

U.S. Navy Sonar and Marine Mammals: A Recommendation of Additional Marine Mammal  
Mitigation Measures in the Northwest Testing and Training (NWTT) Study Area

Meegan Brianna Corcoran

A thesis

submitted in partial fulfillment of the  
requirements for the degree of

Master of Marine Affairs

University of Washington

2014

Committee:

David Fluharty

Beth Bryant

Program Authorized to Offer Degree:

School of Marine and Environmental Affairs

©Copyright 2014  
Meegan Brianna Corcoran

University of Washington

**Abstract**

U.S. Navy Sonar and Marine Mammals: A Recommendation of Additional Marine Mammal Mitigation Measures in the Northwest Testing and Training (NWTT) Study Area

Meegan Brianna Corcoran

Chair of the Supervisory Committee:  
Associate Professor David Fluharty  
School of Marine and Environmental Affairs

National security and environmental health have been at odds in America for decades. An example is the competing interests regarding Navy active sonar and marine mammal impacts. Navy sonar is essential for submarine detection, identification, and tracking. However, active sonar has been correlated to behavioral changes, deafness, hemorrhaging, stranding and death of marine mammals throughout the oceans. The U.S. Navy is currently proposing to increase active sonar testing and training off the Pacific Northwest coast in a range complex known as the Northwest Testing and Training (NWTT) Study Area. The Navy presently employs several marine mammal mitigation measure in order to limit negative impacts. However, additional mitigation measures exist that the Navy may utilize to further decrease harm. I have developed and evaluated five additional measures which support national security and environmental health. It is imperative the Navy assesses alternative mitigation measures that increase environmental protection while maintaining readiness standards.



Meegan B. Corcoran served in the United States Navy as a sonar technician (geographic) while working primarily with low-frequency active (LFA) sonar. She spent four years on active duty and another three and half years as an active reservist. She would like to thank Dr. David Fluharty for his invaluable guidance in the writing process, as well as Professor Beth Bryant for her insight regarding environmental laws. The views and ideas presented in this thesis are the author's alone and do not represent those of the Department of Defense, the United States Navy, or the University of Washington.

## Table of Contents

Section	Page
1. <b>Introduction</b> .....	1
2. <b>National Environmental Policy Act (NEPA)</b> .....	3
2.1 Environmental Impact Statement (EIS).....	4
2.2. Alternatives.....	4
3. <b>Environmental Law Exemptions</b> .....	5
3.1 National Environmental Policy Act (NEPA).....	5
3.2 Marine Mammal Protection Act (MMPA).....	5
3.3 Endangered Species Act (ESA).....	7
4. <b>National Security and Sonar</b> .....	8
5. <b>Sonar and Impacts to Cetaceans</b> .....	9
5.1 Impacts to Marine Mammals.....	11
6. <b>Northwest Testing and Training (NWTT) Study Area</b> .....	14
6.1 Purpose and Need.....	14
6.2 Location and Complexes.....	15
6.3 NWTT Study Area Goals and Objectives.....	16
6.3.1 Goal 1: Execute testing and training in the Pacific Northwest...16	
6.3.2 Goal 2: Continue Marine Protective Measures.....	17
6.4 The NWTT EIS Alternatives.....	18
6.4.1 No Action Alternative.....	19
6.4.2 Alternative 1.....	20
6.4.3 Alternative 2.....	21
6.5 Marine Mammals within the NWTT Study Area.....	22
7. <b>Marine Mammal Mitigation Activities (Current and Proposed)</b> .....	27

<u>Section</u>	<u>Page</u>
7.1 Pre-Exercise Monitoring.....	28
7.2 Posting Trained Lookouts.....	28
7.3 Establishing Mitigation Zones for Marine Species.....	29
7.4 Conducting Safe Navigation.....	32
<b>8. Recommended Mitigation Measures.....</b>	<b>34</b>
8.1 Increase Simulated Training.....	34
8.2 Decrease Sonar Source Level.....	38
8.3 Offshore Relocation.....	41
8.4 Implementation of a Ramp-Up Period.....	42
8.5 Establish a Dedicated Passive Marine Mammal Identifier.....	45
<b>9. Discussion.....</b>	<b>46</b>
 <b>Literature Cited.....</b>	 <b>51</b>
 <b>Appendix A: Guiding Principles for Determining Training Mix.....</b>	 <b>54</b>

### **Tables**

Table 1. Source Level of Common Underwater Sounds.....	11
Table 2. Marine Mammals with Possible or Confirmed Presence within the Northwest Testing and Training Study Area.....	23
Table 3. Acoustic Stressors Applicable to Marine Mammals for Testing and Training Activities.....	24
Table 4. Total Stressors Applicable to Marine Mammals for Testing and Training Activities.....	25

Table 5. Annual Training Effects for Sonar and Other Active Acoustic Sources.....	26
Table 6. Total Number of Training Effects for Acoustic Sources over a 5-Year Period.....	27
Table 7. Predicted Range of Acoustic Effects and Recommended Mitigation Zones.....	31
Table 8. Summary of Recommended and Current Lookout and Mitigation Zone Measures.....	32

### **Figures**

Figure 1. Detailed Map of NWTT Study Area.....	15
--	----

# **U.S. Navy Sonar and Marine Mammals: A Recommendation of Additional Marine Mammal Mitigation Measures in the Northwest Testing and Training (NWT) Study Area**

“I think the environment should be put in the category of our national security. Defense of our resources is just as important as defense abroad. Otherwise what is there to defend?”  
- **Robert Redford**

## **1. Introduction**

National security and environmental protection have been out of balance within the United States for several decades (Babcock, 2007; Abate, 2010). In 1969, the National Environmental Policy Act (NEPA) was signed into law amidst public concern for the environmental impacts of Federal actions. The NEPA, which requires environmental evaluations of major actions by Federal agencies, was fairly effective until the attacks on September 11, 2001, at which time the U.S. government relaxed environmental concerns in order to increase attention on national security issues (Dycus, 2005). Perhaps one of the most controversial activities within the realm of national security is the U.S. Navy’s use of sonar and the confirmed and potential negative impacts to the marine environment, particularly marine mammals. However, the concern regarding the impacts to marine mammals is in direct conflict with the Navy’s mission. The conflict is “a balance of harms” between the potential environmental threats and the possible risk to Americans by naval forces inadequately trained to use sonar to detect enemy submarines and mines. However, it may be possible to achieve optimal national security while decreasing harm to the oceans through simple operational modifications.

The U.S. Navy is currently proposing to maintain or increase sonar testing and training off the coast of Washington, Oregon, Northern California, Southeast Alaska and the Puget Sound, making up a strategic zone known as the Northwest Testing and Training (NWTT) Study Area (Commander, 2014; DoN, 2014). The use of sonar within this area is likely to significantly increase, thus, potentially harming a greater number of marine mammals than if sonar use remained at current levels. As per the NEPA, the Navy is conducting an environmental impact statement (EIS)/ overseas environmental impact statement (OEIS) in which the proposed action as well as “reasonable” alternatives to the action must be identified and analyzed. Alternatives are considered reasonable if they can feasibly be carried out based on “technical, economic, environmental, and other factors and if they meet the purpose and need of the proposed action” (Bass et al., 2001). The Draft EIS (released January 2014) congregate all sources of training (surface, subsurface, and air units) when describing purpose, need, and alternatives. The NWTT EIS/OEIS scoping material outlines three alternatives to be evaluated: “No Action Alternative: continue testing and training activities as defined in prior approved documents; Alternative 1: adjustments to types and levels from baseline activities conducted in the NWTT Study Area to support current and planned Navy at-sea training and testing requirements; and Alternative 2: includes all activities in Alternative 1 plus adjustments to the type and level of training and testing activities” (Commander, 2014).

In accordance with the NEPA, the mitigation measures recommended by the Navy will apply to all alternatives analyzed within the NWTT EIS/OEIS. The Navy currently recommends and utilizes many marine mammal mitigation measures when testing and training with sonar within

the NWTT Study Area as well as within other range complexes. These measures include pre-exercise monitoring, increasing trained lookouts where possible, implementing mitigation zones for marine species, and conducting safe navigation.

This evaluation recommends five additional marine mammal mitigation measures likely to be effective in reducing negative impacts to marine mammals: increasing simulated training, decreasing sonar source levels, offshore relocation, implementation of a ramp-up period, and establishing a dedicated passive marine mammal identifier. Some of the recommended measures have previously been assessed by the Navy and eliminated as a viable mitigation action. I argue against the reasoning for eliminating these particular measures and compare the merits of the Navy's current mitigation measures with the additional measures recommended within this evaluation. The public has an opportunity to comment on the NWTT Draft EIS/OEIS through March 25, 2014. The Final EIS is to be released sometime thereafter, however a definitive date has not been set at this time.

## **2. National Environmental Policy Act (NEPA)**

The NEPA requires Federal agencies to make a series of evaluations and decisions that anticipate adverse effects on environmental resources. This requirement must be fulfilled whenever a Federal agency proposes an action, grants a permit, or agrees to fund or otherwise authorize any other entity to undertake an action that could possibly affect environmental resources (Bass et al., 2001).

## **2.1. Environmental Impact Statement (EIS)**

An EIS is a requirement under NEPA for Federal agency actions “significantly affecting the quality of the human environment.” The EIS is a device for decision makers that presents the positive and negative impacts of a proposed action and also evaluates alternatives to the proposed action. The primary purpose of an EIS is to “serve as an action-forcing device to ensure that the policies and goals defined in NEPA are infused into the ongoing programs and actions of the deferral government.” It should be noted that the lead agency is **not** required to choose the least environmentally harmful alternative, but simply to analyze all relevant alternatives.

## **2.2 Alternatives**

The breadth of alternatives is the backbone of the EIS. Providing alternative actions to meeting the Federal agency’s purpose and need allow the agency and the public to identify the least environmentally damaging alternative. An EIS must also consider alternatives to the proposed action that partially meet the agency’s proposed purpose and need and it must evaluate their comparative merits (Bass et al., 2001).

The identification and evaluation of alternative ways of meeting the purpose and need of the proposed action is the heart of the NEPA analysis. The lead agency or agencies must, “objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated” (Bass et al., 2001).

Reasonable alternatives are those that substantially meet the agency’s purpose and need and include those that are practical or feasible from the technical and economic standpoint. The lead agency must analyze the full range of direct, indirect, and cumulative effects of the preferred

alternative, if any, and of the reasonable alternatives identified in the Draft EIS. They include ecological, aesthetic, historic, cultural, economic, social, or health impacts, whether adverse or beneficial (CEQ, 2007).

### **3. Environmental Law Exemptions**

#### **3.1 National Environmental Policy Act (NEPA)**

The NEPA and other environmental laws have not been providing the intended protection to cetaceans and other marine mammals due to military exemptions. The Department of Defense has sought these exemptions in order to “preserve training flexibility and ensure military readiness” (Bearden, 2007). The Authorization Act of 2004 was amended in 2003 in order to allow for military readiness exercises and national defense (Alexander, 2009).

