Navy rarely trains in many of these areas. Navy activities within these MPAs abide by the regulations of the individual MPA; Table 6.1-2 provides information on the individual MPA regulations and the Navy activities that occur in these areas.

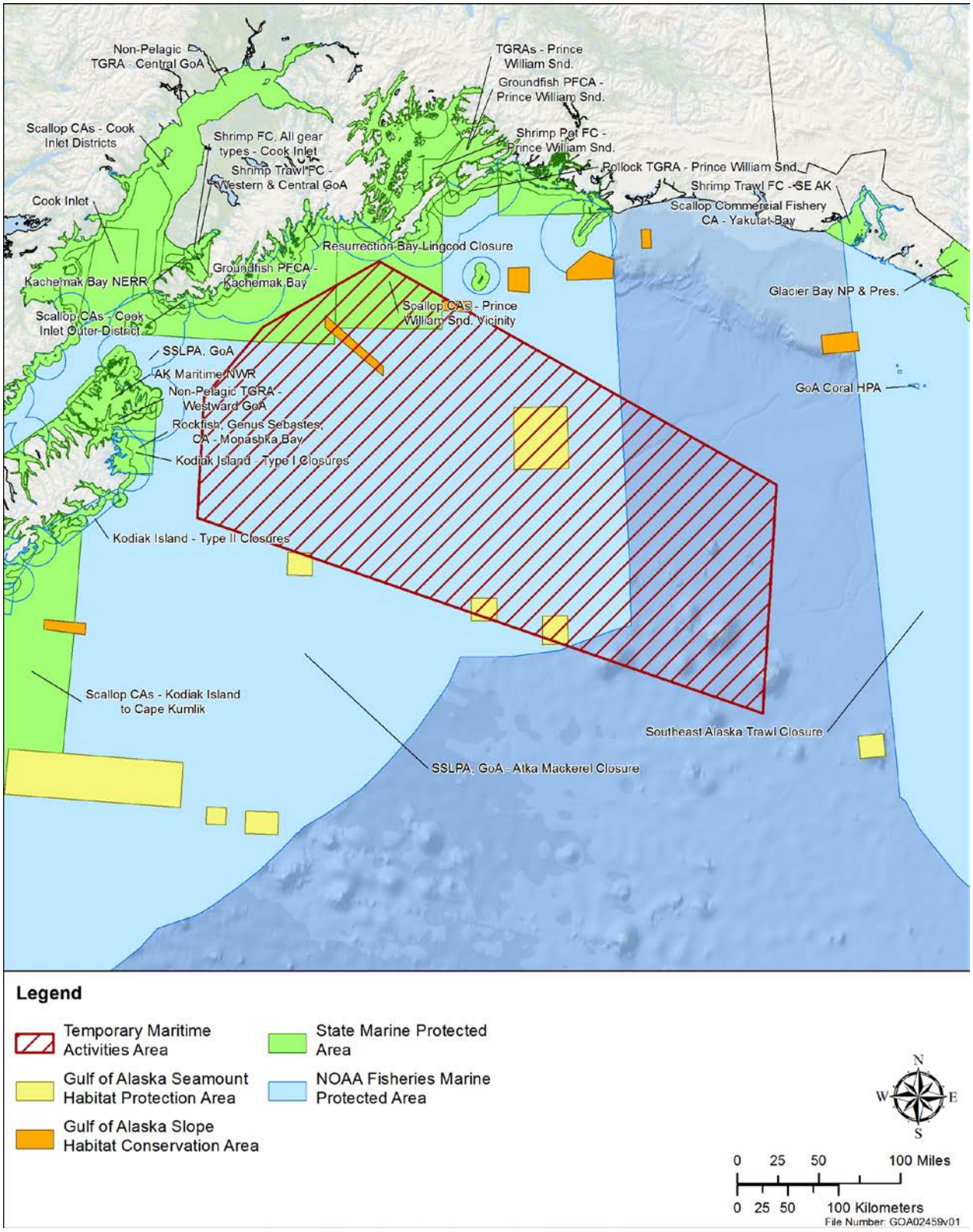

Figure 6.1-1: Map of Marine Protected Areas Near the Study Area

Table 6.1-2: Marine Protected Areas Near the Gulf of Alaska Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement Study Area

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Alaska Maritime National Wildlife Refuge	Borders the Gulf of Alaska and Pacific Ocean	Natural Heritage	Commercial and recreational fishing restricted.	The Navy's proposed activities near the Refuge, would not involve the taking of fish, wildlife, or shellfish.
Becharof National Wildlife Refuge	Southwestern Alaska	Ecosystem	Commercial and recreational fishing restricted.	The Navy's proposed activities near the Refuge, would not involve the taking of fish, wildlife, or shellfish.
Kenai National Wildlife Refuge	Kenai Peninsula of Alaska	Ecosystem	Commercial and recreational fishing restricted.	The Navy's proposed activities near the Refuge, would not involve the taking of fish, wildlife, or shellfish.
Steller Sea Lion Protection Areas	Gulf of Alaska	Natural Heritage	Commercial fishing restricted; Atka Mackerel, Groundfish, Pollock, and Pacific Cod Closures	The Navy's proposed activities near the protected areas, would not involve the taking of fish, wildlife, or shellfish.
Kachemak Bay National Estuarine Research Reserve	Western coast of the Kenai Peninsula in Alaska	Natural Heritage	No restrictions.	The Navy's proposed activities near the Reserve, would not involve the taking of fish, wildlife, or shellfish.
Katmai National Park and Preserve	Southern Alaska	Natural Heritage	Commercial and recreational fishing restricted.	The Navy's proposed activities near the Preserve, would not involve the taking of fish, wildlife, or shellfish.
Kodiak Island Wildlife Refuge	Alaska South Coast	Sustainable Production	Commercial fishing restricted.	The Navy's proposed activities near the Refuge, would not involve the taking of fish, wildlife, or shellfish.

Note: Navy = United States Department of the Navy

6.2 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity

In accordance with the CEQ regulations (Part 1502), this Supplemental EIS/OEIS analyzes of the relationship between the short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may often eliminate the possibility for other uses of that resource. The Navy, in partnership with NMFS, is committed to furthering the understanding of marine resources and developing ways to lessen or eliminate the impacts Navy training and testing activities may have on these resources. For example, the Navy and NMFS collaborate on the Integrated Comprehensive Monitoring Program for marine species to assess the impacts of training activities on

marine species and investigate population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training and testing occurs.

The Proposed Action could result in both short- and long-term environmental impacts. However, these are not expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or general welfare of the public. The Navy is committed to sustainable military range management, including co-use of the Study Area with the general public, tribal, and commercial and recreational interests. This commitment to co-use of the Study Area will maintain long-term accessibility of the GOA Supplemental EIS/OEIS training area. Sustainable range management practices, which are applicable to all Navy training areas, are specified in range complex management plans under the Navy's Tactical Training Theater Assessment and Planning Program. Among other benefits, these practices protect and conserve natural and cultural resources and preserve access to training areas for current and future training requirements while addressing potential encroachments that threaten to impact range and training area capabilities.

6.3 Irreversible or Irretrievable Commitment of Resources

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented" (42 U.S.C. §4332). Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the uses of these resources have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy or minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., the disturbance of a cultural site).

For the Proposed Action, most resource commitments would be neither irreversible nor irretrievable. Most impacts would be short term and temporary, or long lasting but within historical or desired conditions. Because there would be no building or facility construction, the consumption of material typically associated with such construction (e.g., concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irretrievably lost.

Implementation of the Proposed Action would require fuels used by aircraft and vessels, and would be the only irreversible and irretrievable resource commitment. However, since the Navy is not proposing any new or increased activities for fixed- and rotary-wing aircraft or ship activities, total fuel use would not increase relative to the baseline. Therefore, total fuel consumption would not increase under the Proposed Action (Section 6.4, Energy Requirements and Conservation Potential of the Proposed Action and Mitigation Measures), and this nonrenewable resource would not be considered irretrievably lost (see Chapter 4, Cumulative Impacts, and the following discussion on the Navy's Climate Change Roadmap).

6.4 Energy Requirements and Conservation Potential of the Proposed Action and Mitigation Measures

The federal government consumes 2 percent of the total U.S. energy share (Jean 2010). Of that 2 percent, the DoD consumes 93 percent. The Navy consumes one-fourth of the total DoD share. The Navy consumes 1.2 billion to 1.6 billion gallons of fuel each year. The Navy expects an overall 25 percent

increase in fuel consumption for the entire U.S. fleet, in the future because of new ships coming into the fleet and the growth in mission areas (Jean 2010).

Energy requirements would be subject to any established energy conservation practices. The use of energy sources has been minimized wherever possible without compromising safety or training activities. Additionally, as stated above, the Proposed Action in this Supplemental EIS/OEIS is the same as the implemented Preferred Alternative in the 2011 GOA Final EIS/OEIS. Implementation of the Proposed Action for this Supplemental EIS/OEIS would not result in an increase in energy use. The use of energy sources has been minimized wherever possible without compromising safety or training activities. No additional conservation measures related to direct energy consumption by the proposed activities are identified.

The Navy is committed to improving energy security and environmental stewardship by reducing its reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and climate change initiatives that will increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Environmental Readiness Division is taking to implement EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. The Navy's Task Force Energy is responding to the Secretary of the Navy's Energy Goals through energy security initiatives that reduce the Navy's carbon footprint.

Additionally, two Navy programs—the Incentivized Energy Conservation (i-ENCON) Program and the Naval Sea Systems Command's (NAVSEA's) Fleet Readiness, Research and Development Program (FRR&DP)—are helping the fleet conserve fuel via improved operating procedures and long-term initiatives. The i-ENCON Program encourages the operation of ships in the most efficient manner while conducting their mission and supporting the Secretary of the Navy's efforts to reduce total energy consumption on naval ships. The NAVSEA's FRR&DP includes the High-Efficiency Heating, Ventilating, and Air Conditioning and the Hybrid Electric Drive for DDG-51 class ships, which are improvements to existing shipboard technologies that will both help with fleet readiness and decrease the ships' energy consumption and greenhouse gas emissions. These initiatives are expected to greatly reduce the consumption of fossil fuels. Furthermore, to offset the impact of its expected near-term increased fuel demands and achieve its goals to reduce fossil fuel consumption and greenhouse gas emissions, the Navy plans to deploy, throughout the U.S. operating areas, a green strike group by 2016 (a "great green fleet"), composed of nuclear vessels and ships powered by biofuel in local operations and with aircraft flying only with biofuels (Jean 2010).

In recognition of the Navy's efforts and commitment to energy security and environmental stewardship, Congresswoman Marcy Kaptur (Democrat, Ohio, and senior-most woman in the U.S. House of Representatives) commended Navy leadership on efforts to create a greener, more energy-efficient force at an 8 May 2013 gathering of the House of Representatives committee on appropriations. Congresswoman Kaptur stated, "I can honestly say your branch of the military has had more aggressive interest in this than some of the others that I had expected more of. I want to compliment you on that. I want to thank you for being focused on the future, not the past."

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7 List of Preparers

TABLE OF CONTENTS

7 LIST OF PREPARERS 7-1

7.1 GOVERNMENT PREPARERS 7-1
7.2 CONTRACTOR PREPARERS 7-2

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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Appendix A: Federal Register Notices

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3408 Federal Register / Vol. 78, No. 11 / Wednesday, January 16, 2013 / Notices

ACTION: Notice.

SUMMARY: The Corporation for National and Community Service (CNCS) has submitted a public information collection request (ICR) titled "National Service Criminal History Check Recordkeeping Requirement" for review and approval in accordance with the Paperwork Reduction Act of 1995, Public Law 104–13, (44 U.S.C. Chapter 35). Copies of this ICR, with applicable supporting documentation, may be obtained by calling CNCS, Aaron Olszewski, at (202) 606–6709 or email to *aolszewski@cns.gov*. Individuals who use a telecommunications device for the deaf (TTY–TDD) may call 1–800–833–3722 between 8:00 a.m. and 8:00 p.m. Eastern Time, Monday through Friday.

ADDRESSES: Comments may be submitted, identified by the title of the information collection activity, to the Office of Information and Regulatory Affairs, Attn: Ms. Sharon Mar, OMB Desk Officer for the Corporation for National and Community Service, by any of the following two methods by February 15, 2013:

(1) *By fax to:* (202) 395–6974, Attention: Ms. Sharon Mar, OMB Desk Officer for the Corporation for National and Community Service; and

(2) *Electronically by email to: smar@omb.eop.gov.*

SUPPLEMENTARY INFORMATION: The OMB is particularly interested in comments which:

- Evaluate whether the proposed collection of information is necessary for the proper performance of the functions of CNCS, including whether the information will have practical utility;
- Evaluate the accuracy of the agency's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used;
- Propose ways to enhance the quality, utility, and clarity of the information to be collected; and
- Propose ways to minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology, e.g., permitting electronic submissions of responses.

Comments

A 60-day public comment Notice was published in the **Federal Register** on November 9, 2012. This comment period ended January 8, 2013. No public comments were received from this Notice.

Description: CNCS requests renewal of the recordkeeping requirement previously approved under an emergency clearance.

The requirements will be used in the same manner as the existing application. CNCS also seeks to continue using the current application until the revised application is approved by OMB. The current application is due to expire on March 31, 2013.

Type of Review: Renewal of Approved Recordkeeping Requirement.

Agency: Corporation for National and Community Service.

Title: National Service Criminal History Check Recordkeeping Requirement.

OMB Number: 3045–0145.

Agency Number: None.

Affected Public: CNCS Grantees and Subgrantees.

Total Respondents: 112,357.

Frequency: Three times per covered position.

Average Time Per Response: Five minutes.

Estimated Total Burden Hours: 28,089 hours.

Total Burden Cost (capital/startup): None.

Total Burden Cost (operating/maintenance): None.

Dated: January 10, 2013.

Valerie Green,

General Counsel.

[FR Doc. 2013–00775 Filed 1–15–13; 8:45 am]

BILLING CODE 6050–$$–P

DEPARTMENT OF DEFENSE

Office of the Secretary

U.S. Court of Appeals for the Armed Forces Code Committee Meeting

ACTION: Notice of public meeting.

