June – July 2007

Oversea Environmental Assessment (OEA)/Environmental Assessment (EA) for MK 48 Mod 6 Torpedo Exercises in Hawaiian Waters

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NAVSEA
WARFARE CENTERS
NEWPORT

Executive Summary

This Overseas Environmental Assessment (OEA)/Environmental Assessment (EA) analyzes the potential environmental impacts that may result from actions proposed by the United States Navy's Program Manager, Undersea Weapons Program Office (PMS 404). The Proposed Action is to conduct a MK 48 Torpedo Exercise (TORPEX) in Hawaiian waters at Penguin Bank in June or July 2007. The exercise test is necessary per the Secretary of the Navy's Procedures for Defense Acquisition Programs (SECNAV Instruction 5000.2B) to support the program as it proceeds through the system acquisition process. In accordance with the Federal Coastal Zone Management Act Section 307(c)(1), the Navy has determined that the proposed testing of exercise torpedoes in the waters off Hawaii would not affect the uses or the natural resources of the coastal zone and, therefore, a consistency determination is not required.

This OEA/EA has been prepared by the Department of the Navy (DoN) in accordance with Executive Order (EO) 12114; Department of Defense (DoD) Regulations found at 32 Code of Federal Regulations (CFR) Part 187; Department of the Navy procedures for implementing NEPA (32 CFR Part 775); Chief of Naval Operations (CNO) Instruction 5090.1B, Environmental and Natural Resources Program Manual, Appendix E; and guidance as provided by the CNO's Supplemental Environmental Planning Policy of 23 September 2004.

The *purpose* of the proposed action is to evaluate and determine the effectiveness and suitability of the Mk 48 torpedo to counter the technically sophisticated submarine threat. The basis for conducting Mk 48 torpedo exercises in the test sites of Penguin Bank is to obtain a true measure of system performance improvement by direct comparison with previous torpedo software and hardware builds. The *need* for the proposed action is to evaluate system operational capability in order to support a mandatory milestone required by Department of Defense (DoD) regulations for the acquisition of defense systems. Operational testing and evaluation of weapons systems must demonstrate their stated capability before production and deployment to the using forces. The DOD regulation which contains the requirement for this testing is 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs*.

The TORPEX would be conducted during daylight hours and would utilize inert exercise torpedoes. Inert torpedoes carry an exercise section with instrumentation to record performance data in place of a live warhead. Surveillance over-flights would also be conducted during the exercise to ensure that marine mammals and sea turtles are not observed within the test area. The TORPEX would test Mk 48 torpedoes at Penguin Bank chosen due to its unique oceanographic characteristics which represent a threat environment. This location is proposed for torpedo testing due to its proximity to support services and the variety of conditions it offers that are similar to current threat areas.

The proposed TORPEX was analyzed for the following: geology and geography, water quality and circulation, sea surface temperature properties, marine mammals, fish and Essential Fish Habitat (EFH). The main concern for the proposed action is the potential impact upon marine mammals. To alleviate impacts to them, protective measures were considered. After evaluating the proposed action, the determination is that, when the applicable protective measures are implemented (Chapter 5), TORPEXs conducted at Penguin Bank during a preferred limited time frame would not result in significant environmental harm to natural resources in the global

commons and would not significantly impact the environment, marine mammals, endangered or threatened marine species.

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Acronyms and Abbreviations

μPa	Micro Pascal ($1x10^{-6}$ Pascal)
°C	Degrees centigrade
°F	Degrees Fahrenheit
ADCAP	Advanced Capability
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
dB	Decibel
dB re 1μPa^2-sec	units of energy flux density level
DoD	Department of Defense
DON	Department of the Navy
EFD	Energy Flux Density
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FR	Federal Register
Ft	Feet/Foot
GDEMV	General Digital Environmental Model, Variable resolution
HCN	Hydrogen Cyanide
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
HLCC	Hawaiian Lee Counter Current
Hz	Hertz
IFH	Improved Flex Hose
in	Inch(es)
IUCN	International Union for the Conservation of Nature
kg	Kilogram
km	Kilometer

kts	Knots (nautical miles per hour)
lb(s)	Pound(s)
m	Meter
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Area
MSA	Magnuson-Stevens Act
MSFCMA	Magnuson-Steven Fishery Conservation and Management Act
NAVSEA	Naval Sea Systems Command
NDAA	National Defense Authorization
NEC	Northern Equatorial Current
NEPA	National Environmental Policy Act
NHRC	North Hawaii Ridge Current
NMFS	National Marine Fisheries Service
NHRC	North Pacific Subtropical Gyre
nmi	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
OEA	Overseas Environmental Assessment
OPAREA	Operations Area
OPNAVINST	Operational Naval Instruction
OF	Otto Fuel
OTC	Officer in Tactical Command
PMS 404	Program Manager, Undersea Weapons Program Office
psu	Practical Salinity Units
PTS	Permanent Threshold Shift
re	Referenced To
SFA	Sustainable Fisheries Act
SSP	Sound Speed Profile
SST	Sea Surface Temperature
TRB	Torpedo Retrieval Boat