The NEPA does not contain a blanket exemption, but can excuse certain actions from compliance (40 C.F.R. § 1506.11). This is reserved for emergency circumstances and is generally used when there is not enough time to complete the required environmental analysis. The Council on Environmental Quality (CEQ) approves alternative arrangements (Alexander, 2009).

#### **3.2 Marine Mammal Protection Act (MMPA)**

Section 319 of P.L. 108-136 of the Marine Mammal Protection Act (MMPA) provides a “national defense” exemption that allows for “harassment” of otherwise protected marine mammals. This exemption was sought by the U.S. Navy primarily for the use of active sonar for the purpose of military readiness. Amidst concerns of this particular exemption, the House

Armed Services Committee directed the Navy to compare the increase in military readiness with the number and species of marine mammals injured and killed due to the exemption (Bearden, 2007). The exemption is described:

“The Secretary of Defense, after conferring with the Secretary of Commerce, the Secretary of Interior, or both, as appropriate, may exempt any action or category of actions undertaken by the Department of Defense or its components from compliance with any requirement of the Marine Mammal Protection Act, 16 U.S.C. 1361 et seq., if he determines that it is necessary for national defense. Exemptions granted under this section shall be for a period of not more than two years. Additional exemptions for periods not to exceed two years each may be granted for the same action or category of actions upon the Secretary of Defense, after conferring with the Secretary of Commerce, the Secretary of Interior, or both as appropriate, making a new determination.”

Additionally, the MMPA allows, with the granting of a Letter of Authorization (LOA), the incidental “take” of marine mammals by the Navy and other non-fishery activities. A “take” is defined under the MMPA as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” Two categories of “takes” exist: Level A harassment and Level B harassment. Level A harassment “has the potential to injure a marine mammal or marine mammal stock in the wild.” Level B harassment “has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruptions 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” (Public Law

108-136: Sec. 101). A summary of the Navy's expected takes in the NWTT Study Area are listed in Table 6.

### **3.3 Endangered Species Act (ESA)**

The Endangered Species Act of 1973 (ESA) provides protection for species and their habitats that are listed as *endangered* or *threatened*. All Federal agencies, including the Department of the Navy (DoN), must consult with either the Secretary of Commerce or the Secretary of the Interior to ensure that their project or action does not jeopardize a listed species or their habitat. This is referred to as a Section 7 consultation. After assessing best scientific data regarding species of concern the Secretary must issue an *incidental take statement* allowing the agency to take a certain number of species listed. Take is defined under the ESA as “to harass, harm, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 USC §§ 1531 et seq.)

As per the ESA, a Federal agency proposing actions that could potentially affect listed species must apply for and obtain a biological opinion (BiOp). A BiOp is a document, in this case provided by the National Marine Fisheries Service (NMFS), containing the opinion as to whether a “Federal action is likely to jeopardize the continued existence of an ESA-listed species, or result in the destruction or adverse modification of species’ critical habitat (16 USC 1531.7(b)).

The ESA contains several Congress-implemented exemptions, although perhaps the broadest is the Secretary of Defense’s (SECDEF) exemption for national security. There is no apparent limitation to this exemption, however, it has never been used (Alexander, 2009).

#### **4. National Security and Sonar**

The mission of the United States Navy is “[t]o maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas.” (DoN, 2014). In keeping with this mission, the Navy has clearly emphasized the need for increased testing and training of operators, weapon systems, and equipment. The most salient components requiring testing and training are those related to anti-submarine warfare (ASW). ASW has moved to the forefront of national security concerns due to increased threats from nearly silent submarines and possible terrorist attacks from submersibles and underwater mines (Commander, 2014; DoN 2014).

“More than 300 extremely quiet diesel-electric submarines are operated by more than 40 nations worldwide, and these numbers are growing. These quiet, difficult-to-detect submarines, as well as in-water mines and torpedoes, are threats to global commerce, national security and the safety of military personnel. As a result, anti-submarine warfare is a top war-fighting and training priority for the Navy” (Commander, 2014).

The primary technology used to detect, locate, track, and deter such threats is sonar. In the past, both passive and active sonar were employed for this purpose. However, with the construction of nearly silent submarines, the development of highly effective quieting technologies, and increased shipping noise, passive sonar is essentially obsolete, thus active sonar is presently the most relevant ASW tool. Active sonar operators conduct continual training and testing in order to progress with changing threats and maintain combat readiness. It is these sonar training and

testing activities that concern scientists and environmentalist alike in regard to the impacts upon marine mammals.

## **5. Sonar and Impacts to Cetaceans**

Sonar (SOuNd detection And Ranging) is the term given to the propagation of sound (pressure waves) through water. The Navy uses sonar to detect, track, and identify submarines, submerged mines, and surface vessels. Two categories of sonar exist: passive and active. Passive sonar refers to received sounds emitted by sources such submarines, surface vessels, marine organisms, and geophysical processes. Active sonar consists of transmitting sound from a source through water potentially striking a contact and returning to a receiver.

Passive sonar is not damaging to the environment and was once a very useful ASW tool. Again, increased anthropogenic oceanic noise due to shipping and geophysical exploration as well as highly effective submarine quieting technologies has rendered passive sonar obsolete. Therefore, active sonar is currently the U.S. Navy's primary ASW tool.

The Navy utilizes four types of active sonar which are classified by frequency: very high-frequency (VHF), high frequency (HFA), mid-frequency (MFA), and low-frequency (LFA). VHF is sonar used between 100 kHz and 200 kHz and has a very limited range. VHF sonar is generally used for purposes such as bottom floor mapping and it is not thought to be harmful to marine mammals. HFA is operated between 10 kHz and up to 100 kHz and also has a limited range. Like VHF, HFA is useful in mapping the ocean floor, but tends to have a higher resolution, thus it is effective in detecting underwater mines. HFA is not thought to be harmful

to marine mammals. MFA sonar is emitted between 1 kHz and 10 kHz and is the Navy's primary submarine-detecting frequency range. It can travel relatively long distances and is thought to harm marine mammals. LFA sonar is transmitted at frequencies below 1 kHz and is used to detect targets at very long ranges since such low frequencies do not dissipate quickly (DoN, 2014). Many scientists believe LFA sonar is extremely detrimental to marine mammals due to the frequency, amplitude, and range of the sound (Johnson, 2003; Fildalfo et al., 2009). The Navy is proposing the utilization of LFA sonar in the NWTT Study Area during testing activities and is to be used in the Offshore Area. The Navy is pursuing permits to continue or increase VHF, HFA, and MFA sonar use (DoN, 2014).

In addition to emitted frequency of sonar systems, the source level is also of importance. Source level refers to the intensity of the radiated sound at a distance of 1 meter from the source (denoted as dB re 1  $\mu$ Pa at 1 m), where intensity is the amount of sound power transmitted through a unit area in a specified direction (Fox et al., 2013). Source level is given as a relative intensity in units called decibels (dB). Sound behaves very differently in water than in air, thus it is imperative a distinction is made between mediums. Table 1. provides the source level of common underwater sounds in comparative form (DoN, 2014).

**Table 1. Source Levels of Common Underwater Sounds**

Source	Source Level (dB re 1 $\mu$ Pa at 1 m)
Ice breaker ship	193
Large tanker	186
Seismic airgun array	259 (peak)
Dolphin whistles	125-173
Dolphin clicks	194-219
Humpback whale song	144-174
Snapping shrimp	183-189
Sperm whale click	236
Naval mid-frequency active sonar (SQS-53)	235
Naval low-frequency active sonar (SURTASS LFA)	215
Lightning strike	260
Seafloor volcanic eruption	255

Modified from Table G-2 (DoN, 2014).

### **5.1 Impacts to Marine Mammals**

Cetaceans employ sound for almost every aspect of life, but are particularly vulnerable to anthropogenic oceanic noise. Numerous incidents have taken place in which sonar affected the behavior and communication of marine mammals and in some instances stranding and death occurred (Romano et al. 2004, D’Amico et al. 2009, Filadelfo et al. 2009, Tyack et al. 2011). Several studies have found that marine mammals, particularly beaked whales (family Ziphiidae), are susceptible to sonar due to their propensity to dive deep and remain submerged for extended periods of time. Crum and Mao (1996) found beaked whales to be prone to embolisms in the presence of sonar due to two factors. First, when whales conduct deep dives the gasses in their lungs absorb into tissues. Crum and Mao discovered when a sound source as strong as mid-

frequency active sonar strikes a mammal with gas-saturated tissues the sound pressure induces the expansion of the gasses, thus causing hemorrhaging and irreparable tissue damage.

Secondly, it is believed that when marine mammals with gas-saturated tissues hear the sonar signal they cease off-gassing behavior (several short dives after a long dive) and flee the source via the surface, thus suffering from “the bends.”

Sonar is therefore problematic considering a quarter of the world’s whale and dolphin species are beaked whales. It is rare to observe a beaked whale at the surface due to their propensity to remain underwater for extended periods of time (Madin, 2009). Due to the lack of scientific observations, little is known about this class of marine mammals, hence the state of each population is essentially unknown. In addition, their range is the most widespread of any family of cetaceans inhabiting areas near the ice caps to equatorial zones such as the Bahamas (Center for Cetacean Research and Conservation, 2013).

The Navy acknowledges that sonar can have negative impacts to marine mammals but has been reluctant to recognize the extent of harm. However recent studies required in lieu of environmental impact statements conducted for other range complexes have painted a clearer picture of how detrimental sonar can be (Biaassoni et al., 2000; Parsons et al., 2008). Scientists are concerned that the cetaceans found stranded after sonar operations could be just the tip of the iceberg due to harmed animals perishing at sea (Abate, 2010).

“The Navy has agreed that sonar in some situations may cause beaked whales to strand on beaches and die. In current environmental impact statements, the U.S. Navy notes a link between sonar and 37 whale deaths in five stranding events worldwide since 1996. However, given how little information is available, the

problem may well extend beyond these 37 whales. Sonar may have a host of other effects on marine mammals, such as stress, disorientation, hearing loss, and disruption of feeding that may have important impacts but would not be evident in the stranding record” (Madin, 2009).

The NWTT Draft EIS/OEIS divide harm to marine mammals into three classes: behavioral shifts, temporary threshold shifts (TTS), and permanent threshold shifts (PTS). Behavioral shifts constitutes changes in ordinary behavior such a vocalization, feeding, and direction of movement. These changes are not thought to have an unduly negative effect on the individual. A temporary threshold shift refers to a temporary reduction in hearing ability due to exposure to an intense noise for a short period of time (Nachtigall et al., 2003). TTS is defined by the effected individual regaining audible ability possessed prior to the sound event within minutes to hours of the event occurring (DoN, 2014). A permanent threshold shift is a state in which irreversible hearing loss occurs due to intense impulse or continuous sound (Quaranta et al., 1998). Due to a marine mammal’s extensive use of sound within its environment a situation in which a marine mammal suffers from PTT will likely be lethal.