SUMMARY: This notice announces the forthcoming public meeting of the Code Committee established by Article 146(a), Uniform Code of Military Justice, 10 U.S.C. 946(a), to be held at the Courthouse of the United States Court of Appeals for the Armed Forces, 450 E Street NW., Washington, DC 20442–0001, at 10:00 a.m. on Tuesday, March 5, 2013. The agenda for this meeting will include consideration of proposed changes to the Uniform Code of Military Justice and the Manual for Courts-Martial, United States, and other matters relating to the operation of the Uniform Code of Military Justice throughout the Armed Forces.

FOR FURTHER INFORMATION CONTACT: William A. DeCicco, Clerk of Court, United States Court of Appeals for the Armed Forces, 450 E Street Northwest, Washington, DC 20442–0001, telephone (202) 761–1448.

Dated: January 11, 2013.

Aaron Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 2013–00814 Filed 1–15–13; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Intent to Prepare a Supplement to the Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement and to Announce Public Scoping

AGENCY: Department of the Navy, DoD.

ACTION: Notice.

SUMMARY: Pursuant to section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969, as implemented by the Council on Environmental Quality Regulations (40 Code of Federal Regulations (CFR) parts 1500–1508), and Executive Order 12114, the Department of the Navy (DoN) announces its intent to prepare a supplement to the 2011 Gulf of Alaska Navy Training Activities Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS). The SEIS/OEIS will support authorization of incidental takes of marine mammals under the Marine Mammal Protection Act and incidental takes of threatened and endangered marine species, under the Endangered Species Act. These federal regulatory permits and authorizations expire in May 2016. The DoN will evaluate new, relevant information and incorporate that information into revised analyses where appropriate. The SEIS/OEIS will also analyze data using an acoustic model not available for the 2011 EIS/OEIS, the Navy Acoustics Effects Model, to estimate potential marine species effects.

The DoN has requested the National Marine Fisheries Service be a cooperating agency in preparation of this SEIS/OEIS pursuant to 40 CFR § 1501.6.

Dates and Addresses: Given that the DoN's Proposed Action and alternatives have not changed, public scoping meetings will not be held, but public comments will be accepted during the scoping period from January 16, 2013 to March 18, 2013. The DoN will accept scoping comments through the Web site

and mail. Additional information concerning acceptance of scoping comments is available on the SEIS/OEIS web page located at: *http://www.GOAEIS.com.*

FOR FURTHER INFORMATION CONTACT: Mrs. Amy Burt, Naval Facilities Engineering Command, Northwest, 1101 Tautog Circle, Suite 203, Silverdale, Washington 98315–1101, Attn: GOA SEIS/OEIS Project Manager.

SUPPLEMENTARY INFORMATION: This SEIS/OEIS is a supplement to the 2011 Gulf of Alaska Navy Training Activities EIS/OEIS and Record of Decision. The SEIS/OEIS will be used to renew current regulatory permits and authorizations and to support U.S. Pacific Command, Northern Command, and Joint Task Force Commander training requirements to achieve and maintain Fleet readiness as required by Title 10 of the U.S. Code. The DoN's Proposed Action is to continue DoN training in the Gulf of Alaska as detailed under the Preferred Alternative in the 2011 EIS/OEIS, and implemented with the 2011 EIS/OEIS Record of Decision. The Proposed Action does not alter the DoN's original purpose and need or alternative analysis as discussed in the 2011 EIS/OEIS; therefore, the alternative analysis presented in the EIS/OEIS remains relevant and is not proposed to be reanalyzed in the SEIS/OEIS. The continued conduct of at-sea joint exercises in the Gulf of Alaska is needed to support the training of combat-capable naval forces. An SEIS/OEIS is considered to be the appropriate document as the DoN's Proposed Action may significantly impact or harm marine resources.

Resources that will be addressed due to the potential effects from the Proposed Action, new available scientific data, and modeling results will include, but are not limited to, marine mammals and threatened and endangered species.

The Gulf of Alaska (GOA) Navy Training Activities SEIS/OEIS Study Area consists of three components: (1) the GOA Temporary Maritime Activities Area, (2) U.S. Air Force over-land Special Use Airspace and air routes over the GOA and State of Alaska, and (3) U.S. Army training lands underlying Special Use Airspace. Collectively, for the purposes of the SEIS/OEIS, these areas are referred to as the Alaska Training Areas. The U.S. Air Force Special Use Airspace and U.S. Army training lands were previously analyzed for NEPA purposes under separate environmental documents and are not included in the analysis in this SEIS/OEIS but are included by reference.

The scoping process will be used to identify community concerns and local issues that will be addressed in the SEIS/OEIS. Federal agencies, Alaska Native Tribes, state agencies, local agencies, the public, and interested persons are encouraged to provide comments to the DoN to identify specific issues or topics of environmental concern. All comments, provided via the Web site or in writing via postal submission, will receive the same consideration during SEIS/OEIS preparation. Written comments must be postmarked, and Web site comments must be completed no later than March 18, 2013. Written comments should be mailed to: Mrs. Amy Burt, Naval Facilities Engineering Command, Northwest, 1101 Tautog Circle, Suite 203, Silverdale, Washington 98315–1101, Attn: GOA SEIS/OEIS Project Manager.

Dated: January 11, 2013.

C. K. Chiappetta,

Lieutenant Commander, Office of the Judge Advocate General, U.S. Navy, Federal Register Liaison Officer.

[FR Doc. 2013–00847 Filed 1–15–13; 8:45 am]

BILLING CODE 3810–FF–P

DEPARTMENT OF DEFENSE

Department of the Navy

Meeting of the Board of Visitors of Marine Corps University

AGENCY: Department of the Navy, DoD.

ACTION: Notice of Open Meeting.

SUMMARY: The Board of Visitors of the Marine Corps University will meet to review, develop and provide recommendations on all aspects of the academic and administrative policies of the University; examine all aspects of professional military education operations; and provide such oversight and advice, as is necessary, to facilitate high educational standards and cost effective operations. The Board will be focusing primarily on the internal procedures of Marine Corps University. All sessions of the meeting will be open to the public.

DATES: The meeting will be held on Friday, February 22, 2013 from 9:00 a.m. to 3:00 p.m.

ADDRESSES: The meeting will be held at the Crystal Gateway Marriott hotel in Crystal City, Virginia. The address is: 1700 Jefferson Davis Highway, Arlington, Virginia 22202.

FOR FURTHER INFORMATION CONTACT: Joel Westa, Director of Academic Support, Marine Corps University Board of Visitors, 2076 South Street, Quantico, Virginia 22134, telephone number 703–784–4037.

Dated: January 9, 2013.

C.K. Chiappetta,

Lieutenant Commander, Office of the Judge Advocate General, U.S. Navy, Federal Register Liaison Officer.

[FR Doc. 2013–00810 Filed 1–15–13; 8:45 am]

BILLING CODE 3810–FF–P

DEPARTMENT OF EDUCATION

[Docket No. ED–2012–ICCD–0051]

Agency Information Collection Activities; Submission to the Office of Management and Budget for Review and Approval; Comment Request; Application for Client Assistance Program

AGENCY: Department of Education (ED), Office of Special Education and Rehabilitative Services (OSERS).

ACTION: Notice.

SUMMARY: In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. chapter 3501 *et seq.*), ED is proposing an extension of an existing information collection.

DATES: Interested persons are invited to submit comments on or before February 15, 2013.

ADDRESSES: Comments submitted in response to this notice should be submitted electronically through the Federal eRulemaking Portal at *http://www.regulations.gov* by selecting Docket ID number ED–2012–ICCD–0051 or via postal mail, commercial delivery, or hand delivery. Please note that comments submitted by fax or email and those submitted after the comment period will not be accepted. Written requests for information or comments submitted by postal mail or delivery should be addressed to the Director of the Information Collection Clearance Division, U.S. Department of Education, 400 Maryland Avenue SW., LBJ, Room 2E117, Washington, DC 20202–4537.

FOR FURTHER INFORMATION CONTACT: Electronically mail *ICDocketMgr@ed.gov.* Please do not send comments here.

SUPPLEMENTARY INFORMATION: The Department of Education (ED), in accordance with the Paperwork Reduction Act of 1995 (PRA) (44 U.S.C. 3506(c)(2)(A)), provides the general public and Federal agencies with an opportunity to comment on proposed, revised, and continuing collections of information. This helps the Department assess the impact of its information collection requirements and minimize

Appendix B: Agency Correspondence

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TABLE OF CONTENTS

APPENDIX B AGENCY CORRESPONDENCE B-1

B.1 COOPERATING AGENCY CORRESPONDENCE BETWEEN NAVY AND NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS B-1
B.2 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION, AND NAVY B-6
B.3 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS, AND NAVY B-8
B.4 NAVY CORRESPONDENCE WITH U.S. FISH AND WILDLIFE SERVICE, ANCHORAGE FISH AND WILDLIFE OFFICE B-9
B.5 NAVY CORRESPONDENCE WITH NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION B-11
B.6 NAVY CORRESPONDENCE WITH CHIEF, OFFICE OF HISTORY AND ARCHAEOLOGY, AND STATE HISTORIC PRESERVATION OFFICER B-14

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APPENDIX B AGENCY CORRESPONDENCE

B.1 COOPERATING AGENCY CORRESPONDENCE BETWEEN NAVY AND NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

5090
N454/13U139571
11 January 2013

Mr. Samuel D. Rauch III
Assistant Administrator, Acting
National Marine Fisheries Service
1315 East West Highway
Silver Springs, MD 20910

Dear Mr. Rauch:

In accordance with the National Environmental Policy Act (NEPA), the United States (U.S.) Department of the Navy (Navy) is preparing a Supplement to the 2011 *Gulf of Alaska Navy Training Activities Environmental Impact Statement/Overseas Environmental Impact Statement* and *Record of Decision for Final Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities*. The supplemental analysis will support authorization of incidental takes of marine mammals under the Marine Mammal Protection Act (MMPA) and incidental takes of threatened and endangered marine species under the Endangered Species Act (ESA). Existing federal regulatory permits and authorizations expire in May 2016.

The Gulf of Alaska (GOA) consists of three components: 1) The GOA Temporary Maritime Activities Area, 2) U.S. Air Force (Air Force) over-land special use airspace (SUA) and air routes over the GOA and State of Alaska, and 3) U.S. Army (Army) training lands. Collectively, for the purposes of the Supplement to the EIS/OEIS (SEIS/OEIS), these areas are referred to as the Alaska Training Areas. The Air Force SUA and Army training lands were previously analyzed for NEPA purposes under separate environmental documents and are not included in the analysis in this SEIS/OEIS.

The SEIS/OEIS will present the results of a literature search that will include any new research that could affect the analysis. The SEIS/OEIS will also analyze data using an acoustic model not used in the 2011 EIS/OEIS, the Navy Acoustics Effects Model, to estimate marine species effects. The updated information and new acoustic model does not alter the Navy's original purpose and need, proposed action, or alternative analysis as discussed in the 2011 EIS/OEIS; therefore, the alternative analysis presented in the 2011 EIS/OEIS remains relevant and is not proposed to be reanalyzed in the SEIS/OEIS.

An important aspect of the GOA Navy Training Activities SEIS/OEIS will be the analysis of the acoustic effects to marine species protected under the MMPA and the ESA. The GOA Navy Training Activities SEIS/OEIS is also intended to serve as a basis for renewing current regulatory permits and authorizations and obtaining those permits and authorizations necessary to support the Preferred Alternative as outlined in the *Record of Decision for Final*

Environmental Impact Statement/Overseas Environmental Impact Statement for the Gulf of Alaska Navy Training Activities.

The MMPA Final Rule, Letter of Authorization, and Programmatic Biological Opinion for GOA will expire in May 2016. To complete the analysis required by the permitting and consultation process, the Navy and the National Marine Fisheries Service (NMFS) will need to work together. Therefore, in accordance with the Council on Environmental Quality's (CEQ) NEPA guidelines (specifically 40 Code of Federal Regulations Part 1501) and CEQ's 2002 guidance on cooperating agencies, the Navy requests that NMFS serve as a cooperating agency for the development of the GOA Navy Training Activities SEIS/OEIS.

As the lead agency, the Navy will be responsible for overseeing preparation of the SEIS/OEIS that includes, but is not limited to, the following:

- Gathering all necessary background information and preparing the EIS/OEIS and all necessary permit applications associated with acoustic issues within the GOA SEIS/OEIS Study Area.
- Working with NMFS personnel to determine the method of estimating potential effects to protected marine species, including threatened and endangered species.
- Circulating the appropriate NEPA documentation to the general public and any other interested parties.
- Scheduling and supervising meetings held in support of the NEPA process, and compiling any comments received.
- Maintaining an administrative record and responding to any Freedom of Information Act requests relating to the SEIS/OEIS.

The Navy respectfully requests that NMFS, in its role as a cooperating agency, provide support as follows:

- Provide timely comments after the Agency Information Meeting (which will be held at the onset of the SEIS/OEIS process) and on working drafts of the SEIS/OEIS documents. The Navy requests that comments on draft SEIS/OEIS documents (Version 2) be provided within 30 working days.
- Respond to Navy requests for information, in particular, those related to review of the acoustic effects analysis and evaluation of the effectiveness of protection and mitigation measures.
- Coordinate, to the maximum extent practicable, any public comment periods that are necessary in the MMPA permitting process with the Navy's NEPA public comment periods.

2

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

February 6, 2013

Ms. Amy Burt - GOA Supplemental EIS/OEIS Project Manager
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, WA 98315-1101

Re: Notice of Intent to Prepare a Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for Gulf of Alaska (GOA) Navy Training Activities

Dear Ms. Burt:

The National Marine Fisheries Service (NMFS), Alaska Region, has received the request from the Department of the Navy (Navy) to be a cooperating agency on the Supplemental EIS/OEIS for Navy training activities in specific areas of the GOA. This analysis is being prepared to supplement the GOA Navy Training Activities Final EIS/OEIS, completed in May 2011. This document is being prepared to ensure critical training requirements are met and will:

- Evaluate new, relevant information and incorporate that information into revised analyses where appropriate;
- Analyze data using a new acoustic model to estimate potential effects on various marine species; and
- Renew current federal regulatory permits and authorizations.