TORPEX	Torpedo Exercise
TTS	Temporary Threshold Shift
USC	United States Code
USFWS	United States Fish and Wildlife Service
μg/l	Microgram per liter
WPRFMC	Western Pacific Regional Fisheries Management Council

CHAPTER 1 PURPOSE AND NEED

1.1. INTRODUCTION

The Naval Sea Systems Command (NAVSEA), Undersea Weapons Program Office (PMS 404) is planning a Torpedo Exercise (TORPEX) within Hawaiian waters at Penguin Bank in June or July 2007. Penguin Bank is approximately 10-20 nmi west/southwest of the Hawaiian island of Molokai (Figure 1-1). This location is proposed for torpedo testing due to its proximity to support services and the variety of conditions it offers that are similar to current threat areas.

This Overseas Environmental Assessment (OEA)/Environmental Assessment (EA) has been prepared by the Department of the Navy (DoN) in accordance with Executive Order (EO) 12114; Department of Defense (DoD) Regulations found at 32 Code of Federal Regulations (CFR) Part 187; DoD Directive 6050.7; and guidance as provided by the CNO's Supplemental Environmental Planning Policy of 23 September 2004.

This TORPEX would occur within sites designated by two boxes and falling mainly within, but with a portion of Site B outside, the 12 nmi U.S. territorial sea (Figure 1-1). The TORPEX sites are located greater than 3 nmi from the coast of Molokai. Therefore, this OEA/EA has been prepared in compliance with both the National Environmental Policy Act (NEPA) and Executive Order (EO) 12114. The respective geographic coordinates of each corner are:

A) Northwest Test Site bounded by 21-05N to 21-11N; 157-24W to 157-30N
B) Southeast Test Site bounded by 20-55N to 21-01N; 157-26W to 157-33N