The U.S. Navy currently employs several sonar-related marine mammal mitigation measures such as training lookouts, posting additional lookouts where feasible, conducting marine mammal observation periods prior to active operations, establishing mitigation zones, and conducting safe navigation. This analysis will identify present mitigation measures as well as suggest five additional measure that will decrease the potential harm to marine mammals.

Current and proposed marine mammal mitigation procedures can be found in Section 7.

Recommended additional mitigation measures can be found in Section 8.

## **6. Northwest Testing and Training (NWTT) Study Area**

### **6.1 Purpose and Need**

Due to the anticipation of submerged threats from foreign navies and terrorist groups, the U.S. Navy has proposed increased sonar testing and training within territorial and Federal waters. The proposal is focused on the Northwest Testing and Training (NWTT) Study Area (Figure 1.) and the current EIS/OEIS being conducted according to NEPA requirements (However, the proposal can be applied within other Navy range complexes). The purpose of this complex is to meet the NWTT Study Area's mission to "prepare personnel in the Northwest for deployment and homeland defense by providing realistic training and testing environments" (Commander, 2014; DoN, 2014). It must be noted that in addition to sonar, the Navy is proposing to increase testing and training of air and weapons systems. However, due to the controversial nature of sonar, it is the sole focus of this evaluation.

The Pacific Northwest is an ideal location for military readiness and training activities due to extensive sea and air space (Commander, 2014; DoN, 2014). Moreover, a significant number of naval bases are within or in close proximity to the NWTT Study Area allowing for decreases in fuel consumption, emissions, and sailor's time away from home.

## 6.2 Location and Complexes

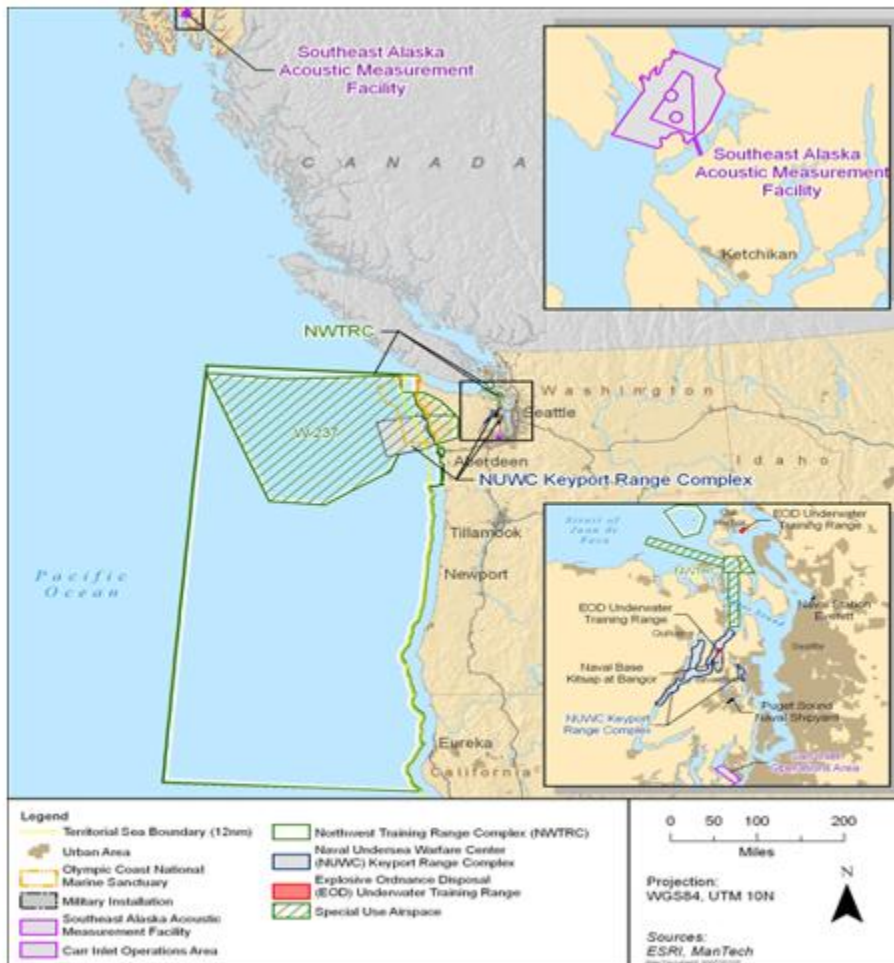


Figure 1. Detailed map of the Northwest Testing and Training Study Area and Range Complex. Source: Commander, 2014.

“The Study Area for the NWTT EIS/OEIS consists of established maritime operating areas and includes activities within four existing range complexes and facilities: (1) the Northwest Training Range Complex, (2) the Naval Undersea Warfare Center Keyport Range Complex, (3) the Carr Inlet Operations Area and (4) the Southeast Alaska Acoustic Measurement Facility. In addition to these range complex areas, the NWTT Study Area includes pier-side locations at Navy bases where sonar maintenance and testing occur, and inland waters where some training or testing could occur that are not part of the range complexes, such as certain areas of the Strait of Juan de

Fuca and waters off the east and west coasts of Whidbey Island that extend outside the boundary of the Northwest Training Range Complex” (Commander, 2014).

“Many of the training and testing activities evaluated in the NWTT EIS/OEIS have been analyzed by the Navy in previous environmental documents (NWRTC LOA 2010, NWTRC USFWS BiOp 2010). The NWTT EIS/OEIS is being prepared to renew Federal regulatory permits and authorizations for current training and testing activities and to propose future activities requiring environmental analysis” (Commander, 2014).

### **6.3 NWTT Study Area Goals and Objectives**

In accordance with the NEPA, the Navy has provided two goals with several objectives in order to meet the purpose and need of the proposed actions within the training complexes.

#### **6.3.1 Goal 1: Execute training and testing in the Pacific Northwest.**

Objective 1: Conduct realistic training and testing to ensure sailors maintain the highest level of readiness and capability.

Activity 1: Conduct classroom and simulation training using computers.

Activity 2: Conduct basic level training, which may consist of individuals, small groups of personnel or a single crew (ship, submarine, or aircraft) training on its own.

Activity 3: Conduct intermediate level training, which involve exercises of strike groups operating together as large forces and may last several weeks. After completing this training, sailors will be well-prepared and may be certified for deployment or other activities depending on the nation’s needs.

Activity 4: Advanced level training, which involve exercises during which a large grouping of forces is provided with a situation, and must plan and respond as if responding to a real crisis.

Objective 2: Test naval systems in order to ensure vessels, aircraft, and systems will meet performance specifications in the real-world environment.

Activity 1: Conduct basic and applied scientific research and technology development.

Activity 2: Evaluate and maintain active and passive sonar systems.

### **6.3.2 Goal 2: Continue marine protective measures.**

Objective 1: Protect marine species during shipboard training at sea.

Activity 1: Navy personnel will conduct pre-exercise monitoring by scanning the area visually and monitor acoustically with passive sonar, as appropriate, to detect the presence of marine species.

Activity 2: Post highly trained lookouts in accordance with the Navy's lookout Training Handbook. All lookouts involved in antisubmarine warfare training events must review Marine Species Awareness Training material, approved by NMFS, prior to using active sonar. At least three lookouts are posted on each ship at all times when it is underway. Additional lookouts are posted before and during training with active hull-mounted sonar.

Activity 3: Establish a safety zone of 1,000 yards during active sonar training. If a marine mammal is detected within this zone the vessel will reduce sonar transmission power. The vessel will further reduce sonar transmission power if a marine mammal is detected within

500 yards. If a marine mammal is detected within 200 yards of the sonar dome, the ship will halt its active sonar transmissions.

Activity 4: While in transit, Navy vessel operators will use extreme caution, operate at a speed consistent with mission and safety, and take proper action if there is a risk of collision with a marine animal.

Activity 5: Navy personnel will report all sightings of marine mammals.

Objective 2: Fund independent research to better understand how marine species live, travel, and respond to human activities in the ocean.

Activity 1: Develop methods to detect and monitor marine species before and during training activities.

Activity 2: Develop tools to model and estimate potential effects of sound.

Given the Navy specifically expresses marine mammal protection as one of two goals leads one to believe that mitigation measures are of extreme importance to the Navy. Unfortunately, the five marine mammal protective activities listed in order to meet this goal are inadequate. This evaluation recommends five additional marine mammal mitigation measures available to the Navy that can be easily implemented and that could be more effective than the current measures. The measures are discussed in detail in Section 8.

#### **6.4 The NWTT EIS Alternatives**

The NEPA requires Federal agencies to evaluate a range of reasonable alternatives to achieve the purpose and need of the proposed action. The NWTT Draft EIS/OEIS contains three alternatives: the required “no action” alternative and two other alternatives that meet the Navy’s

purpose and need. These alternatives, and other reasonable alternatives identified but rejected during the scoping process, are analyzed in the Draft EIS to help determine the appropriate level and type of training and testing activities to meet the Navy's requirements.

The Navy proposes to 1) adjust training and testing activities from current levels to levels needed to support Navy requirements beginning October 2015, and 2) accommodate evolving mission requirements associated with force structure changes, including those resulting from the development, testing, and introduction of new vessels, aircraft, and weapons systems. The following are the alternatives the Navy is currently analyzing as per NEPA and encompass subsurface, surface, and air interests (Commander, 2014).

#### **6.4.1 No Action Alternative**

“Under the ‘No Action Alternative’, the Navy would continue current training and testing activities as defined by existing environmental planning documents, including the Northwest Training Range Complex EIS/OEIS and the Naval Sea Systems Command Naval Undersea Warfare Center Keyport Range Complex Extension EIS/OEIS. The baseline testing activities also include other testing events that historically occur in the NWTTC Study Area and have been subject to previous analysis pursuant to NEPA and Executive Order 12114. Analysis of the No Action Alternative provides a baseline, enabling decision makers to compare the magnitude of the environmental effects of no action (current activities) to the effects of the action alternatives. Baseline activities do not include training with sonar in Puget Sound” (DoN, 2014).

#### **6.4.2 Alternative 1 (Preferred Alternative)**

“Alternative 1 includes adjustments to types and levels from baseline activities conducted in the NWTT Study Area to support current and planned Navy at-sea training and testing requirements. Under Alternative 1, sink exercises would be eliminated” (DoN, 2014).