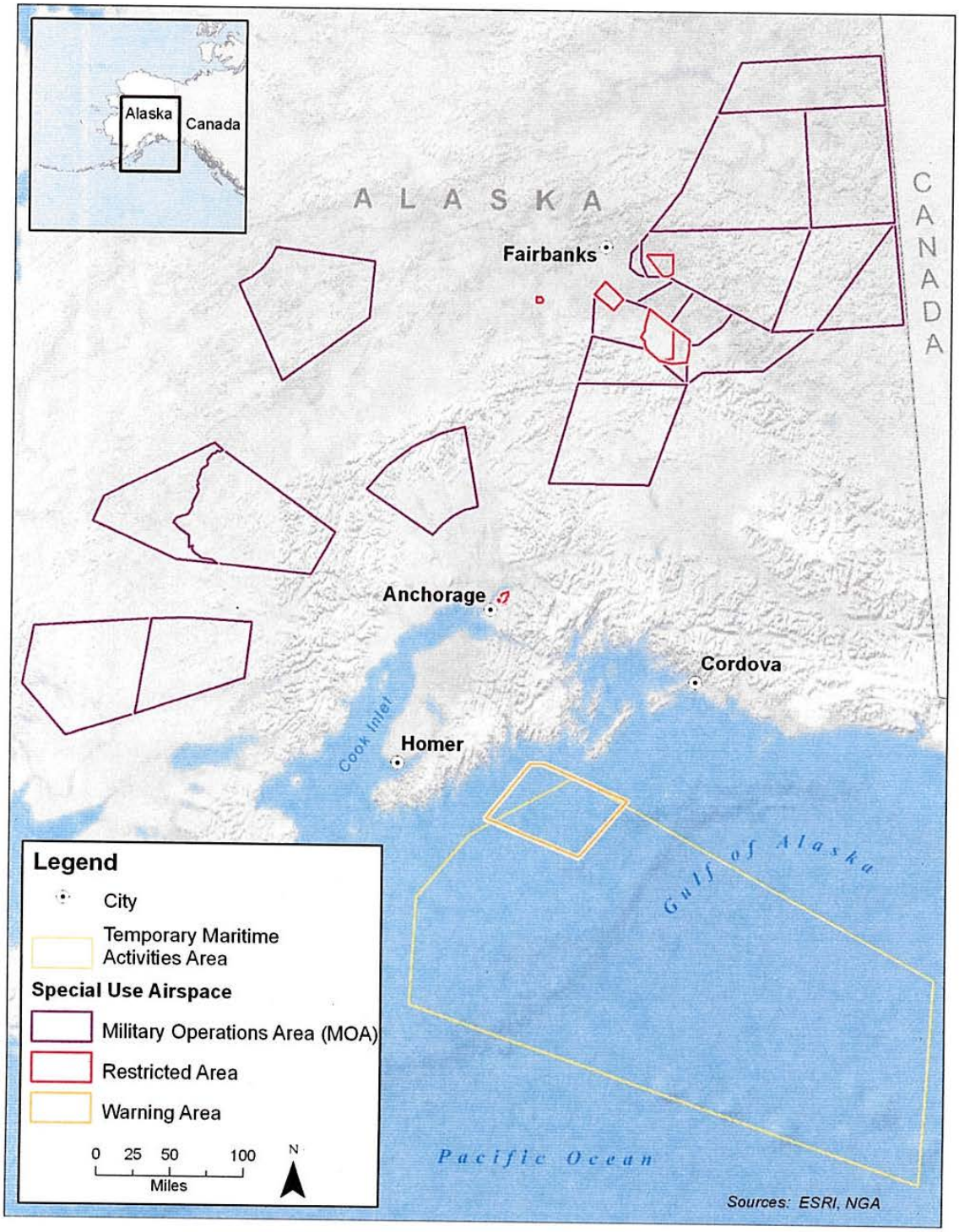
We understand that NMFS's Office of Protected Resources; at our Headquarters in Silver Spring, Maryland, has agreed to be a cooperating agency in the preparation of the Supplemental EIS/OEIS. We regret to inform you that NMFS's Alaska Region is unable to be a cooperating agency due to staff limitations and current work load. However, we are concerned about potential effects to NMFS trust resources as a result of the proposed activities. Although the Alaska Region is not able to serve as a cooperating agency, we intend to provide comments on living marine resources as appropriate through the EIS/OEIS review process. We would appreciate receiving two (2) hard copies of the draft and final statements for our review.

Should you have any questions please contact LTJG Larry V. Thomas Jr. at Larry.V.Thomas@noaa.gov, or by phone 907-271-6620.

Sincerely,

for James W. Balsiger, Ph.D.
Administrator, Alaska Region

ALASKA REGION - http://alaskafisheries.noaa.gov



Enclosure 1: Alaska Training Areas

Supplement to the Environmental Impact Statement/Overseas Environmental Impact Statement (SEIS/OEIS) for Gulf of Alaska (GOA) Navy Training Activities

MILESTONE	DATE
Notice of Intent Published in Federal Register	**16 Jan 2013**
Scoping Period	16 Jan – 18 Mar 2013
***** No Scoping Meetings *****	
Prepare Draft EIS/OEIS	Apr 2013 – Jun 2014
Release Draft EIS/OEIS to Public	Jun 2014
Draft EIS/OEIS Public Comment Period (60 days)	20 Jun 2014 – 19 Aug 2014
Public Hearings	Kodiak, AK Monday, 21 July 2014 Anchorage, AK Tuesday, 22 July 2014 Homer, AK Wednesday, 23 July 2014 Juneau, AK Friday, 25 July 2014 Cordova, AK Saturday, 26 July 2014
Prepare Final EIS/OEIS	Sep 2014 – Jan 2016
Release Final EIS/OEIS to Public	15 Jan 2016
Record of Decision signed	05 Apr 2016

Enclosure 2: Notional Schedule of Events

B.2 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION, AND NAVY

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

February 6, 2013

Ms. Amy Burt - GOA Supplemental EIS/OEIS Project Manager
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, WA 98315-1101

Re: Notice of Intent to Prepare a Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for Gulf of Alaska (GOA) Navy Training Activities

Dear Ms. Burt:

The National Marine Fisheries Service (NMFS), Alaska Region, has received the request from the Department of the Navy (Navy) to be a cooperating agency on the Supplemental EIS/OEIS for Navy training activities in specific areas of the GOA. This analysis is being prepared to supplement the GOA Navy Training Activities Final EIS/OEIS, completed in May 2011. This document is being prepared to ensure critical training requirements are met and will:

- Evaluate new, relevant information and incorporate that information into revised analyses where appropriate;
- Analyze data using a new acoustic model to estimate potential effects on various marine species; and
- Renew current federal regulatory permits and authorizations.

We understand that NMFS's Office of Protected Resources; at our Headquarters in Silver Spring, Maryland, has agreed to be a cooperating agency in the preparation of the Supplemental EIS/OEIS. We regret to inform you that NMFS's Alaska Region is unable to be a cooperating agency due to staff limitations and current work load. However, we are concerned about potential effects to NMFS trust resources as a result of the proposed activities. Although the Alaska Region is not able to serve as a cooperating agency, we intend to provide comments on living marine resources as appropriate through the EIS/OEIS review process. We would appreciate receiving two (2) hard copies of the draft and final statements for our review.

Should you have any questions please contact LTJG Larry V. Thomas Jr. at Larry.V.Thomas@noaa.gov, or by phone 907-271-6620.

Sincerely,

for James W. Balsiger, Ph.D.
Administrator, Alaska Region

ALASKA REGION - http://alaskafisheries.noaa.gov

cc: brad.smith@noaa.gov
jeanne.hanson@noaa.gov
amy.burt@navy.mil
jolie.Harrison@noaa.gov
kara.meckley@noaa.gov
nmfs.hq.nepa@noaa.gov
gretchen.harrington@noaa.gov
jay.nunenkamp@noaa.gov

B.3 COOPERATING AGENCY CORRESPONDENCE BETWEEN NATIONAL MARINE FISHERIES SERVICE, HEADQUARTERS, AND NAVY

FEB 22 2013

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910
THE DIRECTOR

Mr. John P. Quinn
Deputy Director, Energy and Environmental
Readiness Division
Department of the Navy
2000 Navy Pentagon
Washington, DC 20350-2000

Dear Mr. Quinn:

Thank you for your letter requesting that NOAA's National Marine Fisheries Service (NMFS) be a cooperating agency in the preparation of a Supplement to the 2011 Gulf of Alaska Navy Training Activities Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS). NMFS supports the Navy's decision to prepare a supplement to this EIS/OEIS and agrees to be a cooperating agency, due, in part, to our responsibilities under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) and section 7 of the Endangered Species Act.

We will make every effort to support the Navy in the specific ways described in your letter. Therefore, to the maximum extent practicable, NMFS will:

- Provide timely review and comments on working drafts of the SEIS/OEIS documents.
- Respond to Navy requests for information in a timely manner.
- Coordinate any public comment periods that are necessary in the MMPA permitting process with the Navy's NEPA public comment periods.
- Participate in meetings, as necessary, hosted by the Navy to discuss protected marine species including threatened and endangered species.
- Adhere to the Navy's NEPA schedule to the maximum degree possible.

If you have any questions or need additional information, please contact Ms. Jolie Harrison, NMFS Office of Protected Resources, at (301) 427-8420.

Sincerely,

Samuel D. Rauch III
Deputy Assistant Administrator
for Regulatory Programs,
performing the functions and duties of the
Assistant Administrator for Fisheries

Printed on Recycled Paper

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

B.4 NAVY CORRESPONDENCE WITH U.S. FISH AND WILDLIFE SERVICE, ANCHORAGE FISH AND WILDLIFE OFFICE

DEPARTMENT OF THE NAVY
COMMANDER
UNITED STATES PACIFIC FLEET
250 MAKALAPA DRIVE
PEARL HARBOR, HAWAII 96860-3131

IN REPLY REFER TO:
5090
Ser N01CE1/0336
3 Apr 14

Ms. Ann Rappoport, Field Supervisor
Anchorage Fish and Wildlife Field Office
U.S. Fish and Wildlife Service
605 W. 4th Avenue, Room G61
Anchorage, AK 99501

SUBJECT: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS) (CONSULTATION #2010-0075)

Dear Ms. Rappoport:

The purpose of this letter is to provide you with information concerning the status of the Navy's continuation of training activities that were previously the subject of Consultation #2010-0075. Specifically, as discussed below, there are no changes to the actual activities, the geographic parameters, or levels of activities occurring in the areas previously subject to consultation with USFWS. There are also no new listed or proposed species in the study area. As such, none of the criteria for reinitiation of consultation as set forth in 50 C.F.R. § 402.16 are triggered.

The Navy proposes to continue conducting military training activities in the GOA training area, and has undertaken preparation of a Supplemental EIS/OEIS to cover these activities. The Supplemental EIS/OEIS will address the continuation of Navy training activities in the GOA training area from 2016 through the year 2021, incorporating a new acoustic model to estimate impacts to various marine species and renew current federal permits and authorizations. As with consultation #2010-0075, the proposed training activities would continue to occur within the GOA over two 21-day periods during the April-October time frame, as described in the Final EIS/OEIS for "*Gulf of Alaska Navy Training Activities*" of March 2011.

Subj: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS) (CONSULTATION #2010-0075)

The Navy previously prepared a Biological Evaluation covering potential effects of the Navy's training activities to Endangered Species Act (ESA) listed species under jurisdiction of the U.S. Fish and Wildlife Service and provided it to your office on February 24, 2010. The Navy concluded the effects of the proposed action "may affect, not likely to adversely affect" for short-tailed albatross (*Phoebastria albatrus*). Your office responded on March 24, 2010 and concurred with the Navy's determination. The Navy also concluded that the proposed action "may affect, not likely to adversely affect" the northern sea otter (*Enhydra lutris kenyoni*) based on input received at and following our Draft EIS/OEIS public hearings about northern sea otter occurrence in the GOA. Your office also concurred with this determination on March 31, 2011. In May of 2011, after carefully considering the operational and environmental consequences of the proposed action and information received from the public and regulatory agencies, the Navy issued a Record of Decision (ROD), implementing the Preferred Alternative, Alternative 2 of the Final EIS/OEIS.

Because the Navy's training activities, geographic parameters, and level of activities previously analyzed in the GOA Final EIS/OEIS have not changed, the Navy's previous determination that the action "may affect, not likely to adversely affect" U.S. Fish and Wildlife ESA-listed species (specifically, the short-tailed albatross and the northern sea otter) remains unchanged. None of the circumstances articulated at 50 C.F.R. § 402.16(a)-(d) are present. Therefore, the Navy is not requesting to reinitiate consultation at this time.

If you need additional information or have questions, please feel free to contact Mr. Alex Stone, who can be reached at (619) 545-8128 or via email at alexander.stone@navy.mil or Ms. Amy Burt at (360) 396-0924 or via email at amy.burt@navy.mil.

L. M. FOSTER
By direction

Copy to:
Chief of Naval Operations (N454)
Commander, Navy Region Northwest (N40)

2

B.5 NAVY CORRESPONDENCE WITH NATIONAL MARINE FISHERIES SERVICE, ALASKA REGION

DEPARTMENT OF THE NAVY
COMMANDER
UNITED STATES PACIFIC FLEET
250 MAKALAPA DRIVE
PEARL HARBOR, HAWAII 96860-3131

IN REPLY REFER TO:
5090
Ser N01CE1/0337
3 Apr 14

Dr. James W. Balsinger
Regional Administrator, Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

SUBJECT: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS)

Dear Dr. Balsinger:

The purpose of this letter is to provide you with information concerning the status of the Navy's continuation of training activities that were previously the subject of consultations with NMFS in August of 2010. Specifically, as discussed below, there are no changes to the actual activities, the geographic parameters, or levels of activities occurring in the areas previously subject to consultation with NMFS. There have also been no changes to designated essential fish habitat (EFH) areas in the study area. As such, there is no requirement for supplemental consultation with NMFS as required by 50 C.F.R. § 600.920(l).