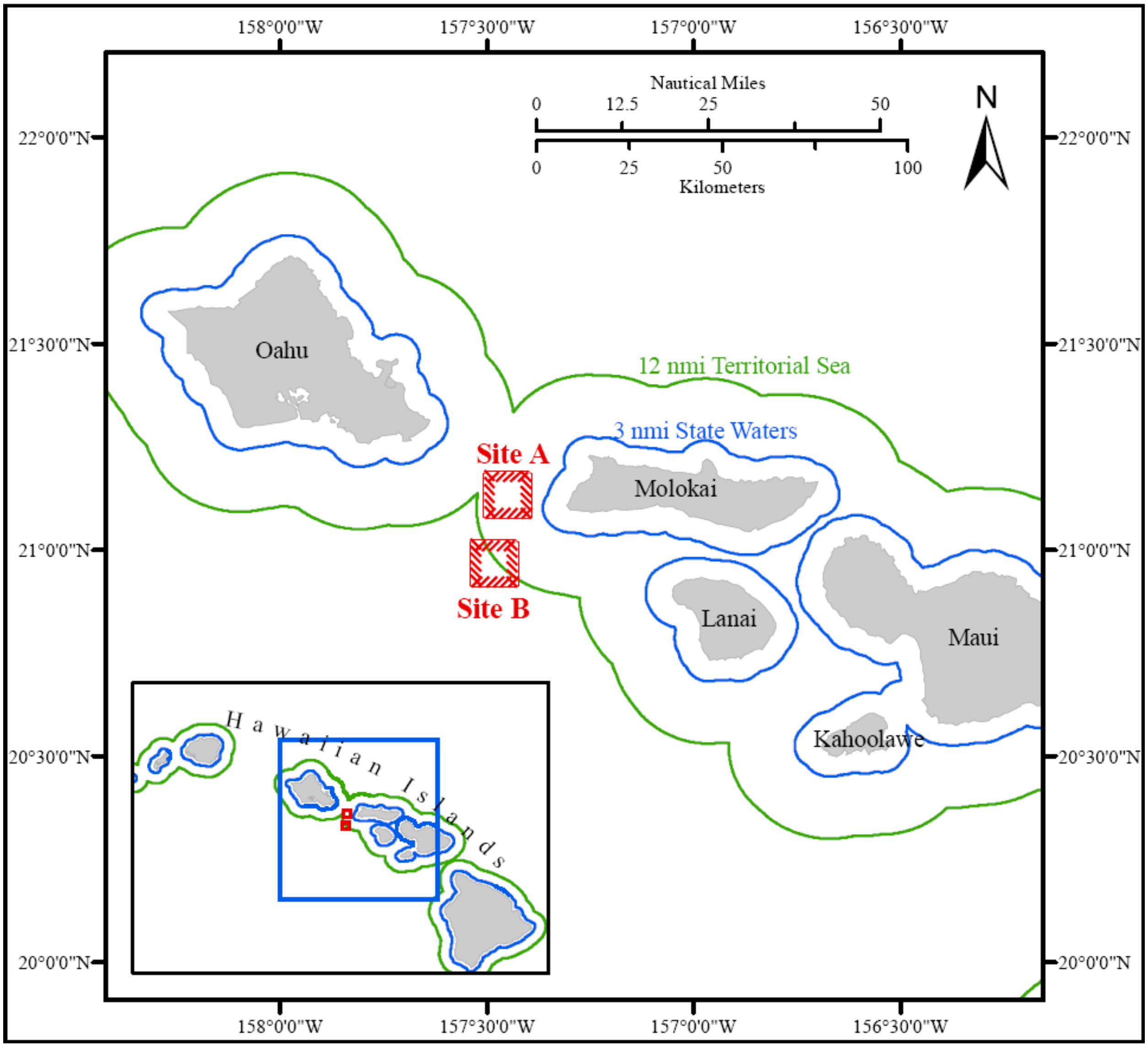

Figure 1-1: TORPEX Sites on Penguin Bank

1.2. PURPOSE AND NEED

The *purpose* of the proposed action is to evaluate and determine the effectiveness and suitability of the Mk 48 torpedo to counter the technically sophisticated submarine threat. Conducting these TORPEXs would provide the Navy with an opportunity to test newly developed torpedoes and torpedo software in-situ and in waters simulating potential littoral threat environments. Performance data collected from the exercise would be the basis for proceeding to the next milestone decision in the acquisition process. Although computer simulation provides some measure of performance, it is only through in-water testing that a realistic assessment of the capabilities and deficiencies of a weapon system can be ascertained. The basis for conducting Mk 48 torpedo exercises in the test sites of Penguin Bank is to obtain a true measure of system performance improvement by direct comparison with previous torpedo software and hardware builds.

The *need* for the proposed action is to evaluate system operational capability in order to support a mandatory milestone required by Department of Defense (DoD) regulations for the acquisition of defense systems. Operational testing and evaluation of weapons systems must demonstrate their stated capability before production and deployment to the using forces. The DOD regulation which contains the requirement for this testing is 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs*.

1.3. APPLICABLE LAWS AND EXECUTIVE DIRECTIVES

1.3.1. Executive Order 12114

Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions, directs Federal agencies to provide for informed decision making for major Federal actions outside U.S. territory. EO 12114 requires environmental consideration for actions that significantly affect the global commons, which are the geographic areas outside the jurisdiction of any nation, including the oceans beyond their territorial limits, which the U.S. defines as 12 nautical miles (nmi) (22 kilometers (km)). In accordance with DoD Directive 6050.7, this OEA/EA evaluates the potential for significant environmental effects of TORPEXs.

1.3.2. The Endangered Species Act (ESA)

The ESA (16 U.S. Code (USC) §§ 1531 *et seq.*) requires that Federal agencies, in consultation with the responsible wildlife agency, ensure that proposed actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat (16 USC § 1536 (a)(2)). Regulations implementing the ESA expand the consultation requirement to include those actions that “may affect” a listed species or adversely modify critical habitat. The offshore areas near Penguin Bank support seven endangered animals, identified in Chapter 3. As explained in Chapter 4, because of the nature of the TORPEXs, the characteristics of the affected environment, and the protective measures that would be taken, there would be no effect on endangered or threatened species or their critical habitats. Thus, no formal consultation with NMFS or USFWS is required.