“Alternative 1 includes (DoN, 2014):

- Testing activities at Navy pierside locations in Puget Sound, the Carr Inlet Operations Area and the Southeast Alaska Acoustic Measurement Facility
- Mission requirements associated with force structure changes, including those resulting from the development, testing and introduction of new vessels, aircraft and weapons systems into the fleet
- Use of new and existing unmanned vehicles and their acoustic sensors, in support of homeland security and anti-terrorism/force protection. This type of training is critical in protecting the nation’s military and civilian harbors, ports and shipping lanes.
- Use of 0.50-caliber blanks in Puget Sound in support of force protection training of the Navy’s Maritime Expeditionary Security Force.
- Addition of a biennial maritime homeland defense mine countermeasure training exercise in Puget Sound and analyzing the amount of time acoustic sensors are used during that event.”

- The Navy is proposing to conduct training and testing activities primarily within existing range complexes, operating areas, testing ranges and select Navy pierside locations in the Pacific Northwest.
- The purpose of the Proposed Action is to conduct training and testing activities to ensure the Navy accomplishes its mission to maintain, train and equip combat-ready military forces.
- The Proposed Action includes pierside sonar testing conducted as part of overhaul, modernization, maintenance and repair activities at Puget Sound Naval Shipyard in Bremerton, Naval Base Kitsap at Bangor and Naval Station Everett.
- The Navy is proposing to conduct testing of high-frequency, low power acoustic sources at Carr Inlet Operations Area.”

### **6.4.3 Alternative 2**

“Alternative 2 includes all activities in Alternative 1 plus adjustments to the type and level of training and testing activities. Under Alternative 2, sink exercises would be eliminated (DoN, 2014).

- An addition of a maritime homeland defense mine countermeasure training exercise in Puget Sound would occur, which may include use of mid- and high-frequency mine hunting sonar systems.
- At the Carr Inlet Operations Area, activities include an assortment of small systems used for unmanned undersea vehicle tracking and navigation, underwater communication, mapping and

location, or sampling of the physical environment. Activities would be conducted for a short duration of a few days at a time, a couple of times a year. No permanent instrumentation would be placed in the water and no land access is needed.”

The current and proposed mitigation measures within the NWTT EIS/OEIS apply to whichever alternative is chosen. It could be argued that a lack of a significant increase in mitigation measures follows the Navy’s stated goal of “*continuing* marine mammal protective measures” versus *increasing* mitigation measures. However, if marine mammal protective measures are a goal one would assume taking further action to protect marine mammals would be ardently undertaken. The Navy has several additional measures at their disposal that will support efforts to decrease harm to the environment (See Section 8.).

## **6.5 Marine Mammals within the NWTT Study Area**

The waters off the West coast of the continental United States and Alaska are considered some of the richest in fauna in the world with hundreds of species residing within or transiting through the zones making up the NWTT Study Area. Many of these species are protected under the ESA and/or the MMPA. The NWTT Draft EIS identify thirty (30) marine mammals that may occur in the range complex with the relative conservation status (Table 2.).

**Table 2. Marine Mammals with Possible or Confirmed Presence within the Northwest Training and Testing Study Area**

Common Name	Scientific Name	Occurrence in Region	ESA/MMPA
<b>Baleen Whales</b>			
Northern Pacific right whale	<i>Eubalaena japonica</i>	Rare	Endangered/Depleted
Humpback whale	<i>Megaptera novaeangliae</i>	Likely Spring-Fall	Endangered/Depleted
Blue whale	<i>Balaenoptera musculus</i>	Likely	Endangered/Depleted
Fin whale	<i>Balaenoptera physalus</i>	Likely	Endangered/Depleted
Sei whale	<i>Balaenoptera borealis</i>	Likely	Endangered/Depleted
Minke whale	<i>Balaenoptera acutorostrata</i>	Likely	
Gray whale	<i>Eschrichtius robustus</i>	Rare-Likely	Endangered/Depleted
<b>Toothed Whales</b>			
Sperm whale	<i>Physeter macrocephalus</i>	Likely	Endangered/Depleted
Pygmy sperm whale	<i>Kogia breviceps</i>	Likely	
Dwarf sperm whale	<i>Kogia sima</i>	Rare	
<b>Dolphins</b>			
Killer whale	<i>Orcinus orca</i>	Likely	Endangered/Depleted
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Rare	
Short-beaked common dolphin	<i>Delphinus delphis</i>	Likely	
Bottlenose dolphin	<i>Tursiops truncatus</i>	Extralimital	
Striped dolphin	<i>Stenella coeruleoalba</i>	Rare	
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	Likely	
Northern right whale dolphin	<i>Lissodelphis borealis</i>	Likely	
Risso's dolphin	<i>Grampus griseus</i>	Likely	
Harbor porpoise	<i>Phocoena</i>	Likely	
Dall's porpoise	<i>Phocoenoides dalli</i>	Likely	
<b>Beaked Whales</b>			
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Likely	
Baird's beaked whale	<i>Berardius bairdii</i>	Likely	
Mesoplodont beaked whales	<i>Mesoplodon spp.</i>	Likely	
<b>Pinnipeds</b>			
Steller sea lion	<i>Eumetopias jubatus</i>	Likely	
California sea lion	<i>Zalophus californianus</i>	Likely	
Northern fur seal	<i>Callorhinus ursinus</i>	Likely	Depleted
Guadalupe fur seal	<i>Arctocephalus townsendi</i>	Extralimital	Threatened/Depleted
Northern elephant seal	<i>Mirounga angustirostris</i>	Extralimital	
Harbor seal	<i>Phoca vitulina</i>	Likely	
<b>Otters</b>			
Northern sea otter	<i>Enhydra lutris kenyoni</i>	Rare	

Modified from Table 3.4-1 (DoN, 2014).

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 sightings or strandings recorded within the Study Area. These species include Bryde’s whale, false killer whale, and long-beaked common dolphin all of which are considered highly vulnerable to active sonar (DoN, 2014).

The NWTT Draft EIS/OEIS proposes a number of activities for testing and training within the range complex over a 5-year period (See Section 6.4). Some of these activities can and are expected to have an impact on marine mammals. Given the scope of this thesis a detailed table of the number of activities anticipated as acoustic stressors is provided in Table 3. with the number of activities expected under each alternative (explosives are included because they are considered sonobuoys, an expendable sonar system).

**Table 3. Acoustic Stressors Applicable to Marine Mammals for Training and Testing Activities**

Components	Number of Components or Activities					
	No Action Alternative		Alternative 1		Alternative 2	
	Training	Testing	Training	Testing	Training	Testing
Sonar and other active sources (hours)	362	2,378	958	9,187	958	10,850
Sonar and other active sources (items)	880	672	916	2,251	916	2,434
Explosives	382	0	544	148	544	164
<b>TOTAL ACOUSTIC STRESSORS</b>	<b>1,624</b>	<b>3,050</b>	<b>2,418</b>	<b>11,586</b>	<b>2,418</b>	<b>13,448</b>

Number of acoustic stressors estimated under each alternative within the NWTT EIS/OEIS. Modified from Table 3.4-3 (DoN, 2014).

Under the Navy’s own estimates, the number of acoustic related activities that could potentially harm marine mammals will increase 3-fold from current operation, or No Action Alternative, to Alternative 1 (preferred alternative). The proposed actions in Alternative 1 are very likely to harm a significant number of marine mammals if the alternative is chosen. Alternative 2 includes a 20% increase in sonar related activities relative to Alternative 1 and has an even higher potential for negative impacts to marine species.

The total number of stressors applicable to marine mammals for each alternative are provided in Table 4. These are all stressors predicted by the Navy in the NWTT Draft EIS/OEIS including acoustic.

**Table 4. Total Stressors Applicable to Marine Mammals for Training and Testing Activities**

	No Action Alternative	Alternative 1	Alternative 2
Acoustic Stressors	10,030	22,595	24,577
Energy Stressors	0	1	1
Physical Disturbance	193,210	203,447	203,978
Entanglement Stressors	8,526	9,758	9,896
Ingestions Stressors	190,743	194,991	195,305
<b>TOTAL ACTIVITIES</b>	<b>402,509</b>	<b>430,792</b>	<b>433,757</b>

Total number of stressors estimated for each category of activities per alternative. (DoN, 2014).

Regardless of the mitigation measures taken to prevent harm to marine mammals, the U.S. Navy recognizes the likelihood of harm due to sonar operations. The Navy thus must obtain LOAs for incidental takes under the MMPA to “take” an extensive number of marine mammals. The NMFS produced a LOA for the take of marine mammals incidental to Navy training and exercises conducted in the Northwest Training Range Complex valid for the period November 12, 2012, through November 9, 2015 (NOAA, 2012). Table 5. lists the marine mammals included in the LOA and the number allotted **per** year (this is a five-year permit). These numbers reflect the combination of both Level A and B harassment. The caveat to Level A harassment is that unless a marine mammal is found stranded it is difficult to determine a Level A harassment.

**Table 5. Annual Training Effects for Sonar and Other Active Acoustic Sources**

Species	Stock	No Action Alternative			Alternative 1			Alternative 2		
		Behavioral	TTS	PTS	Behavioral	TTS	PTS	Behavioral	TTS	PTS
North Pacific right whale	Eastern North Pacific	0	0	0	0	0	0	0	0	0
Humpback whale	CA/OR/WA	2	1	0	7	5	0	7	5	0
	Central North Pacific	0	0	0	0	0	0	0	0	0
Blue whale	Eastern North Pacific	1	0	0	3	2	0	3	2	0
Fin whale	Northeast Pacific	0	0	0	0	0	0	0	0	0
	CA/OR/WA	4	2	0	14	10	0	14	10	0
Sei whale	Eastern North Pacific	0	0	0	0	0	0	0	0	0
Minke whale	Alaska	0	0	0	0	0	0	0	0	0
	CA/OR/WA	3	1	0	9	9	0	9	9	0
Gray whale	Eastern North Pacific	0	0	0	0	6	0	0	6	0
	Western North Pacific	0	0	0	0	0	0	0	0	0
Sperm whale	North Pacific	0	0	0	0	0	0	0	0	0
	CA/OR/WA	26	0	0	80	0	0	80	0	0
Kogia (spp.)	CA/OR/WA	0	2	0	13	56	0	13	56	0
Killer whale	Alaskan Resident	0	0	0	0	0	0	0	0	0
	Northern Resident	0	0	0	0	0	0	0	0	0
	West Coast Transient	0	0	0	5	3	0	5	3	0
	East. N. Pac. Offshore	4	0	0	12	1	0	12	1	0
	Southern Resident	0	0	0	2	0	0	2	0	0
Short-finned pilot whale	CA/OR/WA	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	CA/OR/WA	289	16	0	664	51	0	664	51	0
Bottlenose dolphin	CA/OR/WA	0	0	0	0	0	0	0	0	0
Striped dolphin	CA/OR/WA	6	0	0	0	0	0	0	0	0
Pacific white-sided dolphin	North Pacific	0	0	0	19	2	0	19	2	0
	CA/OR/WA	1,137	75	0	3,176	248	0	3,176	248	0
Northern right whale dolphin	CA/OR/WA	377	23	0	1,212	97	0	1,212	97	0
Risso's dolphin	CA/OR/WA	220	9	0	613	33	0	613	33	0
Harbor porpoise	Southeast Alaska	0	0	0	0	0	0	0	0	0
	Northern OR/WA Coast	7,442	0	0	2,139	8	0	2,139	8	0
	N. CA/S. OR	11,163	0	0	3,209	12	0	3,209	12	0
	WA Inland Waters	0	0	0	571	841	1	571	841	1
Dall's porpoise	Alaska	0	0	0	0	0	0	0	0	0
	CA/OR/WA	125	884	0	758	2,714	2	758	2,714	2
Cuvier's beaked whale	Alaska	0	0	0	0	0	0	0	0	0
	CA/OR/WA	69	0	0	311	0	0	311	0	0
Baird's beaked whale	Alaska	0	0	0	0	0	0	0	0	0
	CA/OR/WA	135	0	0	522	0	0	522	0	0
Mesoplodon beaked whales	CA/OR/WA	279	0	0	1,245	2	0	1,245	2	0
Steller sea lion	Eastern U.S.	118	0	0	398	0	0	398	0	0
Guadalupe fur seal	Mexico	11	0	0	37	0	0	37	0	0
California sea lion	U.S.	228	0	0	796	7	0	796	7	0
Northern fur seal	Eastern Pacific	787	0	0	2,452	1	0	2,452	1	0
	California	11	0	0	37	0	0	37	0	0
Northern elephant seal	California Breeding	335	55	0	990	250	0	990	250	0
Harbor seal	SE Alaska-Clarence St.	0	0	0	0	0	0	0	0	0
	OR/WA Coastal	0	0	0	0	0	0	0	0	0
	WA Inland Waters	0	0	0	174	373	4	174	373	4
Northern sea otter	SE Alaska	0	0	0	0	0	0	0	0	0
	Washington	0	0	0	0	0	0	0	0	0