The Navy proposes to continue conducting military training activities in the GOA training area, and has undertaken preparation of a Supplemental EIS/OEIS to cover these activities. The Supplemental EIS/OEIS will address the continuation of Navy training activities in the GOA training area from 2016 through 2021, incorporating a new acoustic model to estimate impacts to various marine species and renew current federal permits and authorizations. The proposed training activities would continue to occur within the GOA over two 21-day periods during the April-October time frame.

The Navy previously prepared an essential fish habitat (EFH) assessment covering potential impacts of training activities on designated EFH areas within the GOA in accordance with the

Subj: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS)

Magnuson-Stevens Fisheries Conservation and Management Act of 1976, Public Law 94-265 as amended through October 11, 1996 (Magnuson-Stevens Act), section 305(b)(2) and 50 C.F.R. §600.920 and provided it to your office on August 2, 2010. The Navy's determination in the August 2010 EFH assessment was that there would be no adverse effects to EFH in the GOA from Navy training activities.

The EFH assessment of August 2010 explains that, based on the limited extent, duration, and magnitude of potential impacts from GOA Navy training activities, including vessel movements, aircraft overflights, potential fuel spills, ship discharges, explosive and non-explosive ordnance use, sonar training, and weapons firing, there would be no adverse effects to EFH. Sinking Exercises (SINKEX) proposed in the GOA would have the potential to adversely affect Habitat Areas of Particular Concern (HAPCs) within the Temporary Maritime Activities Area. For this reason, the Navy restricted SINKEX activities within designated HAPCs as a part of the Proposed Action. With this restriction, the Navy determined that training activities involving expended materials would have no adverse effects on EFH, including HAPCs, within the GOA due to the limited extent, duration, and magnitude of potential impacts.

Your office responded to the EFH assessment on January 4, 2011 with a determination that the action would have an adverse effect on EFH and provided recommended conservation measures. The Navy provided a response on January 24, 2011, agreeing to implement one of the recommended measures: "Request coordination with other research activities in the GOA to avoid displacement or effects to other activities". In May of 2011, after carefully considering the operational and environmental consequences of the proposed action and information received from the public and regulatory agencies, the Navy issued a Record of Decision (ROD), implementing the Preferred Alternative, Alternative 2 of the Final EIS/OEIS.

Because the Navy's training activities, geographic parameters, and level of activities previously analyzed in the GOA Final EIS/OEIS have not changed, including the restriction of SINKEX activities within designated HAPCs, the Navy's previous analysis of impacts to EFH within the GOA training area remains adequate and does not raise the requirement of supplemental consultation pursuant to 50 C.F.R. § 600.920(l). The Navy would continue to implement the conservation recommendation of coordinating with

2

Subj: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS)

other research activities within the GOA to avoid displacement or effects to other activities. Therefore, the Navy is not requesting to reinitiate consultation at this time.

If you need additional information or have questions, please feel free to contact Mr. Alex Stone, who can be reached at (619) 545-8128 or via email at alexander.stone@navy.mil or Ms. Amy Burt, who can be reached at (360) 396-0924 or via email at amy.burt@navy.mil.

L. M. FOSTER
By direction

Copy to:
Chief of Naval Operations (N454)
Commander, Navy Region Northwest (N40)

3

B.6 NAVY CORRESPONDENCE WITH CHIEF, OFFICE OF HISTORY AND ARCHAEOLOGY, AND STATE HISTORIC PRESERVATION OFFICER

DEPARTMENT OF THE NAVY
COMMANDER
UNITED STATES PACIFIC FLEET
250 MAKALAPA DRIVE
PEARL HARBOR, HAWAII 96860-3131

IN REPLY REFER TO:
5090
Ser N01CE1/0338
3 Apr 14

Ms. Judith E. Bittner
Chief, Office of History and Archaeology, and State Historic Preservation Officer (SHPO)
550 West 7th Ave., Suite 1310
Anchorage, Alaska 99501-3565

SUBJECT: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS)

Dear Ms. Bittner:

The purpose of this letter is to provide you with information concerning the status of the Navy's continuation of military training activities that were previously the subject of consultation with your office (File number 3130-IR Navy). Specifically, as discussed below, there are no changes to the actual activities, levels of activities, or the area of potential effect (APE), which were subject to consultation with SHPO. As such, none of the criteria for re-initiation of consultation as set forth in 36 Code of Federal Regulations (C.F.R.) §800 are triggered.

The Navy proposes to continue conducting military training activities in the GOA training area, and has undertaken preparation of a Supplemental EIS/OEIS to cover these activities. The Supplemental EIS/OEIS will address the continuation of Navy training activities in the GOA training area from 2016 through 2021. The proposed training activities would continue to occur within the GOA over two 21-day periods during the April-October time frame, as described in the Final EIS/OEIS for *"Gulf of Alaska Navy Training Activities"* of March 2011.

The Navy previously prepared a determination of no adverse effects to historic properties from the proposed actions and provided it to your office on April 14, 2010. The APE for the Proposed Action was the GOA Temporary Maritime Activities Area (TMAA) and over-flight areas between the TMAA and Air Force

Subj: CONTINUATION OF NAVY TRAINING ACTIVITIES UNDER THE GULF OF ALASKA (GOA) NAVY TRAINING ACTIVITIES SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)/OVERSEAS EIS (OEIS)

Special Use Areas and Army training lands. The Navy's April 2010 determination of no adverse effects was based on several factors: 1) as confirmed with the 12 Alaska Native tribes in the GOA area, there are no traditionally religious and/or culturally important properties within the APE; 2) the APE for Navy proposed actions in Alaska is limited to aquatic lands located some distance from shore and potential cultural resources in the area are comprised of sunken shipwrecks; and 3) none of the nine shipwrecks that may lie within the APE have been determined to be eligible for inclusion in the National Register of Historic Places (NRHP), therefore, they are not historic property as defined in 36 C.F.R. §800.16(1)(1).

Your office responded on May 18, 2010 and concurred with the Navy's determination of no adverse effects. In May of 2011, after carefully considering the operational and environmental consequences of the proposed action and information received from the public and regulatory agencies, the Navy issued a Record of Decision (ROD), implementing the Preferred Alternative, Alternative 2 of the Final EIS/OEIS.

Because the Navy's training activities, level of activities, and the APE previously analyzed in the GOA Final EIS/OEIS have not changed, the Navy's previous determination of no adverse effects to historic properties remains unchanged. None of the circumstances articulated at 36 C.F.R. § 800.8(c)(5) are present. Therefore, the Navy is not requesting to reinitiate consultation at this time.

If you need additional information or have questions, please feel free to contact Mr. Alex Stone, who can be reached at (619) 545-8128 or via email at alexander.stone@navy.mil or Ms. Amy Burt at (360) 396-0924 or via email at amy.burt@navy.mil.

L. M. FOSTER
By direction

Copy to:
Chief of Naval Operations (N454)
Commander, Navy Region Northwest (N40)

2

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Appendix C: Public Participation

TABLE OF CONTENTS

APPENDIX C PUBLIC PARTICIPATION C-1

C.1 PROJECT WEBSITE C-1
C.2 GENERAL SUMMARY OF THE SCOPING PERIOD C-1
C.2.1 TRIBAL NOTIFICATION LETTERS C-1
C.2.2 PUBLIC SCOPING NOTIFICATION C-2
C.2.2.1 Scoping Notification Letters C-2
C.2.2.2 Postcard Mailers C-4
C.2.2.3 Press Releases C-4
C.2.2.4 Newspaper Display Advertisements C-5
C.2.3 SCOPING MEETINGS C-5
C.2.4 PUBLIC SCOPING COMMENTS C-5
C.2.4.1 Impacts on Marine Species C-6
C.2.4.2 Impacts on Airspace C-6
C.2.4.3 Impacts on Fisheries C-6
C.2.4.4 Issues Regarding the 2011 Gulf of Alaska Final Environmental Impact Statement/Overseas Environmental Impact Statement C-6
C.2.4.5 General C-6

LIST OF TABLES

TABLE C-1: PUBLIC SCOPING COMMENT SUMMARY C-6

LIST OF FIGURES

There are no figures in this section.

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APPENDIX C PUBLIC PARTICIPATION

This appendix includes information about the public's participation in the development of the Gulf of Alaska (GOA) Navy Training Activities Supplemental Environmental Impact Statement (EIS)/Overseas EIS (Supplemental EIS/OEIS).

C.1 PROJECT WEBSITE

A public website was established specifically for this project (http://www.GOAEIS.com/). This website address was published in the *Notice of Intent to Prepare a Supplement to the Gulf of Alaska Navy Training Activities Environmental Impact Statement and Overseas Impact Statement and to Announce Public Scoping* (Notice of Intent [NOI]) and has subsequently been re-printed in all newspaper advertisements, agency letters, and public postcards. Project Fact Sheets and various other materials will be available on the project website throughout the course of the project.

C.2 GENERAL SUMMARY OF THE SCOPING PERIOD

In accordance with the Council on Environmental Quality regulations for implementing the requirements of the National Environmental Policy Act (NEPA), scoping is not required for a Supplemental EIS/OEIS; however, in an effort to maximize public participation and ensure the public's concerns are addressed, the United States (U.S.) Department of the Navy (Navy) chose to conduct a scoping period for this Supplemental EIS/OEIS. The public scoping period began with the issuance of the NOI in the *Federal Register* on 16 January 2013. This notice included a project description and scoping meeting dates and locations. The scoping period lasted 60 days, concluding on 18 March 2013. Sections C.2.1 and C.2.2 describe the Navy's notification efforts during scoping. The scoping period allowed a variety of opportunities for the public to comment on the scope of the Supplemental EIS/OEIS.

C.2.1 TRIBAL NOTIFICATION LETTERS

Tribal letters were mailed on 11 January 2013 to 12 Alaska Native federally-recognized tribes. Recipients included:

Yakutat Tlingit Tribe
Tangirnaq Native Village
Sun'aq Tribe of Kodiak
Native Village of Tatitlek
Native Village of Port Lions
Native Village of Port Graham
Native Village of Ouzinkie
Native Village of Old Harbor
Native Village of Eyak
Native Village of Chenega
Native Village of Afognak
Kaguyak Village

Additionally, personalized tribal notification letters were distributed to 28 tribal chairpersons and staff, including presidents, environmental coordinators, and natural resource managers.

C.2.2 PUBLIC SCOPING NOTIFICATION

The Navy made significant efforts at notifying the public to ensure maximum public participation during the scoping process. A summary of these efforts follows.

C.2.2.1 Scoping Notification Letters

NOI/Notice of Scoping period letters were distributed on 11 January 2013 to 164 federal, state, and local elected officials and government agencies. Recipients included:

Federal
U.S. Senators (Alaska) and Staff
U.S. Representative (Alaska At-Large District) and Staff
Alaska Maritime National Wildlife Refuge
Alaska Science Center
Bureau of Indian Affairs
Bureau of Land Management, Alaska State Office
Federal Aviation Administration
    Washington, D.C., Headquarters
    Regional Administrator, Alaska Region
    Alaska Air Traffic Representative
    Air Defense Liaison Officer, Headquarters North American Aerospace Defense Command
    Northwest Mountain Region
Office of Aviation Services
    Alaska Regional Director
U.S. Army Corps of Engineers
    Environmental Special Programs Director
    Alaska District Commander and District Engineer
    Executive Office
U.S. Department of Agriculture, Forest Service
    Director, Alaska Region
    Ranger, Chugach National Forest
    Biologist, Chugach National Forest
    Forest Supervisor, Chugach National Forest
U.S. Department of Commerce
    Acting Secretary, Washington, D.C., Headquarters
    National Oceanic and Atmospheric Administration
        Supervisory Fishery Research Biologist, Kodiak, Alaska
        Fishery Resource Management Specialist, Juneau, Alaska
        Alaska Fisheries Science Center, Seattle, Washington
        Director, Kasitsna Bay Lab, Homer, Alaska
    National Marine Fisheries Service (NMFS)
        Alaska Regional Administrator
        Assistant Regional Administrator, Office of Protected Resources
        Deputy Regional Administrator
        Alaska Fisheries Science Center
        Alaska Regional Habitat Conservation Division
            Alaska Habitat Conservation Division
        Office of Protected Resources

Office of Protect Resources Alaska Region
Sustainable Fisheries Division
North Pacific Fisheries Management Council
U.S. Department of Homeland Security
U.S. Coast Guard
Office of Environmental Management
Chief
Environmental Planning Team Lead
Office of Operating and Environmental Standards
U.S. Department of the Interior
Special Assistant to the Secretary
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Ocean Energy Management, Regulation, and Enforcement
Director
Regional Director
Regional Supervisor, Leasing and Environment
Office of Environmental Policy and Compliance
Regional Environmental Officer
U.S. Environmental Protection Agency
Anchorage Operations Office
NEPA Compliance Division, Washington, D.C.
Region X, Juneau, Alaska
Region X NEPA Review Unit Office, Seattle, Washington
U.S. Fish and Wildlife Service
Alaska Regional Office
Kodiak National Wildlife Refuge
Branch Chief, Conservation Planning Assistance, Anchorage Field Office
Field Supervisor, Anchorage Field Office
U.S. Geological Survey
Alaska Science Center
Western Fisheries Research Center
U.S. National Park Service
Alaska Regional Aviation Manager
Alaska Regional Director
Wildlife Biologist, Humpback Whale Monitoring Program, Glacier Bay National Park and Preserve

State of Alaska
Governor and Staff
State Senators (Districts A, B, C, E, G, N, O, P, Q, R, and S) and Staff
State Representatives (Districts 2–7, 9–11, 13, 14, 16, and 27–37) and Staff
Alaska Marine Highway
Department of Natural Resources
Division of Forestry
Division of Geological and Geophysical Surveys
Division of Mining, Land and Water Anchorage
Division of Oil and Gas

Division of Parks and Outdoor Recreation
Public Information Center
Department of Commerce
Community and Economic Development
Division of Community and Regional Affairs
Department of Environmental Conservation
Commissioner's Office
Division of Administrative Services
Division of Air Quality
Division of Environmental Health
Division of Spill and Prevention Response
Department of Fish and Game
Commercial Fisheries Division
Division of Wildlife Conservation
Habitat Division
Sport Fisheries Division (Anchorage and Fairbanks)
Sportfishing Division (Glen Allen Office)
Statewide Subsistence Division
Subsistence Division (Anchorage)
Department of Military and Veterans Affairs
Department of Transportation and Public Facilities
North Region Fairbanks
Ports and Harbors Division (Juneau Office)
Statewide Aviation Office
Kachemak Bay Conservation Society
Regulatory Commission of Alaska

Local – Alaska
City and Borough of Juneau
City of Cordova
Fairbanks North Star Borough
Kenai Peninsula Borough
Kodiak Island Borough
Matanuska-Susitna Borough
Municipality of Anchorage

C.2.2.2 Postcard Mailers

On 11 January 2013, postcards were mailed to 399 nongovernmental organizations; community, business, fishing, aviation, recreation and marina groups; government agencies; elected officials; and individuals on the project mailing list. Postcards included the scoping period dates and comment instructions.