1.3.3. The Marine Mammal Protection Act (MMPA)

The MMPA (16 USC §§ 1361 *et seq.*) established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates "takes" of marine mammals in U.S. territorial waters and high seas to the border of foreign Exclusive Economic Zones (EEZs). The term "take," as defined in Section 3 (16 USC § 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of "harassment," Level A (potential injury) and Level B (potential disturbance).

On November 24, 2003, President George W. Bush signed into law the National Defense Authorization Act of 2004 (NDAA). The NDAA amended the portions of the Marine Mammal Protection Act (MMPA) that apply where a "military readiness activity" is concerned. Section 101(a)(5) of the MMPA was amended to exempt military readiness activities from the "specified geographical region" and "small numbers" requirements. The term "military readiness activity" is defined to include all training and operations of the Armed Forces that relate to combat; and the adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use. For military readiness activities, such as the proposed TORPEX, the relevant definition of harassment is any act that "injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild ("Level A harassment"), or "disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered" ("Level B harassment")(16 U.S.C. §§ 1362 (18)(B)). The protective measures suitable for this proposed action are described in Chapter 5.

1.3.4. Magnuson-Stevens Fishery Conservation and Management Act (MSA)

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act (MSA)) (16 USC §§ 1801 *et seq.*), enacted to conserve and restore the nation's fisheries, includes a requirement for National Marine Fisheries Service (NMFS) and regional fishery councils to describe and identify Essential Fish Habitat (EFH) for all species that are federally managed. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the Act, Federal agencies must consult with the Secretary of Commerce regarding any activity or proposed activity that is authorized, funded, or undertaken by the agency that may adversely affect EFH. The MSA is concerned with the conservation and management of the fisheries resources found off the coasts of the U.S., and the anadromous species and continental shelf fishery resources of the U.S. In accordance with 62 FR 244, page 66535, "With few exceptions, direct NMFS regulatory authority applies only to Federal waters, the EEZ."

1.3.5. EO 13158 Marine Protected Areas (MPA)

A MPA, as defined in EO 13158, is "any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." Section 5 of EO 13158 stipulates, "Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA." Once designated in accordance with the EO, MPAs form a collection of marine resource areas that conserve and protect biological integrity and habitat diversity, as well as the social or cultural value of a specific portion of the marine environment (National Research Council (NRC), 2000).

1.3.6. Coastal Zone Management Act (CZMA)

In accordance with the Federal Coastal Zone Management Act Section 307(c)(1), the Navy has determined that the proposed testing of exercise torpedoes in the waters off Hawaii would not affect the uses or the natural resources of the coastal zone and, therefore, a consistency determination is not required.

CHAPTER 2 PROPOSED ACTION AND ALTERNATIVES

This OEA/EA has been prepared by the Department of the Navy in accordance with the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA); Department of the Navy procedures for implementing NEPA (32 CFR Part 775); Chief of Naval Operations (CNO) Supplemental Environmental Planning Policy of 23 September 2004; and Chief of Naval Operations Instruction 5090.1B, the Environmental and Natural Resources Program Manual.

2.1 PROPOSED ACTION

The proposed action includes a test series that consists of multiple in-water runs of exercise Mk 48 torpedoes and would include one submarine as both target and launch platform. This exercise tests the performance of Mk 48 torpedoes in locating and tracking targets. None of the torpedoes contain a warhead; exercise instrumentation, and recording equipment that collects performance data would replace the warhead. The Mk 48 firings would autonomously execute search and homing tactics. The exercise configured Mk 48 torpedoes are approximately 230 inches long, 21 inches diameter, and weigh about 2500 lbs. The MK 48 torpedoes are high-speed, deep-diving, wire-guided torpedoes with Otto Fuel engines. They use active and passive sonar to acquire and home on targets. A maximum of seven (7) Mk 48 exercise firings would be conducted during daylight, over the course of approximately three days, and would be exercise configured Set-Not-to-Hit the submarine target. At the completion of the test each torpedo would be recovered.

Participants in the exercise would include a submarine, an exercise command vessel, a torpedo recovery vessel, and aircraft. The exercise command vessel may also serve as the torpedo recovery vessel. The aircraft would be used to monitor the test area for non-participants, marine mammals and sea turtles. Countermeasure equipment would be expended and not recovered.

Operational requirements include, but are not limited to, the ability to (1) launch, recover, extract test data, service, and transport exercise torpedoes, (2) monitor the test site from sea and air, (3) monitor surface and subsurface vessels, and underwater weapons, and (5) provide for and coordinate operations and communications among all test participants. Requirements for the TORPEX location include a minimum depth of 200 ft (61 m), and the ability to visually monitor the test area for protected marine species.