CA=California, N=North, Pac=Pacific, PTS=Permanent Threshold Shift, S=South, SE=Southeast, St<sub>t</sub>=Straight, TTS=Temporary Threshold Shift, OR=Oregon, WA=Washington. Source: Table 3.4-17 (DoN, 2014).

The number of marine mammal takes allowed by NMFS within the NWT Study Area is extensive. It is even further compounded when the allotted takes are multiplied over a five-year

period (the term of the LOA). Table 6. provides the total number of takes, level A and B harassment combined, allowed for each alternative over five years. As per the LOA, the Navy is allowed 10% over the allotted marine mammal takes each year (NOAA, 2012).

**Table 6. Total Number of Training Effects for Acoustic Sources over a 5-Year Period**

	No Action Alternative	Alternative 1	Alternative 2
Behavioral	113,860	97,340	19,468
TTS	5,340	23,655	23,655
PTS	0	35	35
<b>TOTAL POTENTIAL AFFECTED MARINE MAMMALS</b>	<b>119,200</b>	<b>121,030</b>	<b>121,030</b>

PTS=Permanent Threshold Shifts, TTS=Temporary Threshold Shifts. Number of total takes allowed under the MMPA within the NWT Study Area. Modified from Table 3.4-17 (DoN, 2014).

## **7. Marine Mammal Mitigation Activities (Current and Proposed)**

The Navy currently employs several marine mammal mitigation measures with regard to sonar training and testing. Although exempt from the MMPA and ESA, the Navy must comply with the “Mid-Frequency Active Sonar (MFAS) Mitigation Measures during Major Training Exercises or within Established DoD Maritime Ranges and Established Operating Areas” when employing mid-frequency sonar during training (England, 2007). The required actions include pre-exercise monitoring, posting trained lookouts, establishing mitigation zones for marine species, and conducting safe navigation (DoN, 2014).

## 7.1 Pre-Exercise Monitoring

Monitoring consists of passive sonar detection of marine mammal vocalizations as well as visual detection at the ocean surface. Lookouts are required to scan the area for marine species prior to commencement of sonar activities. Helicopters deploying dipping sonar during training exercises must observe/survey the area ten (10) minutes prior to commencing ASW activities (DoN, 2014).

As described in Section 5.1, the most vulnerable of marine mammals, beaked whales, are rarely observed at the surface due to the extensive amount of time they spend diving. Thus, visual monitoring is helpful but may not be a highly effective mitigation measure. Nonetheless, pre-exercise monitoring should continue to be included in marine species mitigation measures.

## 7.2 Posting Trained Lookouts

The Navy currently operates with lookouts that observe the air and water for biological resources as well as conduct other duties such as training personnel and watching for navigational hazards. Navy sailors must qualify as a lookout in accordance with the Navy's Lookout Training Handbook. Additionally, all lookouts involved in antisubmarine warfare training events must complete Marine Species Awareness Training, approved by NMFS, prior to using active sonar or standing watch. A minimum of one lookout is posted on each vessel at all times when underway. Additional lookouts are posted before and during training with active sonar. If marine mammals are detected acoustically lookouts will increase visual detection efforts. The Navy does not currently have mitigation measures for high-frequency or non-hull mounted mid-frequency sonar *testing* activities in the NWT Study Area, so they are proposing the addition of one lookout on ships or aircraft conducting such activities. When *training* with low-frequency

and hull-mounted mid-frequency active sonar the Navy proposes to use lookouts for visual observation from a ship immediately before and during the activity (DoN, 2014).

The Navy acknowledges that each lookout has primary duties and the activity of observing marine species is in addition to these duties. However, given the rarity of observing cetaceans at the surface, posting trained lookouts whose primary duties do not include searching for marine species, one can assume this mitigation measure is an inefficient mitigation measure.

Furthermore, observations can only be made during daylight hours, thus, limiting the total effectiveness of trained lookouts. It must be noted that lookouts increase the likelihood of detecting marine mammals. Lookouts should continue to be employed on surface vessels and aircraft as a viable mitigation measure.

### **7.3 Establishing Mitigation Zones for Marine Species**

A mitigation zone is an area designed for the purpose of reducing potential impacts on marine mammals during testing and training activities. The Navy is currently researching effective ranges for mitigation zones based on temporary and permanent threshold shift parameters for some of the most acoustically sensitive cetaceans. This will create a baseline range assumed to protect the majority of marine mammals that are not as vulnerable to sonar and sonobouys.

Table 7. summarizes the recommended mitigation zones for each acoustic source (DoN, 2014).

Mitigation zones for low-frequency and hull-mounted mid-frequency *training* activities involve “powering down the sonar by 6 dB when a marine mammal is sighted within 1,000 yd. (920 m) of the sonar dome, and by an additional 4 dB when sighted within 500 yd. (460 m) from the source, for a total reduction of 10 dB. Active transmissions will cease if a marine mammal is sighted within 200 yd. (180 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 minutes, (4) the ship has transited more than 2,000 yd. (1.8 kilometers [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" (DoN, 2014).

The Navy is proposing to add mitigation measures for *testing* of low frequency and hull-mounted sonar systems. "If a cetacean is sighted within 1,000 yd. (920 m) of the sound source, active transmissions will cease. 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 minutes, or (4) the sound source has transited more than 2,000 yd. (1.8 km) beyond the location of the last sighting" (DoN, 2014).

While transiting "the Navy is proposing to continue to use the 500 yd. (460 m) mitigation zone currently established for whales, and to implement a 200 yd. (180 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. (460 m) around observed whales and 200 yd. (180 m) around all other marine mammals (except bow-riding dolphins)" (DoN, 2014).

**Table 7. Predicted Range of Acoustic Effects and Recommended Mitigation Zones**

Activity Category	Representative Source (Bin) <sup>1</sup>	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
<b>Sonar and Other Active Acoustic Sources</b>					
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar	SQS-53 ASW hull-mounted sonar (MF1)	4,251 yd. (3,887 m)	281 yd. (257 m)	< 292 yd. (< 267 m)	<u>Training:</u> 1,000 yd. (920 m) and 500 yd. (460 m) power downs and 200 yd. (180 m) shutdown for cetaceans and sea turtles, 100 yd. (90 m) mitigation zone for pinnipeds <u>Testing:</u> 1,000 yd. (920 m) for cetaceans, 100 yd. (90 m) for pinnipeds
High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar <sup>2</sup>	AQS-22 ASW dipping sonar (MF4)	226 yd. (207 m)	< 55 yd. (< 50 m)	< 55 yd. (< 50 m)	<u>Training:</u> 200 yd. (180 m) <u>Testing:</u> 200 yd. (180 m) for cetaceans, 100 yd. (90 m) for pinnipeds
<b>Explosive and Impulse Sound</b>					
Improved Extended Echo Ranging Sonobuoys	Explosive sonobuoy (E4)	237 yd. (217 m)	133 yd. (122 m)	235 yd. (215 m)	<u>Training:</u> 600 yd. (550 m) <u>Testing:</u> 600 yd. (550 m)
Signal Underwater Sound (SUS) buoys using 0.6–2.5 lb. NEW	Explosive sonobuoy (E3)	178 yd. (163 m)	92 yd. (84 m)	214 yd. (196 m)	<u>Training:</u> 350 yd. (320 m) <u>Testing:</u> 350 yd. (320 m)

PTS=Permanent Threshold Shift, TTS=Temporary Threshold Shift. Source: Table 5.3-2 (DoN, 2014).

The Navy predicts that the maximum range of PTS (Permanent Threshold Shift) for low-frequency and hull-mounted mid-frequency active sonar sources is approximately 292 yards (267 meters) for one transmission, thus the Navy believes a 200 yard shut down threshold will greatly reduce permanent hearing loss to marine mammals in relatively close vicinities (DoN, 2014). This estimate may be accurate, however as the Navy acknowledges, more research needs to be conducted. While establishing these mitigations zones is a practical measure to reduce negative impacts to marine mammals, perhaps increasing the range and/or shutting down sonar operations with the initial detection of a marine mammal would further protect them. Table 8. summarizes the proposed and current lookout and mitigation zone measures described.