C.2.2.3 Press Releases

One press release was distributed by the Navy Region Northwest Public Affairs Office to media outlets, elected officials, and other potentially interested parties. The news release was distributed on 15 January 2013 and announced the intent to prepare a Supplemental EIS/OEIS. The press releases

included information about the Proposed Action and its purpose and need, and project website and comment submittal information.

C.2.2.4 Newspaper Display Advertisements

Five display advertisements were published in each of the following newspapers: *Anchorage Daily News*, *Cordova Times*, *Juneau Empire*, *Kodiak Daily Mirror*, *and Peninsula Clarion*. The first series of newspaper advertisements ran concurrently with the NOI publication in the *Federal Register* on 16 January 2013, and ran for 3 consecutive days, with the exception of the weekly-published *Cordova Times*, which ran on the first 3 days the newspaper was scheduled to publish. The second and third series of advertisements were published on 2 additional days during the middle and end of the scoping period.

Anchorage, Alaska
Anchorage Daily News (daily)
Wednesday, Jan. 16, 2013
Thursday, Jan. 17, 2013
Friday, Jan. 18, 2013
Wednesday, Feb. 13, 2013
Wednesday, Mar. 6, 2013

Juneau, Alaska
Juneau Empire (daily)
Wednesday, Jan. 16, 2013
Thursday, Jan. 17, 2013
Friday, Jan. 18, 2013
Wednesday, Feb. 13, 2013
Wednesday, Mar. 6, 2013

Anchorage and Kenai Peninsula Alaska
Peninsula Clarion (daily)
Wednesday, Jan. 16, 2013
Thursday, Jan. 17, 2013
Friday, Jan. 18, 2013
Wednesday, Feb. 13, 2013
Wednesday, Mar. 6, 2013

Cordova, Alaska
Cordova Times (weekly – Friday)
Friday, Jan. 18, 2013
Friday, Jan. 25, 2013
Friday, Feb. 1, 2013
Friday, Feb. 15, 2013
Friday, Mar. 8, 2013

Kodiak and Anchorage, Alaska
Kodiak Daily Mirror (daily)
Wednesday, Jan. 16, 2013
Thursday, Jan. 17, 2013
Friday, Jan. 18, 2013
Wednesday, Feb. 13, 2013
Wednesday, Mar. 6, 2013

C.2.3 Scoping Meetings

Given that the Navy's Proposed Action and Alternatives have not changed from the 2011 GOA Final EIS/OEIS, public scoping meetings were not held, but public comments were accepted during the scoping period from 16 January 2013 to 18 March 2013.

C.2.4 Public Scoping Comments

Scoping participants submitted comments in three ways:

- Written letters (received any time during the public comment period)
- Electronic mail (received any time during the public comment period)
- Comments submitted directly on the project website (received any time during the public comment period)

In total, the Navy received 13 comment submissions from individuals, groups, agencies, and elected officials. Six comment submissions were submitted via the project website, five comment submissions were submitted via postal mail, and two comment submissions were submitted via e-mail. Table C-1 provides a breakdown of areas of concern based on comments received during scoping. Because many of the comment submissions addressed more than one issue, the total number of issues raised is greater than the 13 comment submissions received. However, as the general theme of some of the comments

remained the same, they have been consolidated into areas of concern. The summary following Table C-1 provides an overview of comments and is organized by area of concern.

Table C-1: Public Scoping Comment Summary

Area of Concern	Count	Percent of Total
Impacts on Marine Species	6	42.8%
Impacts on Airspace	1	7.2%
Impacts on Fisheries	3	21.4%
Issues Regarding the 2011 GOA Final EIS/OEIS	3	21.4%
General	1	7.2%
TOTAL	**14**	**100.0%**

Notes: EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, GOA = Gulf of Alaska

C.2.4.1 Impacts on Marine Species

- Concern about how military training in the area would impact various marine species
- Opposition to acoustic training in sensitive waters of the Gulf of Alaska
- Opposition to the issuance of any federal permits or authorizations
- Concern about how marine species would be impacted by hazardous substances, bioaccumulation, chemical pollutants, and the use of sonar
- Need to study cumulative impacts on marine mammals from military training, warming waters, and oil drilling
- Belief that the Navy harms animals and people wherever it trains

C.2.4.2 Impacts on Airspace

- Concern about the impacts military training in the Gulf of Alaska would have on special use airspace

C.2.4.3 Impacts on Fisheries

- Request to eliminate Navy training activities within 100 nautical miles of commercial, sport, and subsistence fisheries
- Concern for potential effects proposed training activities would have on NMFS trust resources
- Discussion of NMFS as a cooperating agency at both the local and headquarters levels

C.2.4.4 Issues Regarding the 2011 Gulf of Alaska Final Environmental Impact Statement/Overseas Environmental Impact Statement

- Dissatisfaction with how public and agency comments were addressed in the 2011 GOA Final EIS/OEIS
- Belief that the Navy presented flawed counts of species density in the 2011 GOA Final EIS/OEIS and need to fix density counts in the Supplemental EIS/OEIS
- Belief that it is unnecessary to conduct a Supplemental EIS/OEIS when the Final EIS/OEIS was recently completed

C.2.4.5 General

- Support for Navy training within the Gulf of Alaska to maintain readiness

Appendix D: Acoustic Primer

TABLE OF CONTENTS

APPENDIX D ACOUSTIC PRIMER D-1

D.1 TERMINOLOGY/GLOSSARY D-1
D.1.1 PARTICLE MOTION AND SOUND PRESSURE D-1
D.1.2 FREQUENCY D-1
D.1.3 DUTY CYCLE D-2
D.1.4 LOUDNESS D-2
D.2 PREDICTING HOW SOUND TRAVELS D-3
D.2.1 SOUND ATTENUATION AND TRANSMISSION LOSS D-4
D.2.1.1 Spreading Loss D-4
D.2.1.2 Reflection and Refraction D-5
D.2.1.3 Diffraction, Scattering, and Reverberation D-6
D.2.1.4 Multipath Propagation D-6
D.2.1.5 Surface and Bottom Effects D-6
D.2.1.6 Air-Water Interface D-6
D.3 SOURCES OF SOUND D-8
D.3.1 UNDERWATER SOUNDS D-10
D.3.2 PHYSICAL SOURCES OF UNDERWATER SOUND D-10
D.3.3 BIOLOGICAL SOURCES OF UNDERWATER SOUND D-10
D.3.4 ANTHROPOGENIC SOURCES OF UNDERWATER SOUND D-11
D.3.5 AERIAL SOUNDS D-11
D.3.6 NAVY SOURCES OF SOUND IN THE WATER D-11
D.4 SOUND METRICS D-12
D.4.1 PRESSURE D-12
D.4.1.1 Sound Pressure Level D-13
D.4.1.2 Sound Exposure Level D-13
D.4.2 LOUDNESS AND AUDITORY WEIGHTING FUNCTIONS D-15

LIST OF TABLES

TABLE D-1: COMMON IN-AIR SOUNDS AND THEIR APPROXIMATE DECIBEL RATINGS D-3
TABLE D-2: SOURCE LEVELS OF COMMON UNDERWATER SOUNDS D-10

LIST OF FIGURES

FIGURE D-1: GRAPHICAL REPRESENTATION OF THE INVERSE SQUARE RELATIONSHIP IN SPHERICAL SPREADING D-4
FIGURE D-2: CHARACTERISTICS OF SOUND TRANSMISSION THROUGH THE AIR-WATER INTERFACE D-7
FIGURE D-3: OCEANIC AMBIENT NOISE LEVELS FROM 1 HERTZ TO 100,000 HERTZ, INCLUDING FREQUENCY RANGES FOR PREVALENT NOISE SOURCES D-9
FIGURE D-4: EXAMPLES OF IMPULSE AND NON-IMPULSE SOUND SOURCES D-12
FIGURE D-5: VARIOUS SOUND PRESSURE METRICS FOR A HYPOTHETICAL (A) PURE TONE (NON-IMPULSE) AND (B) IMPULSE SOUND D-13
FIGURE D-6: SUMMATION OF ACOUSTIC ENERGY (CUMULATIVE EXPOSURE LEVEL, OR SOUND EXPOSURE LEVEL) FROM A HYPOTHETICAL, INTERMITTENTLY PINGING, STATIONARY SOUND SOURCE D-14
FIGURE D-7: CUMULATIVE SOUND EXPOSURE LEVEL UNDER REALISTIC CONDITIONS WITH A MOVING, INTERMITTENTLY PINGING SOUND SOURCE (CUMULATIVE EXPOSURE LEVEL = SOUND EXPOSURE LEVEL) D-15

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APPENDIX D ACOUSTIC PRIMER

This section introduces basic acoustic principles and terminology describing how sound travels or "propagates" in air and water. These terms and concepts are used when analyzing potential impacts due to acoustic sources and explosives used during naval training. This section briefly explains the transmission of sound; introduces some of the basic mathematical formulas used to describe the transmission of sound; and defines acoustical terms, abbreviations, and units of measurement. Because seawater is a very efficient medium for the transmission of sound, the difference between transmission of sound in water and in air are discussed. Finally, it discusses the various sources of underwater sound, including physical, biological, and anthropogenic sounds.

D.1 TERMINOLOGY/GLOSSARY

Sound may be described in terms of both physical and subjective attributes. Physical attributes may be directly measured. Subjective (or sensory) attributes cannot be directly measured and require a listener to make a judgment about the sound. Physical attributes of a sound at a particular point are obtained by measuring pressure changes as sound waves pass. The following material provides a short description of some of the basic parameters of sound.

D.1.1 PARTICLE MOTION AND SOUND PRESSURE

Sound is produced when a medium (air or water in this analysis) is set into motion, often by a vibrating object within the medium. As the object vibrates, its motion is transmitted to adjacent particles of the medium. The motion of these particles is transmitted to adjacent particles, and so on. As the sound wave travels through the medium, the individual particles of the medium oscillate about their original positions but do not actually move with the sound wave. The result is a mechanical disturbance (the "sound wave") that propagates away from the source. The measurable properties of a sound are the pressure oscillations of the sound wave and the velocity, displacement amplitude, and direction of particle movements. The basic unit of sound pressure is the Pascal (Pa) (1 Pa = 1.45×10^{-4} pounds per square inch), although the most commonly encountered unit is the micropascal (µPa) (1 µPa = 1×10^{-6} Pa).

Animals with an eardrum or similar structure directly detect the pressure component of sound. Some marine fish also have specializations to detect pressure changes. Certain animals (e.g., most invertebrates and some marine fish) likely cannot detect sound pressure, only the particle motion component of sound. Because particle motion is most detectable near a sound source and at lower frequencies, this difference in acoustic energy sensing mechanisms limits the range at which these animals can detect most sound sources analyzed in this document.

D.1.2 FREQUENCY

The number of oscillations or waves per second is called the frequency of the sound, and the metric is Hertz (Hz). One Hz is equal to one oscillation per second, and 1 kilohertz (kHz) is equal to 1,000 oscillations per second. The inverse of the frequency is the period or duration of one acoustic wave.

Frequency is the physical attribute most closely associated with the subjective attribute "pitch"; the higher the frequency, the higher the pitch. Human hearing generally spans the frequency range from 20 Hz to 20 kHz. The pitch based on these frequencies is subjectively "low" (at 20 Hz) or "high" (at 20 kHz).

Pure tones have a constant, single frequency. Complex tones contain multiple, discrete frequencies, rather than a single frequency. Broadband sounds are spread across many frequencies. The frequency range of a sound is called its bandwidth. A harmonic of a sound at a particular frequency is a multiple of that frequency (e.g., harmonic frequencies of a 2 kHz tone are 4 kHz, 6 kHz, 8 kHz, etc.). A source operating at a nominal frequency may emit several harmonic frequencies at much lower sound pressure levels.

In this document, sounds are generally described as either low- (less than 1 kHz), mid- (1–10 kHz), high- (greater than 10–100 kHz), or very high- (greater than 100 kHz) frequency. Hearing ranges of marine animals (e.g., fish, birds, and marine mammals) are quite varied and are species-dependent. For example, some fish can hear sounds below 100 Hz and some species of marine mammals have hearing capabilities that extend above 100 kHz. Discussions of noise and potential impacts must therefore focus not only on the sound pressure, but the composite frequency of the noise and the species considered.

D.1.3 Duty Cycle

Duty cycle describes the portion of time that a sound source actually generates sound. It is defined as the percentage of the time during which a sound is generated over a total operational period. For example, if a sound navigation and ranging (sonar) source produces a 1-second ping once every 10 seconds, the duty cycle is 10 percent. Duty cycles vary among different acoustic sources; in general, a low duty cycle is 20 percent or less and a high duty cycle is 80 percent or higher.

D.1.4 Loudness

Sound levels are normally expressed in decibels (dB), a commonly misunderstood term. Although the term “decibel” always means the same thing, decibels may be calculated in several ways, and the explanations of each can quickly become both highly technical and confusing.

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound pressure level is described by taking the logarithm of the ratio of the sound pressure to a reference pressure (American National Standards Institute 1994). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale. (The softest audible sound has a power of about 0.000000000001 watt/square meter [m^2] and the threshold of pain is around 1 watt/m^2. With the advantage of the logarithmic scale, this ratio is efficiently described as 120 dB.)