2.1. ALTERNATIVES

TORPEXs must be conducted in a variety of littoral areas representative of a range of potential threat environments. Penguin Bank offers a range of threat environments within a small area and access to critical exercise assets. Therefore, other more remote geographic alternatives were not considered further. In additional to determination of the test criteria with regard to test location, the main selection criteria used to screen the action alternatives for feasibility was seasonality based on the presence or absence of marine mammals. The likelihood of some species being present at the test sites is seasonally dependent. As a result, the following alternatives have been identified:

2.1.1. Alternative 1 – No Action Alternative

The "No Action" Alternative would not allow for conducting TORPEXs. This alternative would not meet the test objectives of the proposed action. Specifically, the purpose of testing newly developed torpedo software in a realistic in-water environment would be thwarted and an assessment of the capabilities and deficiencies of the weapon system would not be provided.

2.1.2. Alternative 2 – Year-Round TORPEXs at Penguin Bank

This alternative proposes to conduct TORPEXs at any time throughout the year at Penguin Bank. This alternative would meet the test objectives and is considered to explore the full range of possibilities for conducting TORPEXs at Penguin Bank.

2.1.3. Alternative 3 – Seasonally Limited TORPEXs at Penguin Bank

This alternative would restrict the conduct of TORPEXs to environmentally preferable months at Penguin Bank. Testing would be limited to June or July 2007 (within the warm season) where both species abundance and species diversity are at a minimum. This alternative would meet the test objectives while reducing the potential environmental consequences. Alternative 3 is the Preferred Alternative.

CHAPTER 3 EXISTING ENVIRONMENT

3.1. PHYSICAL ENVIRONMENT

Physical oceanography includes geography, geology, and climate of the region. The sections below outline the physical environments within the vicinity of the proposed test site including geology, water quality, sea surface temperature, and salinity.

3.1.1. Geology and Geography

Important processes that determine the marine geology of the Hawaiian islands include volcanism, isostatic adjustment, and sedimentation (Moberly and McCoy, 1966). The Hawaiian archipelago developed on a large broad swell (800 km wide) with the islands raising abruptly form the archipelagic apron of the adjacent seafloor (Miller, 1994). The bathymetric features of the islands have a steep, narrow continental margin and a seafloor consisting of depressed island moats, seamounts, submarine canyons, and submerged banks (Figure 3-1: Major geological features of the Hawaiian Islands). A search of literature indicates that there are no coral reefs in the area of the proposed action.

Seamounts are undersea mountains that rise from the ocean floor to over 1,000 m above the surrounding sediments of the ocean basin (Department of the Navy, 2005). Although no seamounts occur in the Penguin Bank area, the waters surrounding the Hawaiian Islands have an average abundance of 309 seamounts per 10^6 km^2. Submarine canyons have steep walls, winding valleys, narrow “V-shaped” cross-sections, steps, and an irregularity along the sea floor (Kennett, 1982). Submarine canyons have not been identified at Penguin Bank but have been identified along the coastlines of Molokai, Oahu, and Kauai (Moore and Clague, 2004). Penguin Bank is considered to be a submerged bank, which are raised offshore plateaus similar to nearshore shelves except they lack a bordering land area (Emery, 1960). Penguin Bank is located to the west of West Molokai Volcano and has an average depth of 60 m with depths ranging from 50 to 200m (Miller, 1994). Penguin Bank is covered with an unknown thickness of coral deposit (U.S. Geological Survey, 2003). Bottom sediments that overlay Penguin Bank as well as other submerged banks are dominated by sand with occasional outcrops of course sediments, limestone talus, limestone holes, and limestone platforms (Miller, 1994).