**Table 8. Summary of Recommended and Current Lookout and Mitigation Zone Measures**

Activity Category or Mitigation Area	Proposed Lookout Procedural Measures	Proposed Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Marine Species Awareness Training	<u>Training:</u> Applicable personnel will complete the United States Navy Marine Species Awareness Training prior to standing watch or serving as lookout. <u>Testing:</u> Same as training	<u>Training:</u> The mitigation zones observed by lookouts are specified for each Mitigation Zone Procedural Measure below. <u>Testing:</u> Same as training	<u>Training:</u> Applicable personnel will complete the United States Navy Marine Species Awareness Training prior to standing watch or serving as a lookout. <u>Testing:</u> Same as training
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare and Mine Warfare	<u>Training:</u> 2 lookouts (general), 1 lookout (minimally manned, moored, or anchored) <u>Testing:</u> 2 lookouts (general), 1 lookout (small boats, minimally manned, moored, anchored, pierside, or shore-based)	<u>Training:</u> 1,000 yd. and 500 yd. power downs and 200 yd. shut down for cetaceans and sea turtles (excluding bow-riding dolphins) <u>Testing:</u> Cetacean mitigation zone 1,000 yd.	<u>Training:</u> 1,000 yd. and 500 yd. power downs and 200 yd. shutdown for marine mammals and sea turtles <u>Testing:</u> Observation conducted from all participating surface craft and, where available, adjacent shore sites, with a cetacean mitigation zone 1,000 yd.
High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar	<u>Training:</u> 2 lookouts (general), 1 lookout (minimally manned, moored, or anchored) <u>Testing:</u> 2 lookouts (general), 1 lookout (minimally manned, moored, anchored, and aircraft systems testing)	<u>Training:</u> 200 yd. for marine mammals and concentrations of floating vegetation <u>Testing:</u> 200 yd. for marine mammals and from intended track of the test unit	<u>Training:</u> Non-hull-mounted mid-frequency: 200 yd. for marine mammals, floating vegetation and kelp paddies. High-frequency: None Sonobuoy <u>Testing:</u> None <u>All Other Testing:</u> Observation conducted from all participating surface craft and, where available, adjacent shore sites, with a cetacean mitigation zone 1,000 yd from intended track of the test unit
Improved Extended Echo Ranging Sonobuoys	<u>Training:</u> 1 lookout <u>Testing:</u> 1 lookout	<u>Training:</u> 600 yd. for marine mammals, sea turtles, and concentrations of vegetation <u>Testing:</u> Same as training	<u>Training:</u> 1,000 yd. for marine mammals and sea turtles <u>Testing:</u> Same as training

Modified from Table 5.4-1 (DoN, 2014).

## 7.4 Conducting Safe Navigation

Ship strike is a significant threat to marine mammals world-wide and have increased with the development of large, high-speed vessels (Laist, 2001). The Navy is acutely aware of this issue and has implemented mitigation measures to avoid collisions between vessels and cetaceans.

While in transit, Navy vessel operators are watchful for objects in their path, use caution, operate

at a speed consistent with mission and safety, and take proper action if there is a risk of collision with a marine animal (DoN, 2014).

During *training* exercises “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.” In addition, “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.” Navy vessels and aircraft shall not approach within 100 yd. (90m) of marine mammals but shall ensure the safety of the craft and personnel onboard (DoN, 2014).

The described navigational mitigation measures are adequate and appear to be as effective as possible in preventing ship strikes. No further recommendation with regard to navigation is necessary.

The Navy's current and proposed marine mammal mitigation measures with regard to testing and training in the NWTT Study Area can be effective in reducing harm to marine species. However, numerous additional measures exist that can supplement and increase the efficacy of mitigating harm. The Navy has previously analyzed some of the measures recommended within this thesis

and have determined them to be either ineffective or contrary to stated missions or goals. The mitigation measures are reintroduced and the validity of the Navy's previous determinations are argued.

## **8. Recommended Marine Mammal Mitigation Measures**

The marine mammal mitigation measures recommended to the Navy for consideration are not limited to the NWT Study Area but may be utilized across range complexes such as the Hawaii-Southern California range complex. Additionally, the measures are not mutually exclusive, thus, more than one can be employed simultaneously to meet the Navy's goal: to continue marine mammal protective measures. Each recommended mitigation measure will be discussed in as much detail as possible in order to convey the necessity and adoptability of such actions.

### **8.1 Increase Simulated Training**

Simulated training is the ability to reproduce realistic environments and situations for the purpose of training generally with an emphasis on reducing harm to humans or the environment. Simulated training is an invaluable tool not only for the Navy, but for all branches of the military. In many cases it is the only option to train soldiers for situations such as combat and flight hazards. In the case of sonar, simulating training decreases the harm to marine mammals by eliminating actual sonar transmissions in the water. Virtual training is inexpensive, practical, and safe. "The Navy has increased its emphasis on and use of synthetic training over the last decade" (GAO, 2012).

The Navy has strict guidelines concerning training of sonar operators and testing of sonar systems and equipment. U.S. Navy sailors “participate in four levels of training, from learning basic skills to participating in joint (multi-service) exercises. Training levels include (Commander, 2014):

- Classroom and simulation training, usually using computers.
- Basic level training, which may consist of individuals, small groups of personnel or a single crew (ship, submarine or aircraft) training on its own.
- Intermediate level training, which involve exercises of strike groups operating together as large forces and may last several weeks. After completing this training, Sailors are well-prepared and may be certified for deployment or other activities depending on the nation’s needs.
- Advanced level training, which involve exercises during which a large grouping of forces is provided with a situation, and must plan and respond as if responding to a real crisis.”

Guiding principles have been established by the Navy in order to determine the proper combination of real-time and simulated military training. The first guiding principle is to devise an efficient balance of live and synthetic approaches. This is accomplished through replacing live training with simulators to the maximum extent possible where effectiveness and operational readiness are not compromised. A government briefing for the Senate and House Armed Services Committee states

“[i]f a skill or talent *can be* developed or refined, or if a proficiency *can be* effectively and efficiently maintained in a simulator, then these skills/talents/proficiencies *should be* developed/ refined/ maintained in a

simulator. If a qualification or certification can realistically and economically be accomplished in a simulator, do it in a simulator” (GAO, 2012).

(Complete list of guiding principles found in Appendix A)

The U.S. Navy currently uses in-situ and simulated training in order to prepare sonar operators for real-time situations. Simulated training can be conducted onshore, pierside, or at sea by “playing back” previously recorded active transmissions. These recordings can be inserted into the sonar consoles where they replay on the screen. The tools available to sonar operators during real-time training are also accessible when in play-back mode. Essentially, the contrast between simulated operations and real-time operations while aboard ship are the ship’s actual coordinates will deviate from that of the played back transmissions and, most importantly, the elimination of active sonar transmission in the water. The Navy has an abundance of recordings of which many contain contacts that are properly suited for training. Given that the archived recordings can be played back aboard ship and at sea, sonar operators are capable of training in an authentic environment without transmitting sound.

The sonar systems must at times be tested to ensure proper performance. Within the current EIS, the Navy is proposing to occasionally conduct high- and mid-frequency sonar testing pierside. This is problematic due to the possibility of reverberation within the Puget Sound basin and the high density of marine mammals in the area. In addition, testing sonar systems pierside in the Puget Sound does not correspond with the Navy’s second goal within the NWT Study Area; to continue marine protective measures. The Navy claims pierside testing is convenient and fiscally beneficial due to the lack of need to transit offshore. Nonetheless, the Navy could defer

sonar system testing to large-scale recurrent annual exercises (RIMPAC, Panamax, etc.), a likely time to test not only systems, but operator proficiency. By reserving testing and training with active sonar for annual exercises, the Navy can properly evaluate the proficiency of systems and sailors while reducing overall active transmissions, thus decreasing the risk of harm to marine mammals. Furthermore, the potential for harm would be localized both on a spatial and temporal scale. In other words, if sonar testing and training were to be reserved for annual exercises, the total use of sonar would decrease and actual sonar transmissions would be congregated in one area at specific times, thus limiting the total number of marine mammals potentially affected. Consequently, by choosing this mitigation measure, the Navy would reach both goals set within the NWT: execute training and testing in the Pacific Northwest, and continue marine protective measures.

The Navy stands firm concerning the need for real-time training. According to the NWT EIS/OEIS scoping materials, sonar proficiency requires constant training in realistic conditions at sea. The Navy claims sailors are at risk of harm in real combat situations in the absence of realistic training. Furthermore, the Navy states it is unlawful to train primarily with simulators (DoN, 2014).

“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 and testing fails to meet the purpose of and need for the Proposed Action and therefore was eliminated from consideration as a mitigation measure.”

While these statements may be accurate, it can be argued that a *decrease* (not complete elimination) of active sonar transmissions while training and testing could adequately meet the Navy's purpose and need "to maintain, train, and equip combat-ready naval forces." As discussed, training sonar operators at-sea with the sonar systems in play-back mode creates an extremely realistic environment while actual sonar transmissions are ceased. However, In order to test both the sonar systems and operators, in-situ sonar operations can be reserved for recurring annual exercises. This mitigation measure will reduce the total number of active sonar pings while aggregating the majority of sonar transmissions in one area over a specific time period, thus effectively reducing the number of marine mammals exposed to sonar.

## **8.2 Decrease Sonar Source Level**

The frequency range of mid-frequency and low-frequency active sonar is detrimental to marine mammals, but the source level (measured in decibels) has an even greater affect. The US Navy's current proposal within the NWT Study Area includes the use of mid-frequency active sonar emitted within a range of 170 to 195 dB (DoN, 2014). The current Letter of Authorization (LOA) provided by NOAA for active sonar use within the NWT Study Area states "[the] Navy shall operate active sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives" (NOAA, 2012). Furthermore, the LOA also provides guidelines for decreasing dB level when a marine mammal is detected. Thus, the ability to operate sonar at lower dB levels is potentially a viable mitigation measure.

By lowering the decibel level of active sonar transmissions the detection range for contacts is reduced. Consequently, the potential harm to marine mammals is significantly decreased while the ability to train in a real-time environment is maintained. While this may constitute a semi-unrealistic situation, sonar training with decreased source levels will likely meet the Navy's readiness standards and goals within the NWT Study Area while limiting the potential harm to cetaceans. As stated in the "increase simulated training" mitigation measure (Section 8.1), the use of optimal active sonar transmissions can be reserved for annual exercises where overall competence of systems and operators can be tested.

The recognized disadvantage of this alternative is the limited range available for detection of contacts. By decreasing the decibel level the range of the sonar transmission is greatly reduced, thus, depending on the dB level decrease, the effectiveness of operators to detect a submerged contact is decreased.

The U.S. Navy has previously considered lowering sonar source levels as a viable mitigation measure, but determined such an action would be perilous (DoN, 2014).

"Reducing active sonar source levels....during training and testing 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 always 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... 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."

It can be argued that reducing sonar source levels would not reduce the sonar operator's ability to utilize the full range of system capabilities. Sonar operators closely analyze environmental conditions that effect sound propagation in water such as temperature, salinity, depth, currents, bottom topography, etc. Operators are able to identify sound propagation paths of different sonar

source levels within the same environmental conditions. In other words, even if the source level was reduced, it would not affect the operator's ability to determine the sonar effective range or likely areas of contact detection because the operator is capable of making these determinations with any dB level. Furthermore, as stated in the "increase simulated training" mitigation measure, testing and training with the full range of system capabilities could be reserved for recurring annual exercises. Annual exercises, many of which are multi-national and strike group exercises, are considered the final stage of training (Commander, 2014). It is at this point the opportunity to use optimal source levels for increased contact detection should and can be used.