On the decibel scale, the smallest audible sound (near total silence) is 0 dB. A sound 10 times more powerful is 10 dB. A sound 100 times more powerful than near total silence is 20 dB. A sound 1,000 times more powerful than near total silence is 30 dB. Table D-1 compares common sounds to their approximate decibel rating.

Table D-1: Common In-Air Sounds and Their Approximate Decibel Ratings

Source	Source Level (dB re 20 µPa)
Near total silence	0
Whisper	15
Normal conversation	60
Lawnmower	90
Car horn	110
Rock concert	120
Gunshot	140

Note: dB re 20 µPa = decibels referenced to 20 micropascals

D.2 PREDICTING HOW SOUND TRAVELS

Sounds are produced throughout a wide range of frequencies, including frequencies beyond the audible range of a given receptor. Most sounds heard in the environment do not consist of a single frequency, but rather a broad band of frequencies differing in sound level. The intensities of each frequency add to generate perceptible sound.

The speed of sound is not affected by its intensity, amplitude, or frequency, but rather depends wholly on characteristics of the medium through which it is passing. Sound generally travels faster as the density of the medium increases. Speeds of sound through air are primarily influenced by air temperature, relative humidity, and pressure, averaging about 1,115 feet per second (ft./s) (340 meters per second [m/s]) at standard barometric pressure. Sound speeds in air increase as air temperature increases. Sound travels differently in the water than in air because seawater is a very efficient medium for the transmission of sound. Sound moves at a faster speed in water, about 4,921 ft./s (1,500 m/s). The speed of sound through water is influenced by temperature, pressure, and salinity because sound travels faster as any of these parameters increase.

In the simple case of sound propagating from a point source without obstruction or reflection, the sound waves take on the shape of an expanding sphere. As spherical propagation continues, the sound energy is distributed over an ever-larger area following the inverse square law: the intensity of a sound wave decreases inversely with the square of the distance between the source and the receptor. For example, doubling the distance between the receptor and a sound source results in a reduction in the intensity of the sound of one-fourth of its initial value; tripling the distance results in one-ninth of the original intensity, and so on (Figure D-1). As expected, sound intensity drops at increasing distance from the point source. In spherical propagation, sound pressure levels drop an average of 6 dB for every doubling of distance from the source. Potential impacts on sensitive receptors, then, are directly related to the distance from the receptor to the noise source, and the intensity of the noise source itself.

While the concept of a sound wave traveling from its source to a receptor is relatively simple, sound propagation is quite complex because of the simultaneous presence of numerous sound waves of different frequencies and other phenomena such as reflections of sound waves and subsequent constructive (additive) or destructive (cancelling) interferences between reflected and incident waves. Other factors such as refraction, diffraction, bottom types, and surface conditions also affect sound propagation. While simple examples are provided here for illustration, the Navy Acoustic Effects Model used to quantify acoustic exposures to marine mammals and sea turtles takes into account the influence of multiple factors to predict acoustic propagation (Marine Species Modeling Team 2014).

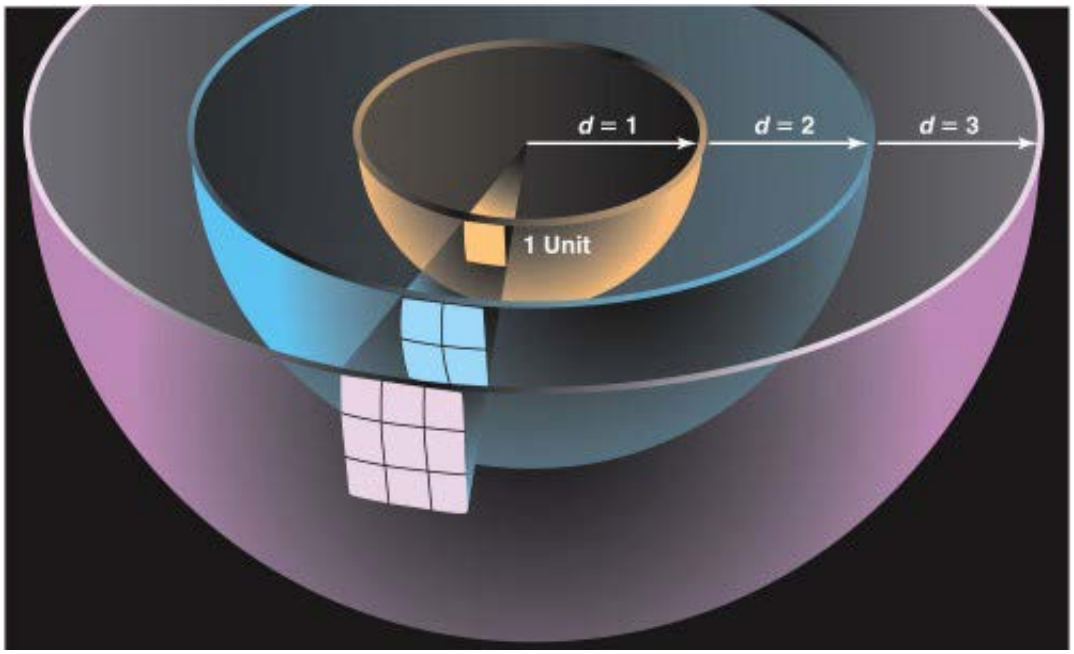


Figure D-1: Graphical Representation of the Inverse Square Relationship in Spherical Spreading

D.2.1 SOUND ATTENUATION AND TRANSMISSION LOSS

As a sound wave passes through a medium, the intensity decreases with distance from the sound source. This phenomenon is known as attenuation or propagation loss. Sound attenuation may be described in terms of transmission loss (TL). The units of transmission loss are dB. The transmission loss is used to relate the source level (SL), defined as the sound pressure level produced by a sound source at a distance of 3.3 feet (ft.) (1 meter [m]), and the received level (RL) at a particular location, as follows:

$$RL = SL - TL$$

The main contributors to sound attenuation are as follows:

- Geometrical spreading of the sound wave as it propagates away from the source
- Sound absorption (conversion of sound energy into heat)
- Scattering, diffraction, multipath interference, boundary effects
- Other nongeometrical effects (Urick 1983)

D.2.1.1 Spreading Loss

Spreading loss is a geometrical effect representing regular weakening of a sound wave as it spreads out from a source (Campbell et al. 1988). Spreading describes the reduction in sound pressure caused by the increase in surface area as the distance from a sound source increases. Spherical and cylindrical spreading are common types of spreading loss.

As described before, a point sound source in a homogeneous medium without boundaries will radiate spherical waves—the acoustic energy spreads out from the source in the form of a spherical shell. As the distance from the source increases, the shell surface area increases. If the sound power is fixed, the sound intensity must decrease with distance from the source (intensity is power per unit area). The surface area of a sphere is $4\pi r^2$, where r is the sphere radius, so the change in intensity is proportional to

the radius squared. This relationship is known as the spherical spreading law. The transmission loss for spherical spreading is:

$$TL = 20\log_{10}r$$

where r is the distance from the source. This is equivalent to a 6 dB reduction in sound pressure level for each doubling of distance from the sound source. For example, calculated transmission loss for spherical spreading is 40 dB at 328.1 ft. (100 m) and 46 dB at 656.2 ft. (200 m).

In cylindrical spreading, spherical waves expanding from the source are constrained by the water surface and the seafloor and take on a cylindrical shape. In this case the sound wave expands in the shape of a cylinder rather than a sphere and the transmission loss is:

$$TL = 10\log_{10}r$$

Cylindrical spreading is an approximation to wave propagation in a water-filled channel with horizontal dimensions much larger than the depth. Cylindrical spreading predicts a 3 dB reduction in sound pressure level for each doubling of distance from the source. For example, calculated transmission loss for cylindrical spreading is 20 dB at 328.1 ft. (100 m) and 23 dB at 656.2 ft. (200 m).

D.2.1.2 Reflection and Refraction

When a sound wave propagating in a medium encounters a second medium with a different density or sound speed (e.g., the air-water boundary) part of the incident sound will be reflected back into the first medium and part will be transmitted into the second medium (Kinsler et al. 1982). If the second medium has a different sound speed than the first, the propagation direction will change as the sound wave enters the second medium; this phenomenon is called refraction. Refraction may also occur within a single medium if the sound speed varies in the medium.

Refraction of sound resulting from spatial variations in the sound speed is one of the most important phenomena that affect sound propagation in water (Urick 1983). The sound speed in the ocean primarily depends on hydrostatic pressure (i.e., depth) and temperature. Sound speed increases with both hydrostatic pressure and temperature. In seawater, temperature has the most important effect on sound speed for depths less than about 984.2 ft. (300 m). Below 4,921.3 ft. (1,500 m), the hydrostatic pressure is the dominant factor because the water temperature is relatively constant. The variation of sound speed with depth in the ocean is called a sound speed profile.

Although the actual variations in sound speed are small, the existence of sound speed gradients in the ocean has an enormous effect on the propagation of sound in the ocean. If one pictures sound as rays emanating from an underwater source, the propagation of these rays changes as a function of the sound speed profile in the water column. Specifically, the directions of the rays bend toward regions of slower sound speed. This phenomenon creates ducts in which sound becomes “trapped,” allowing it to propagate with high efficiency for large distances within certain depth boundaries. During winter months, the reduced sound speed at the surface due to cooling can create a surface duct that efficiently propagates sound such as shipping noise. The deep sound channel or Sound Frequency and Ranging channel is another duct that exists where sound speeds are lowest in the water column (1,968.5–3,937 ft. [600–1,200 m] depth at the mid-latitudes). Intense low-frequency underwater sounds, such as explosions, can be detected halfway around the world from their source via the Sound Frequency and Ranging channel (Baggeroer and Munk 1992).

D.2.1.3 Diffraction, Scattering, and Reverberation

Sound waves experience diffraction in much the same manner as light waves. Diffraction may be thought of as the bending of a sound wave around an obstacle. Common examples include sound heard from a source around the corner of a building and sound propagating through a small gap in an otherwise closed door or window. An obstacle or inhomogeneity (e.g., smoke, suspended particles, or gas bubbles) in the path of a sound wave causes scattering if secondary sound spreads out from it in a variety of directions (Pierce 1989). Scattering is similar to diffraction. Normally diffraction is used to describe sound bending or scattering from a single object, and scattering is used when there are multiple objects. Reverberation, or echo, refers to the prolongation of a sound that occurs when sound waves in an enclosed space are repeatedly reflected from the boundaries defining the space, even after the source has stopped emitting.

D.2.1.4 Multipath Propagation

In multipath propagation, sound may not only travel a direct path from a source to a receiver, but also be reflected from the surface or bottom multiple times before reaching the receiver (Urick 1983). At some distances, the reflected wave will be in phase with the direct wave (their waveforms add together) and at other distances the two waves will be out of phase (their waveforms cancel). The existence of multiple sound paths, or rays, arriving at a single point can result in multipath interference, a condition that permits the addition and cancellation between sound waves resulting in the fluctuation of sound levels over short distances. A special case of multipath propagation loss is called the Lloyd mirror effect, where the sound field near the water's surface reaches a minimum because of the destructive interference (cancellation) between the direct sound wave and the sound wave being reflected from the surface. This can cause the sound level to decrease dramatically within the top few meters of the water column.

D.2.1.5 Surface and Bottom Effects

Because the sea surface reflects and scatters sound, it has a major effect on the propagation of underwater sound in applications where either the source or receiver is at a shallow depth (Urick 1983). If the sea surface is smooth, the reflected sound pressure is nearly equal to the incident sound pressure; however, if the sea surface is rough, the amplitude of the reflected sound wave will be reduced.

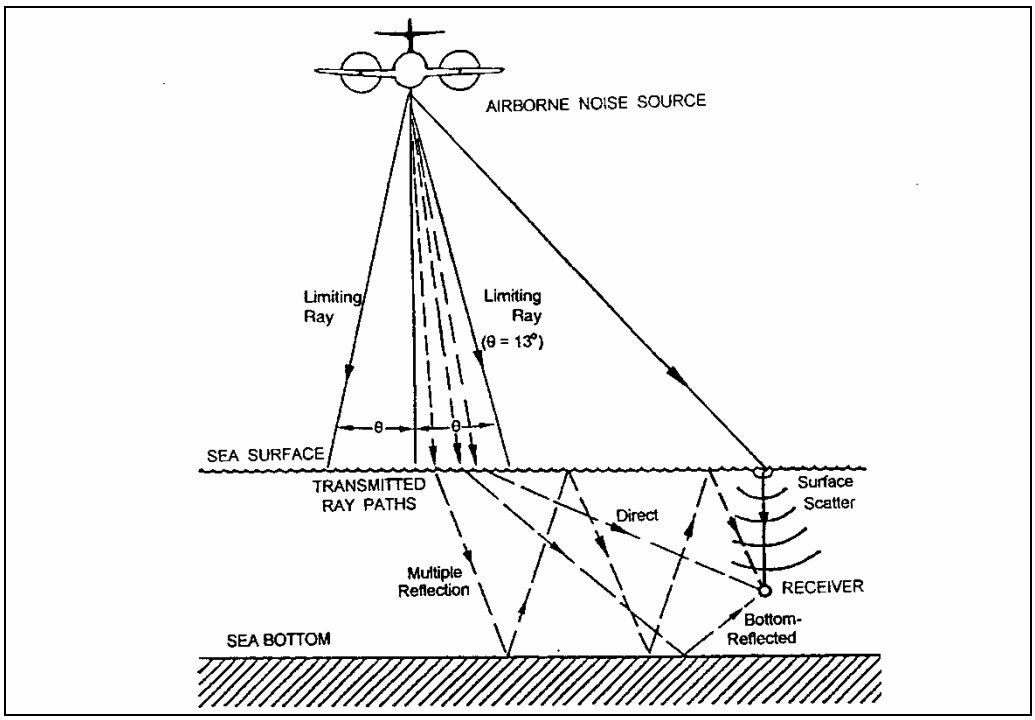
The sea bottom is also a reflecting and scattering surface, similar to the sea surface. Sound interaction with the sea bottom is more complex, however, primarily because the acoustic properties of the sea bottom are more variable and the bottom is often layered into regions of differing density and sound speed. The Lloyd mirror effect may also be observed from sound sources located near the sea bottom. For a hard bottom such as rock, the reflected wave will be approximately in phase with the incident wave. Thus, near the ocean bottom, the incident and reflected sound pressures may add together, resulting in an increased sound pressure near the sea bottom.

D.2.1.6 Air-Water Interface

Sound from aerial sources such as aircraft, muzzle blasts, and projectile sonic booms, can be transmitted into the water. The most studied of these sources are fixed-wing aircraft and helicopters, which create noise with most energy below 500 Hz. Noise levels in water are highest at the surface and are highly dependent on the altitude of the aircraft and the angle at which the aerial sound encounters the ocean surface. Transmission of the sound once it is in the water is identical to any other sound as described in the section above.

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Young (1973), Urick (1983), Richardson et al. (1995), Eller and Cavanagh (2000), Laney and Cavanagh (2000), and others. Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct-refracted paths reflected from the bottom in shallow water; (3) evanescent transmission in which sound travels laterally close to the water surface; and (4) scattering from interface roughness due to wave motion.

Airborne sound is refracted upon transmission into water because sound waves move faster through water than through air (a ratio of about 0.23:1). Based on this difference, the direct sound path is reflected if the sound reaches the surface at an angle more than 13 degrees from vertical. As a result, most of the acoustic energy transmitted into the water from an aircraft arrives through a relatively narrow cone extending vertically downward from the aircraft (Figure D-2). The intersection of this cone with the surface traces a "footprint" directly beneath the flight path, with the width of the footprint being a function of aircraft altitude. Sound may enter the water outside of this cone due to surface scattering and as evanescent waves, which travel laterally near the water surface.



Source: Richardson et al. 1995

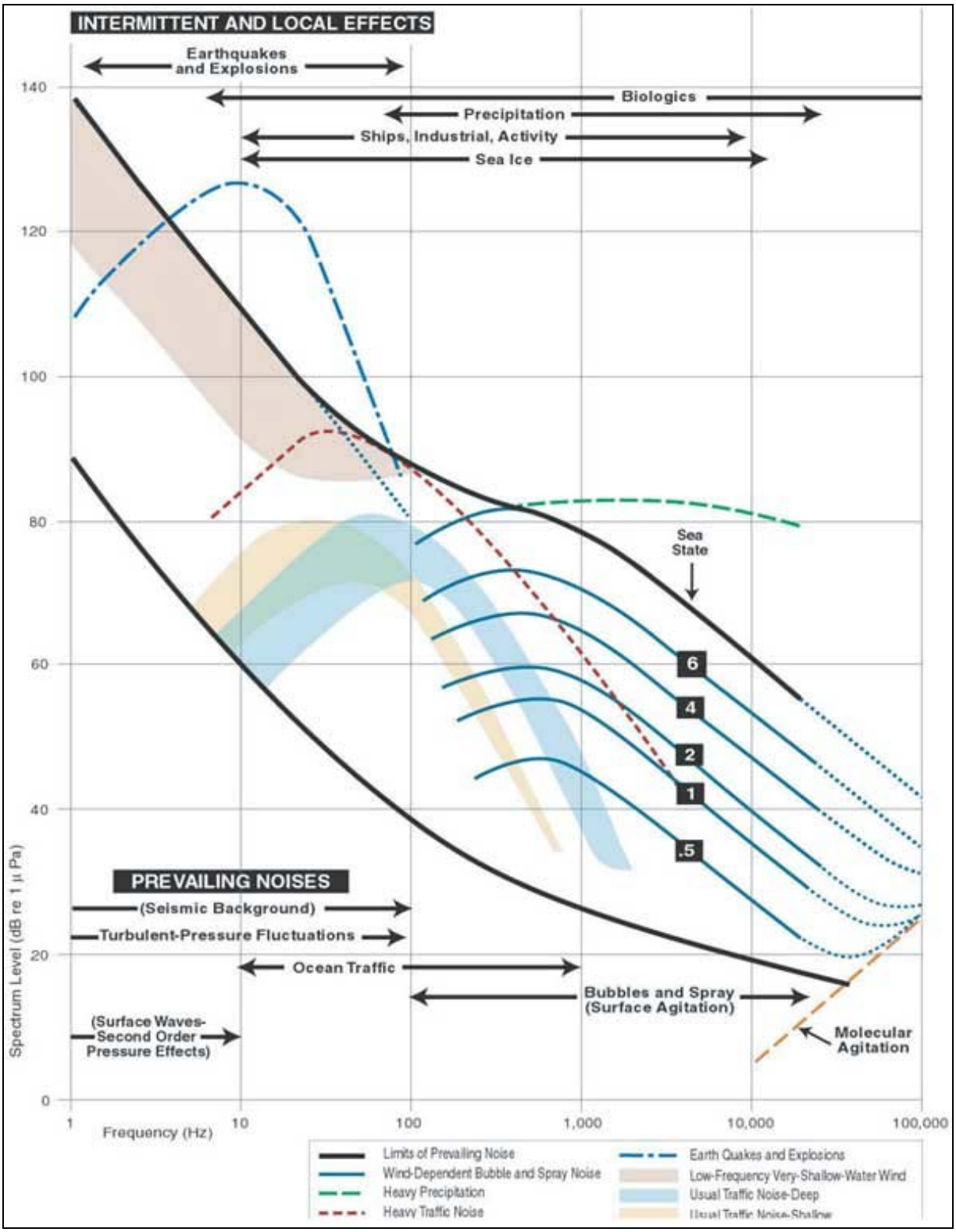
Figure D-2: Characteristics of Sound Transmission through the Air-Water Interface

The sound pressure field is actually doubled (+6 dB) at the air-to-water interface because of the large difference in the acoustic properties of water and air. For example, an airborne sound with a sound pressure level of 100 dB re 1 µPa at the sea surface becomes 106 dB re 1 µPa just below the surface. The pressure and sound levels then decrease with increasing distance as they would for any other in-water noise.

D.3 SOURCES OF SOUND

Ambient noise is the collection of ever-present sounds of both natural and human-generated origin. Ambient noise in the ocean comprises sound generated by natural physical, natural biological, and anthropogenic (human-generated) sources (Figure D-3). Preindustrial physical and biological noise sources in marine environments were often not high enough to interfere with the hearing of marine animals (Richardson et al. 1995). However, the increase in anthropogenic noise sources in recent times is a concern.

Except for sounds generated by some marine species, most natural ocean sound is broadband (composed of a spectrum of numerous frequencies). Virtually the entire frequency spectrum is represented in ambient sound sources (National Research Council 2003, adapted from Wenz 1962). Earthquakes and explosions produce sound signals from 1 Hz to 100 Hz; marine species can produce signals from 100 Hz to more than 10,000 Hz; and commercial shipping, industrial activities, and naval ships have signals between 10 and 10,000 Hz (Figure D-3). Spray and bubbles associated with breaking waves are the major contributions to the ambient sound in the 50–100,000 Hz range. At frequencies greater than 100,000 Hz (or approximately 80,000 Hz in the Inland Waters of the Study Area), “thermal noise” caused by the random motion of water molecules is the primary source. Natural sources, especially from wave and tidal action, can cause coastal environments to have particularly high ambient sound levels.



Source: National Research Council (2003), adapted from Wenz (1962)

Figure D-3: Oceanic Ambient Noise Levels from 1 Hertz to 100,000 Hertz, Including Frequency Ranges for Prevalent Noise Sources

D.3.1 UNDERWATER SOUNDS

Physical, biological, and anthropogenic sounds all contribute to the ambient underwater noise environment. Example source levels for various underwater sounds are shown in Table D-2. Many naturally occurring sounds have source levels similar to anthropogenic sounds.

Table D-2: Source Levels of Common Underwater Sounds

Source	Source Level (dB re 1 μPa at 1 m)
Ice breaker ship	193[1]
Large tanker	186[1]
Seismic airgun array (32 guns)	259 (peak)[1]
Dolphin whistles	125–173[1]
Dolphin clicks	194–219[2]
Humpback whale song	144–174[3]
Snapping shrimp	183–189[4]
Sperm whale click	236[5]
Naval mid-frequency active sonar (SQS-53)	235
Lightning strike	260[6]
Seafloor volcanic eruption	255[7]

[1] Richardson et al. 1995, [2] Rasmussen et al. 2002, [3] Payne and Payne 1985, Thompson et al. 1979, [4] Au and Banks 1998, [5] Levenson 1974, Watkins 1980, [6] Hill 1985, [7] Northrop 1974

Note: dB re 1 μPa at 1 m = decibels referenced to 1 micropascal at 1 meter

D.3.2 PHYSICAL SOURCES OF UNDERWATER SOUND

Physical processes that create sound in the ocean include rain, wind, waves, sea ice, lightning strikes at the sea surface, undersea earthquakes, and eruptions from undersea volcanoes. Generally, these sound sources contribute to a rise in the ambient sound levels on an intermittent basis. Underwater sound from rain typically is between 1 and 3 kHz. Wind produces frequencies between 100 Hz and 30 kHz, while wave-generated sound is a significant contributor in the infrasonic range (i.e., 1–20 Hz) (Simmonds et al. 2003). Seismic activity results in the production of low-frequency sounds that can be heard for great distances. At short ranges, underwater sounds from earthquakes can extend to frequencies greater than 100 Hz, and the arriving signal can have a very sharp onset, similar to that of an explosion, and can last from a few seconds to a few minutes (National Research Council 2003). Energy from large man-made explosions generates the same types of T-phase waves that seismic sources do and they both can emit energy at frequencies up to 500 Hz (Richardson et al. 1995). Seismically active regions are subject to intense disturbances from strong sounds produced by earthquakes that can kill or injure marine mammals living in the region. The T-phase source signal level (10–30 Hz range) can exceed 200 dB, for a magnitude 4–5 earthquake. On 22 February 2005, a fin whale in the Gulf of California covered 13 kilometers (km) in 26 minutes (mean speed = 30.2 km/hour), in response to a 5.5 Richter scale earthquake (Gallo-Reynoso et al. 2011).

D.3.3 BIOLOGICAL SOURCES OF UNDERWATER SOUND

Marine animals use sound to navigate, communicate, locate food, reproduce, and detect predators and other important environmental cues. For example, reproductive activity, including courtship and spawning, accounts for the majority of sounds produced by fish. During the spawning season, croakers (family Sciaenidae) vocalize for many hours and often dominate the acoustic environment (Ramcharitar et al. 2006). In addition, toothed whales and dolphins (Odontocetes) produce a wide

variety of sounds including clicks, whistles, and pulsed sounds. Marine life of various types can increase ambient sound levels by nearly 20 dB over the range of a few kilohertz (e.g., crustaceans and fish) or over the range of tens to hundreds of kilohertz (e.g., dolphin clicks and whistles). For instance, bottlenose dolphin clicks and whistles have a dominant frequency range of 110–130 kHz and 3.5–14.5 kHz, respectively (Au 1993). In addition, sperm whale clicks range in frequency from 0.1 to 30 kHz, with dominant energy in two bands (2–4 kHz and 10–16 kHz) (Richardson et al. 1995). Blue and fin whales produce low-frequency moans at frequencies of 10–25 Hz. Colonies of snapping shrimp can generate sounds at frequencies of 2–15 kHz.

D.3.4 Anthropogenic Sources of Underwater Sound

In addition to sounds generated during Navy training, other non-Navy activities also introduce similar types of anthropogenic (human-generated) sound into the ocean from a number of sources, including non-military vessel traffic, industrial operations onshore (pile driving), seismic profiling for oil exploration, oil drilling, underwater explosions, and in-air sources that can enter the water. Noise levels resulting from human activities in coastal and offshore areas are increasing; however, there are few historical records of ambient noise data to substantiate the level of increase.

Commercial shipping is the most widespread source of human-made, low-frequency (0–1,000 Hz) noise in the oceans and may contribute more than 75 percent of all human-made sound in the sea (International Council for the Exploration of the Sea 2005), particularly in coastal areas and near shipping lanes (see Figure 3.8-5 for commercial vessel density in the Study Area). There are approximately 20,000 large commercial vessels at sea worldwide at any given time. Because low-frequency sounds carry for long distances, a large vessel emitting sound at 6.8 Hz can be detected 75–250 nautical miles away (Polefka 2004). The dominant component of low-frequency ambient noise is commercial tankers, which contribute twice as much noise as cargo vessels and at least 100 times as much noise as research vessels (Hatch et al. 2008). Most of these sounds are produced as a result of propeller cavitation (when air spaces created by the motion of propellers collapse) (Southall et al. 2007).

High-intensity, low-frequency impulse sounds are emitted during seismic surveys to determine the structure and composition of the geological formations below the sea bed to identify potential hydrocarbon reservoirs (i.e., oil and gas exploration) (Simmonds et al. 2003).

D.3.5 Aerial Sounds

Aerial sounds may be produced by physical, biological, or anthropogenic sources. These sounds may be transmitted across the air-water interface as well. Of the physical sources of sound, surf noise is one of the most dominant. The highest sound levels from surf are typically low frequency (below 100 Hz). Biological sources of sound can be a significant contribution to the noise level in coastal environments such as areas occupied by highly vocal sea lions. Anthropogenic noise sources like ships, industrial sites, cars, and airplanes are also potential contributors.

D.3.6 Navy Sources of Sound in the Water

Many of the Navy's activities may introduce sound into the ocean. The type of sound will determine how that source is measured and evaluated for potential impacts to the environment. All of the Navy-produced sounds may be categorized as impulse or non-impulse. Impulse sounds feature a very rapid increase to high pressures, followed by a rapid return to the static pressure. Impulse sounds are often produced by processes involving a rapid release of energy or mechanical impacts (Hamernik and Hsueh 1991). Non-impulse sounds lack the rapid rise time and can have longer durations than impulse sounds.

Non-impulse sound can be continuous or intermittent. See Figure D-4 for examples of impulse and non-impulse underwater sound sources.