This recommended mitigation measure to decrease the source level while training (except during annual exercises) with active sonar adheres to the Navy's stated purpose and need to maintain and train combat ready forces. Decreasing the decibel level while training provides a realistic environment for sonar operators and allows for detection of contacts, although with a decreased range. This measure also meets the Navy's goals to execute testing and training in the Pacific Northwest and continue, if not enhance, marine protective measures.

### **8.3 Offshore Relocation**

The majority of marine fauna reside or transit in littoral waters (EPA, 2011). At over 126,000 square nautical miles, the NWTT Study Area encompasses the Olympic Coast National Marine Sanctuary, a segment of the Grey Whale migration route, and habitat for numerous marine mammals including threatened and endangered Northern Right Whales, Grey whales, Stellar sea lions, and Southern Resident Orcas all of which are potentially vulnerable to sonar.

These biologically significant waters are not the ideal location for increased sonar testing and training. Relocating training and testing missions further offshore could significantly mitigate the effects of sonar on marine mammals. An analysis of the most beneficial distance from shore would be required in order to identify distances likely to reduce interactions with marine mammals while maintaining a realistic environment to train for potential submerged threats. Note, this is not a recommendation to displace testing and training activities to other range complexes, but to simply adjust the boundaries of the NWTT Study Area so that such operations do not take place in close proximity to coastal zones.

An obstacle to the success of this mitigation measure is the potential cost increase due to fuel consumption. Washington State has the highest concentration of naval bases and fleet assets of which many are expected to be utilized in the proposed actions within the NWTT area (Commander, 2014). Therefore, increasing the distance of the NWTT Study Area boundaries away from the littoral zone to an offshore location still within the EEZ would require the fleet to transit further resulting in increased fuel costs and emissions.

To mitigate fuel expenses and emissions, the number of training missions could be decreased while the length of each mission, or on-station time, could expand. This training scheme would maintain an equivalent amount of training hours. National security would be maintained while system shut downs due to marine mammal proximity would decrease improving efficiency of training missions.

#### **8.4 Implementation of a Ramp-Up Period**

A ramp-up period refers to a gradual increase in sonar source level until the optimum source level is reached (von Benda-Beckmann et al., 2013; Tyack et al., 2011). Currently the Navy

conducts initial and concurrent sonar transmissions at the optimum decibel level. This does not allow marine mammals to evade the area of active transmissions and may significantly harm animals in relatively close proximity to the sonar source. Implementing a ramp-up period was once accepted by the Navy as a viable mitigation measure, but it has been eliminated in the current NWTT EIS. The Navy claims the use of a ramp-up sequence has not demonstrated avoidance behavior or a decrease in negative impacts to marine mammals (DoN, 2014).

“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.”

“Although ramp-up procedures have been used for some testing activities, effectiveness at avoiding or reducing impacts on marine mammals has not been demonstrated. Until evidence suggests that ramp-up procedures are an effective means of avoiding or reducing potential impacts on marine mammals, the Navy is proposing to eliminate the implementation of this measure for testing activities as part of the Proposed Action.”

The basis of anti-submarine warfare is silence and stealth. It is undeniable that producing any kind of moderate sound source, let alone a sonar transmission, will give away the sonar vessel's position. However, when discussing these mitigation measures as well as the proposed actions of this EIS/OEIS the focus is training and testing, not actual combat situations. For the purpose of testing and training, a ramp-up period seems rational. By implementing such a measure, training of sonar operators will not be significantly affected but only marginally postponed while the sonar system reaches the optimum source level. Conducting a ramp-up period could potentially last just minutes. In a non-combat situation like testing and training, giving away the vessel's position is not a concern and is thus, not a valid justification for eliminating the mitigation measure.

Lastly, the Navy claims the effectiveness of a ramp-up period to divert marine mammals away from sonar sources has not been demonstrated, however, studies have shown this mitigation measure to be efficient. In a study funded by the U.S. Navy, scientists found avoidance thresholds among marine mammals differed by species where certain animals had a lower threshold to mid-frequency sonar (von Benda-Beckmann et al., 2013). Moreover, the study determined that ramp-up periods were effective when the maximum source level exceeded 150 dB (mid-frequency sonar is operated at approximately 235 dB). Finally, short ramp-up periods just minutes in duration were effective in reducing the number of cetaceans experiencing temporary or permanent threshold shifts. Factors determined to limit the effectiveness of a ramp-up period were high source levels, rapid moving sonar sources, and long silences between consecutive sonar transmissions.

An initial ramp-up period of only a few minutes for sustained sonar transmissions would likely not diminish training effectiveness or a sonar operator's ability to detect submerged contacts nor

would a ramp-up period cause significant risk to naval vessels due to the potential to reveal the ship's position. The justification that the effectiveness of a ramp-up period has yet to be determined is inaccurate. This mitigation measure is conducive to meeting the Navy's goals with little compromise on the part of the Navy. It is recommended the Navy reinstate this measure for not only testing activities but training activities as well.

### **8.5 Establish a Dedicated Passive Marine Mammal Identifier**

The Navy employs visual lookouts during daylight hours and passive acoustic lookouts prior to sonar operations in order to detect marine mammals in the vicinity. However, given the extended period of time some marine mammals spend completely submerged, such as highly vulnerable beaked whales, the likelihood of visually detecting particular marine mammals are low. An effective tool to detect marine mammals at all times (assuming vocalizations are occurring) is vocal identification using passive sonar.

Presently the US Navy lacks a dedicated passive sonar marine mammal identifier whose primary duties are to detect, track, and report marine mammals prior to and during sonar operations. The tasks associated with such a position would include expert knowledge of marine mammals likely to be encountered in the region, ability to acoustically detect marine mammal vocalizations, and authority to halt active transmissions when a marine mammal is detected. The need to employ additional personnel for such a position is unnecessary if a "marine mammal watch" was implemented among sonar operators. Sonar operators could stand this specific watch either prior to or following standard sonar watches, thus not incurring any additional costs to the Navy.

This is an additional mitigation activity that is easy to implement, inexpensive, and has the potential to be highly effective given proper training and ideal environmental conditions. This measure adheres to the Navy's stated goals within the NWTT Study Area.

## **9. Discussion**

The U.S. Navy is currently proposing to make adjustments to levels and types of testing and training within the NWTT Study Area (Figure 1.). In doing so, the Navy is required by the NEPA to complete an EIS with the intention of identifying any positive or negative impacts to the human environment due to the proposed action. Required within the EIS are alternatives to the proposed action so the lead agency, the U.S. Navy, can determine the best course of action to meet the stated purpose and need. Three alternatives to meet the purpose and need of the range complex are provided: the No Action alternative (current military readiness activities), Alternative 1 (adjustments to the baseline and additional weapons, platforms, and systems), and Alternative 2 (includes Alternative 1 plus increased tempo of training and testing activities) (descriptions of alternatives found in Section 6.4). In these alternatives, the Navy is proposing to maintain or increase the use of active sonar (high-, mid-, and low-frequency) within the boundaries of the NWTT Study Area.

Active sonar has been linked to negative impacts to marine mammals such as behavioral changes, hearing loss, hemorrhaging, stranding and death. It is estimated about thirty marine mammals are expected to be found within the NWTT Study Area, thus can potentially be affected by sonar testing and training. All of these species are protected under the MMPA and several are listed under the ESA. However, exemptions exist for each law for the purpose of

national security. The Navy must be granted permits under each law, a LOA and BiOp respectively, in order to conduct proposed actions within the NWT Study Area.

The Navy acknowledges the potential effects active sonar may pose to marine species and has dedicated a significant amount of funding for research in the field of impacts and useful measures to mitigate such impacts. The Navy currently employs or is proposing to utilize four major mitigation measures: pre-exercise monitoring, posting trained lookouts, establishing mitigation zones, and conducting safe navigation (descriptions found in Section 7.). Each measure suitably meets the Navy's second goal within the NWT Study Area "to continue marine mammal protective measures", however the efficacy of some may be minimal. For example, the use of visual lookouts are only viable during daylight hours. In addition, the duties conducted by lookouts are only secondary to their primary duties which may be training, navigating, etc. These primary duties diminish attention from detecting and identifying marine species. Lastly, beaked whales, the most vulnerable of marine species to sonar, are extremely difficult to detect due to their propensity to dive deep and remained submerged for long periods of time. For these three reasons, posting lookouts is not especially effective in mitigating harm to marine species. While these measures have the potential to sufficiently protect marine mammals, several additional mitigation measures exist that can provide further safeguards. Five additional mitigation measures were identified and described that meet the Navy's goals to conduct testing and training in the Pacific Northwest and continue marine mammal protective measures (descriptions found in Section 8.).

The first recommended mitigation measure, and perhaps the most effective, is to increase simulated training. In essence, training levels would remain the same while actual active sonar transmissions would decrease. This would be accomplished through conducting training on

shore or ship-based sonar consoles where recorded sonar transmissions and contacts can be “played back” in a genuine environment. The major differences between live training and simulated training is the lack of an actual sonar transmission, thus eliminating sound in the water, and an inability to determine actual ship’s coordinates, course, and speed via the sonar console. While these discrepancies alter a portion of sonar operator training, the significance of affect is minor. The financial cost to the Navy is either maintained or decreased relative to current operations due to the lack of need to transit out to sea for training purposes.

The mitigation measure to decrease sonar source levels while testing and training with mid- and low-frequency active sonar will limit the range of submarine detectability, but lessen the area of affect to marine species. By decreasing the decibel level of the sonar transmission operators are still able to detect contacts although within a restricted space around the ship. While this is not ideal in a combat situation, with regard to training and mitigation purposes this mitigation measure will suffice. There is likely no increased cost to the Navy if this measure was implemented.

Relocating the NWTT Study Area further offshore is a mitigation measure the Navy currently contests. The recommendation is for the Navy to relocate testing and training activities further out to sea away from littoral zones that tend to support large aggregates of marine species. The Navy argues that this will increase fuel costs and sailors’ time away from home. However, if ships were required to travel further offshore to conduct testing and training the on-station time could also increase. Essentially, instead of conducting several short testing and training activities close to littoral zones, the Navy could execute fewer, but lengthier exercises further offshore. By adopting this mitigation measure the Navy would not incur any additional costs

with regard to fuel or sailors' morale while limiting the number of marine mammals exposed to active sonar.

The implementation of a ramp-up period has been the subject of several studies due to potentially high efficacy with low compromise on the part of the Navy. The theory is that when the sonar source is initiated at a low decibel level and then incrementally increased until the optimal source level is achieved it provides marine mammals an opportunity to move away from the source and avoid detrimental exposure to sonar. The Navy once incorporated this mitigation measure while testing sonar systems, but have since eliminated it due to a lack of evidence providing its effectiveness. However, a Navy-funded study found that a short duration ramp-up period was actually effective in promoting an avoidance response in certain species of marine mammals (von Benda-Beckmann et al., 2013). This mitigation measure is unlikely to affect combat readiness or incur extra costs to the Navy. With the effective period only lasting minutes the compromise on behalf of the Navy is negligible.