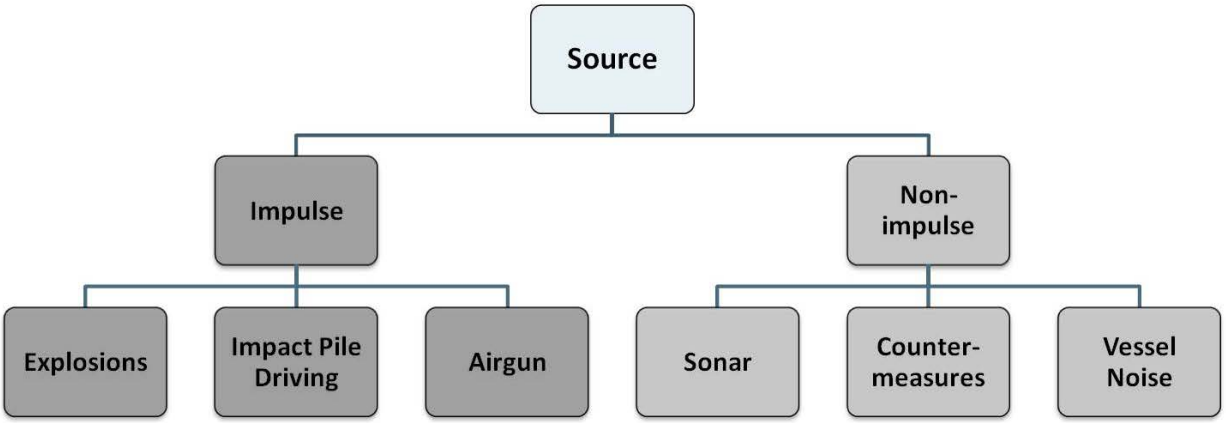


Figure D-4: Examples of Impulse and Non-Impulse Sound Sources

D.4 SOUND METRICS

D.4.1 PRESSURE

Various sound pressure metrics are illustrated in Figure D-5 for (a) a non-impulse and (b) an impulse sound. Sound pressure varies differently with time for non-impulse and impulse sounds. As shown in Figure D-5, the non-impulse sound has a relatively gradual rise in pressure from static pressure (the ambient pressure without the added sound), while the impulse sound has a near-instantaneous rise to a higher peak pressure. The peak pressure shown on both illustrations is the maximum absolute value of the instantaneous sound pressure during a specified time interval, which accounts for the values of peak pressures below the static (ambient) pressure (American National Standards Institute 1994). Peak-to-peak pressure is the difference between the maximum and minimum sound pressures. The root-mean-squared sound pressure is often used to describe the average pressure level of sounds. As the name suggests, this method takes the square root of the average squared sound pressure values over a time interval. The duration of this time interval can have a strong effect on the measured root-mean-squared sound pressure for a given sound, especially where pressure levels vary significantly, as during an impulse. If the analysis duration includes a significant portion of the waveform after the impulse has ended and the pressure has returned to near static, the root-mean-squared level would be relatively low. If the analysis duration includes the highest pressures of the impulse and excludes the portion of the waveform after the impulse has terminated, the root-mean-squared level would be comparatively high. For this reason, it is important to specify the duration used to calculate the root-mean-squared pressure for impulse sounds.

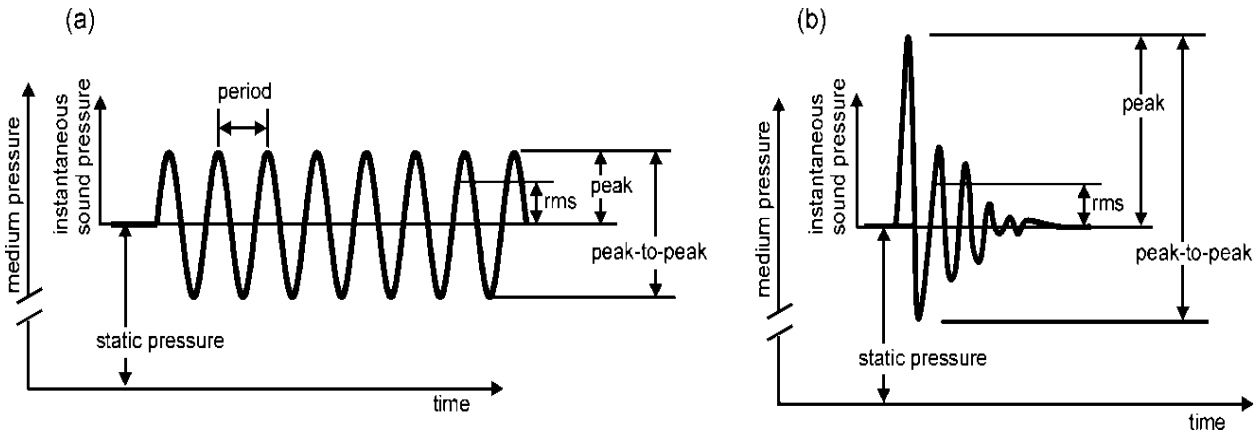


Figure D-5: Various Sound Pressure Metrics for a Hypothetical (a) Pure Tone (Non-Impulse) and (b) Impulse Sound

D.4.1.1 Sound Pressure Level

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound pressure level is described by taking the logarithm of the ratio of the sound pressure to a reference pressure (American National Standards Institute 1994). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale.

Sound levels are normally expressed in dB. To express a pressure *X* in decibels using a reference pressure X_{ref}, the equation is:

$$20\log_{10}\left(\frac{X}{X_{ref}}\right)$$

The pressure *X* is the root-mean-square value of the pressure. When a value is presented in decibels, it is important to specify the value and units of the reference pressure. Normally the decibel value is given, followed by the text "re," meaning "with reference to," and the value and unit of the reference pressure. The standard reference pressures are 1 µPa for water and 20 µPa for air (American National Standards Institute 1994). It is important to note that, because of the difference in reference units between air and water, the same absolute pressures would result in different dB values for each medium.

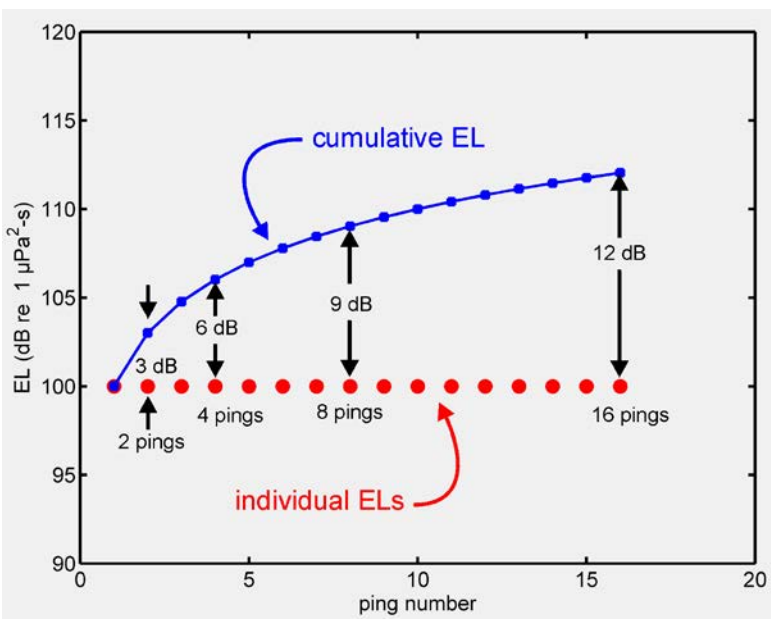
D.4.1.2 Sound Exposure Level

When analyzing effects on marine animals from multiple moderate-level sounds, it is necessary to have a metric that quantifies cumulative exposure(s) (American National Standards Institute 1994). The Sound Exposure Level (SEL) can be thought of as a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., a series of sonar pings) have two main characteristics: (1) a sound level that changes throughout the event and (2) a period of time during which the source is exposed to the sound. Cumulative SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. Sound exposure level is determined by calculating the decibel level of the cumulative sum-of-squared pressures over the duration of a sound, with units of dB re 1 micropascal squared second (μPa^2-s) for sounds in water.

Some rules of thumb for SEL are as follows:

- The numeric value of SEL is equal to the sound pressure level of a 1-second sound that has the same total energy as the exposure event. If the sound duration is 1 second, sound pressure level and SEL have the same numeric value (but not the same reference quantities). For example, a 1-second sound with a sound pressure level of 100 dB re 1 µPa has a SEL of 100 dB re 1 μPa^2-s.
- If the sound duration is constant but the sound pressure level changes, SEL will change by the same number of decibels as the sound pressure level.
- If the sound pressure level is held constant and the duration (*T*) changes, SEL will change as a function of $10\log_{10}(T)$:
    - $10\log_{10}(10) = 10$, so increasing duration by a factor of 10 raises SEL by 10 dB.
    - $10\log_{10}(0.1) = -10$, so decreasing duration by a factor of 10 lowers SEL by 10 dB.
    - Since $10\log_{10}(2) \approx 3$, so doubling the duration increases SEL by 3 dB.
    - $10\log_{10}(1/2) \approx -3$, so halving the duration lowers SEL by 3 dB.

Figure D-6 illustrates the summation of energy for a succession of sonar pings. In this hypothetical case, each ping has the same duration and sound pressure level. The SEL at a particular location from each individual ping is 100 dB re 1 μPa^2-s (red circles). The upper, blue curve shows the running total or cumulative SEL.

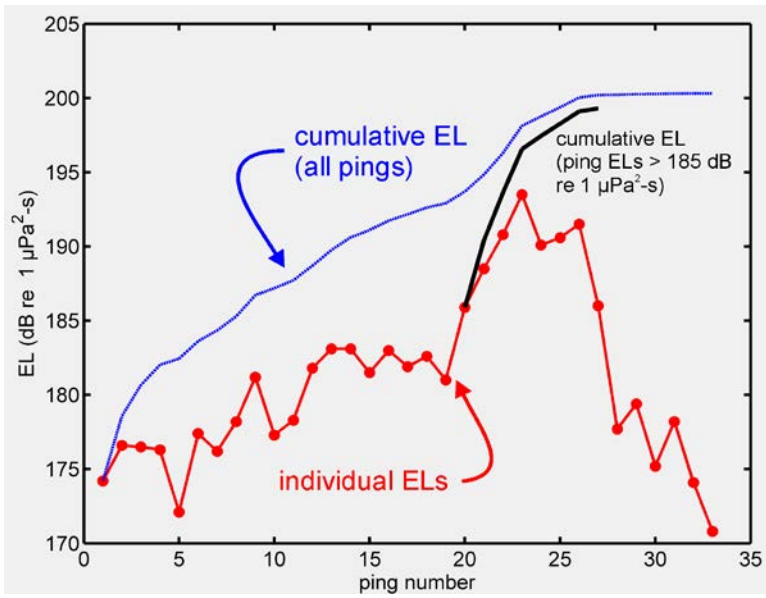


Note: EL = Exposure Level

Figure D-6: Summation of Acoustic Energy (Cumulative Exposure Level, or Sound Exposure Level) from a Hypothetical, Intermittently Pinging, Stationary Sound Source

After the first ping, the cumulative SEL is 100 dB re 1 μPa^2-s. Since each ping has the same duration and sound pressure level, receiving two pings is the same as receiving a single ping with twice the duration. The cumulative SEL from two pings is therefore 103 dB re 1 μPa^2-s. The cumulative SEL from four pings is 3 dB higher than the cumulative SEL from two pings, or 106 dB re 1 μPa^2-s. Each doubling of the number of pings increases the cumulative SEL by 3 dB.

Figure D-7 shows a more realistic example where the individual pings do not have the same sound pressure level or SEL. These data were recorded from a stationary hydrophone as a sound source approached, passed, and moved away from the hydrophone. As the source approached the hydrophone, the received sound pressure level from each ping increased, causing the SEL of each ping to increase. After the source passed the hydrophone, the received sound pressure level and SEL from each ping decreased as the source moved farther away (downward trend of red line), although the cumulative SEL increased with each additional ping received (slight upward trend of blue line). The main contributions are from those pings with the highest individual SELs. Individual pings with SELs 10 dB or more below the ping with the highest level contribute little (less than 0.5 dB) to the total cumulative SEL. This is shown in Figure D-7 where only a small error is introduced by summing the energy from the eight individual pings with SEL greater than 185 dB re 1 µPa2-s (black line), as opposed to including all pings (blue line).



Note: EL = Exposure Level

Figure D-7: Cumulative Sound Exposure Level under Realistic Conditions with a Moving, Intermittently Pinging Sound Source (Cumulative Exposure Level = Sound Exposure Level)

Impulse (Pascal-seconds)

Impulse is a metric used to describe the pressure and time component of an intense shock wave from an explosive source. The impulse calculation takes into account the magnitude and duration of the initial peak positive pressure, which is the portion of an impulse sound most likely to be associated with damage. Specifically, impulse is the time integral of the initial peak positive pressure with units of Pascal-seconds. The peak positive pressure for an impulse sound is shown in Figure D-5 as the first and largest pressure peak above static pressure. This metric is used to assess potential injurious effects from explosives.

D.4.2 Loudness and Auditory Weighting Functions

Animals, including humans, are not equally sensitive to sounds across their entire hearing range. The subjective judgment of a sound level by a receiver such as an animal is known as loudness. Two sounds received at the same sound pressure level (an objective measurement), but at two different frequencies, may be perceived by an animal at two different loudness levels depending on its hearing sensitivity

(lowest sound pressure level at which a sound is first audible) at the two different frequencies. Furthermore, two different species may judge the relative loudness of the two sounds differently.

Auditory weighting functions are a method common in human hearing risk analysis to account for differences in hearing sensitivity at various frequencies. This concept can be applied to other species as well. When used in analyzing the impacts of sound on an animal, auditory weighting functions adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges of less or no sensitivity. A-weighted sound levels, often seen in units of “dBA” (A-weighted decibels), are frequency-weighted to account for the sensitivity of the human ear to a barely audible sound. Many measurements of sound in air appear as dBA in the literature because the intent of the authors is often to assess noise impacts on humans.

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