Lastly, appointing a dedicated passive marine mammal identifier to each vessel utilizing sonar has the potential to be a viable mitigation measure. Each active sonar vessel employs passive sonar while transmitting active sonar. This would allow the employment of highly-trained, dedicated personnel to identify marine mammals in the vicinity (given the animals were vocalizing). Contrary to visual lookouts, passive sonar lookouts would conduct surveillance as a primary duty, thus increasing attention to detecting and identifying marine mammals. Again, this measure would not require extra funding by the Navy if current sonar operators adopted a rotating watch where each operator stood watch as a passive marine mammal identifier while conducting active operations.

These recommended mitigation measures are provided as additional measures to the Navy's current and proposed measures discussed above. They are not mutually exclusive thus one or all measures could be adopted depending on how intentional the Navy is in meeting their goal to continue marine mammal protective measures. With each mitigation measure endorsed the likelihood of harm to marine species lessens. Akin to the Navy's current and proposed measures, the recommended measures should apply to all three alternatives described in the NWTT EIS/OEIS.

Most importantly, these recommended measure can be applied across **all** range complexes both domestic and foreign. As discussed, the mitigation measures recommended here within are of minimal or no cost to the Navy and are to be utilized only during testing and training exercises, not during mission deployments or conflicts at sea. The Navy should analyze the effectiveness of each measure keeping in the mind the counter-arguments provided within this thesis.

The public comment period for the NWTT EIS/OEIS closes March 25, 2014. The final draft will be released sometime thereafter. However, given the ability to apply these measures to other range complexes, the public and Navy have an opportunity to consider these additional mitigation measures in future environmental impact statements involving sonar.

Protecting our marine resources is vital to maintaining a healthy ecosystem, economy, and community. A balance must be struck between the environment and national security. But is not our environment part of our national security? Perhaps then, the issue should be framed as striking a balance between the country's two national securities.

## Literature Cited

- Abate, Randall S. "Nepa, National Security, and Ocean Noise: the Past, Present, and Future of Regulating the Impact of Navy Sonar on Marine Mammals. (National Environmental Policy Act of 1969)(New Research Approaches and Policy Ideas for Human-Wildlife Interactions)." *Journal of International Wildlife Law & Policy*. 13.4 (2010). Print.
- Alexander, Kristina. Whales and Sonar: Environmental Exemptions for the Navy's Mid-Frequency Active Sonar Training. February 18, 2009 - RL34403
- Babcock, Hope M. "National Security and Environmental Laws: a Clear and Present Danger? (25th Anniversary Symposium Issue: the Next 25 Years; Interdisciplinary Directions in Environmental Law)." *Virginia Environmental Law Journal*. 25.1 (2007): 105-156. Print.
- Bass, Ronald E, Albert I. Herson, Kenneth M. Bogdan, and Ronald E. Bass. *The Nepa Book: A Step-by-Step Guide on How to Comply with the National Environmental Policy Act*. Point Area, Calif: Solano Press Books, 2001. Print.
- Bearden, David M. *Exemptions from Environmental Law for the Department of Defense: An Overview of Congressional Action*. Washington, D.C.: Congressional Information Service, Library of Congress, 2007. Print.
- Benda-Beckmann, A.M. von, Wensveen, P.J., Kvadsheim, P.H., Lam, F.P.A., Miller, P.J.O., Tyack, P.L., & Ainslie, M.A. *Modeling Effectiveness of Gradual Increases in Source Level to Mitigate Effects of Sonar on Marine Mammals.*, 2013. Internet resource.
- Biassoni, Nicoletta, Patrick J. O. Miller, and Peter L. Tyack. *Preliminary Results of the Effects of Surtass-Lfa Sonar on Singing Humpback Whales*. Woods Hole, Mass: WHOI, 2000. Print.
- Center for Whale Research and Conservation. "Beaked Whales." *WhaleResearch.org*. 2013 <> <http://www.whaleresearch.org/projects/beaked.php>>
- Commander, Pacific Fleet. Northwest Training and Testing EIS/OEIS. 21 Feb. 2014. Department of the Navy. 16 Mar. 2014 <>. <http://www.nwtteis.com>>
- Council on Environmental Quality (CEQ) Executive Office of the President. *A Citizen's Guide to the NEPA: Having Your Voice Heard*. Executive Office of the President of the United States, 2007. Print.
- Crum, LA, and Y Mao. "Acoustically Enhanced Bubble Growth at Low Frequencies and Its Implications for Human Diver and Marine Mammal Safety." *The Journal of the Acoustical Society of America*. 99.5 (1996): 2898-907. Print.

D'Amico, Angela, Robert C. Gisiner, Darlene R. Ketten, Jennifer A. Hammock, Chip Johnson, Peter L. Tyack, and James Mead. "Beaked Whale Strandings and Naval Exercises." *Aquatic Mammals*. 35.4 (2009): 452-472. Print.

Department of the Navy, U.S. *Northwest Training and Testing Activities Draft Environmental Impact Statement/Overseas Environmental Impact Statement*. Prepared by Naval Facilities Engineering Command Northwest. (2014)

Dycus, Stephen. "Osama's Submarine: National Security and Environmental Protection After 9/11." *William and Mary Environmental Law and Policy Review*. 30.1 (2005): 1-54. Print.

*Endangered Species Act of 1973*. 16 USC Sec. 1531. Print.

England, Gordon. Office of the Secretary of Defense. Memorandum for Secretary of the Navy: *National Defense Exemption from Requirements of the Marine Mammal Protection Act for Certain DoD Military Readiness Activities That Employ Mid-Frequency Active Sonar or Improved Extended Echo Ranging Sonobuoys*. 2007. Print.

Filadelfo, R, J Mintz, E Michlovich, Amico A. D, P.L Tyack, and D.R Ketten. "Correlating Military Sonar Use with Beaked Whale Mass Strandings: What Do the Historical Data Show?" *Aquatic Mammals*. 35.4 (2009): 435-444. Print.

Fox, Bradley K, Kelvin D. Gorospe, Roxanne D. Haverkort-Yeh, and Malia A. J. Rivera. "It's a Snap! an Inquiry-Based, Snapping Shrimp Bioacoustics Activity." *The American Biology Teacher*. 75.7 (2013): 470-475. Print

Government Accountability Office, U.S. *Navy Training: Observations on the Navy's Use of Live and Simulated Training*. Briefing for the Senate and House Armed Services Committees (GAO-12-725R). Washington: Government Printing Office, 2012.

Johnson, Joseph. *SURTASS LFA environmental compliance experience*. Presentation at ECOUS (Environmental Consequences of Underwater Sound), San Antonio, Texas, 12–16 May 2003.

Laist, D W, A R. Knowlton, J G. Mead, A S. Collet, and M Podesta. "Collisions between Ships and Whales." *Marine Mammal Science*. 17 (2001): 35-75. Print.

*Marine Mammal Protection Act of 1972 As Amended*. Washington, D.C. (1825 Connecticut Ave., N.W., Washington 20009: The Commission, 1995. Print.

Nachtigall, PE, JL Pawloski, and WW Au. "Temporary Threshold Shifts and Recovery Following Noise Exposure in the Atlantic Bottlenosed Dolphin (*tursiops Truncatus*)." *The Journal of the Acoustical Society of America*. 113.6 (2003): 3425-9. Print.

National Oceanic and Atmospheric Administration. Office of Protected Resources. *Northwest Training Range Complex (NWTRC) Letter of Authorization (LOA)*. National Marine Fisheries Service, Nov. 2010. Print.

National Oceanic and Atmospheric Administration. Office of Protected Resources. *Northwest Training Range Complex (NWTRC) Letter of Authorization (LOA)*. National Marine Fisheries Service, Oct. 2012. Print.

National Marine Fisheries Service. (2010). Biological Opinion on the U.S. Navy's Proposed Training Activities on the Northwest Training Range from June 2010 to June 2015 [Memorandum]. Keyport, WA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

“Occupational Noise Exposure Limits.” 29 CFR 1910.95(a).1991

Parsons, EC, SJ Dolman, AJ Wright, NA Rose, and WC Burns. "Navy Sonar and Cetaceans: Just How Much Does the Gun Need to Smoke Before We Act?" *Marine Pollution Bulletin*. 56.7 (2008): 1248-57. Print.

“Protection of Environment.” 40 CFR 1506.11.1979

Quaranta, A, P Portalatini, and D Henderson. "Temporary and Permanent Threshold Shift." *Scandinavian Audiology Supplementum*. (1998): 75-86. Print.

Romano, T A, M J. Keogh, C Kelly, P Feng, L Berk, C E. Schlundt, D A. Carder, and J. Finneran. "Anthropogenic Sound and Marine Mammal Health: Measures of the Nervous and Immune Systems Before and After Intense Sound Exposure." *Canadian Journal of Fisheries and Aquatic Sciences*. 61.7 (2004): 1124-1134. Print.

Tyack, Peter L, Walter M. X. Zimmer, David Moretti, Brandon L. Southall, Diane E. Claridge, John W. Durban, Christopher W. Clark, Angela D'Amico, Nancy DiMarzio, Susan Jarvis, Elena McCarthy, Ronald Morrissey, Jessica Ward, and Ian L. Boyd. "Beaked Whales Respond to Simulated and Actual Navy Sonar." *Plos One*. 6.3 (2011). Print

## Appendix A

### Guiding Principles for Determining Training Mix: Fleet Training Simulator Strategy

- 1) Effective training requires an efficient balance of live and synthetic approaches.
- 2) Simulator decisions are complex and require thoughtful and thorough analysis.
- 3) Train in port and validate at sea, or train on the ground and validate in the air, or train at home base and validate in the field.
- 4) Training simulators should be used to replace live training to the maximum extent possible where training effectiveness and operational readiness are not compromised.
- 5) Some live training events cannot or should not be replaced by a simulator.
- 6) If a skill or talent *can be* developed or refined, or if a proficiency *can be* effectively and efficiently maintained in a simulator, then these skills/talents/proficiencies *should be* developed/refined/maintained in a simulator.
- 7) If a qualification or certification can realistically and economically be accomplished in a simulator, do it in a simulator.
- 8) Simulator training objectives must be directly linked with specific Navy Mission Essential Tasks or individual personnel qualification standard requirements.
- 9) Simulators that are intended to interface with other simulators during Fleet Synthetic Training<sup>2</sup> events must be compatible with the Navy Continuous Training Environment network.
- 10) Simulators that could conceivably be used for multi-platform or cross platform mission area training should be designed with integration as a primary goal.
- 11) Simulators should provide the appropriate level of fidelity required to effectively and economically train to the specified task(s).

12) Simulator procurement needs to stay aligned with Fleet-wide technical innovation to deliver timely, cost effective solutions.

Source: GAO, 2012.