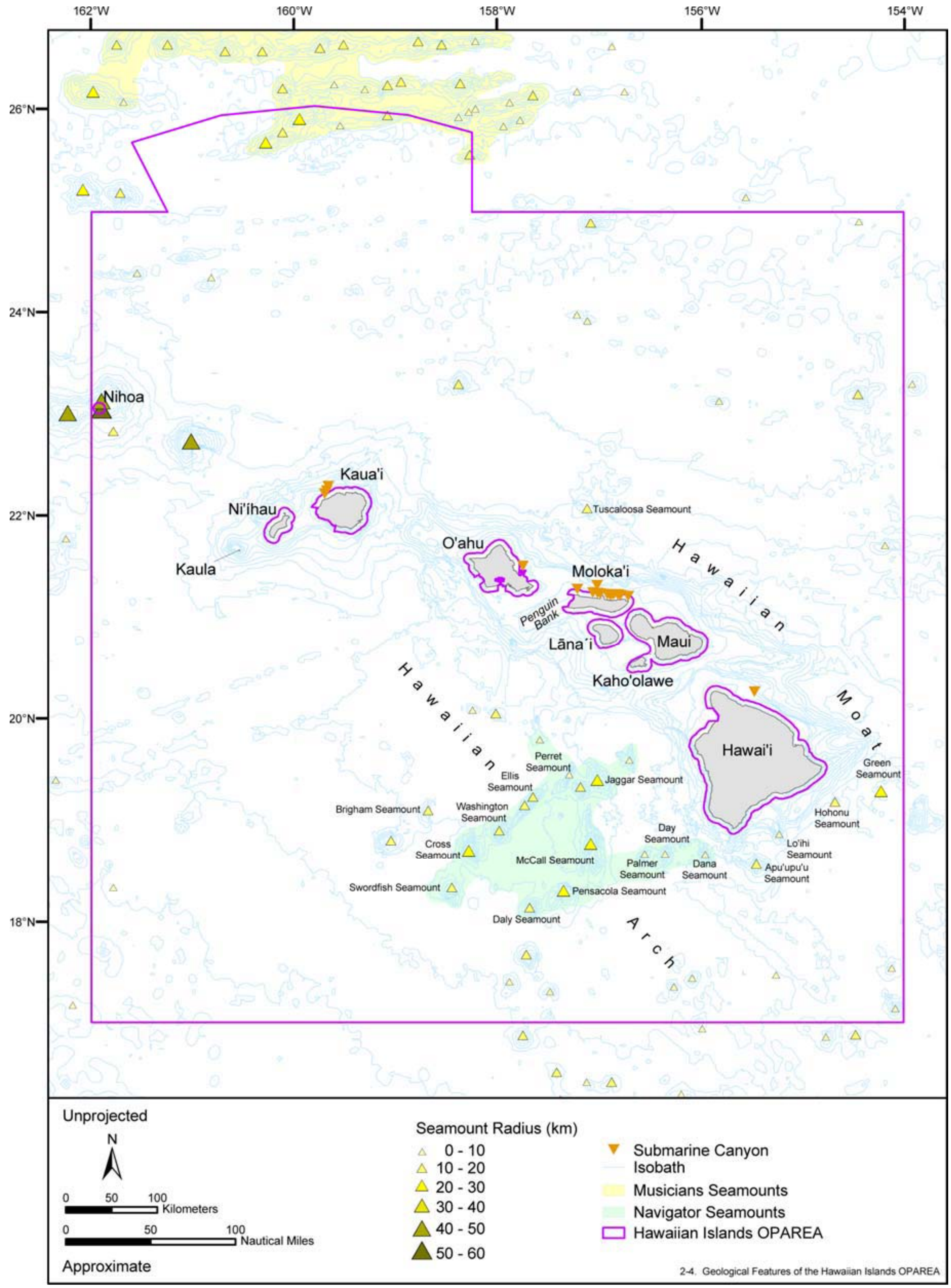

Figure 3-1: Major geological features of the Hawaiian Islands

Source: (Department of the Navy, 2005)

3.1.2. Water Quality and Circulation

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes caused by natural and human activities. This dynamic equilibrium can be represented by a variety of indicators including temperature, salinity, dissolved oxygen, and nutrient levels. The by-products produced during the testing of the torpedo would be rapidly diluted and not effect the water quality. The section on Hazardous Materials and Wastes describes the materials entering the water.

The area surrounding the Hawaiian Islands has a strong sea surface temperature (SST) gradient from the north to the south (Figure 3-2). Annual temperatures average between 24 °C and 28 ºC (Itano and Holland, 2000). Low temperatures occur from January to March and at times can drop below 21 °C. Maximum temperatures occur from June to October reaching as high as 29 ºC (Miller, 1994).

The average salinity in the waters surrounding the Hawaiian Islands reaches a maximum of 35.2 practical salinity units (psu) at 26ºN and decreases to 34.3 psu at 10ºN (Flament et al., 1998). Higher salinity values (35.2 psu) are located at about 150 m depth and are traceable to high salinity surface waters north of Hawaii. The salinity typically decreases to around 34.1 psu at a depth of 500m and below 500m the salinity increases to about 34.7 psu (Flament et al., 1998).

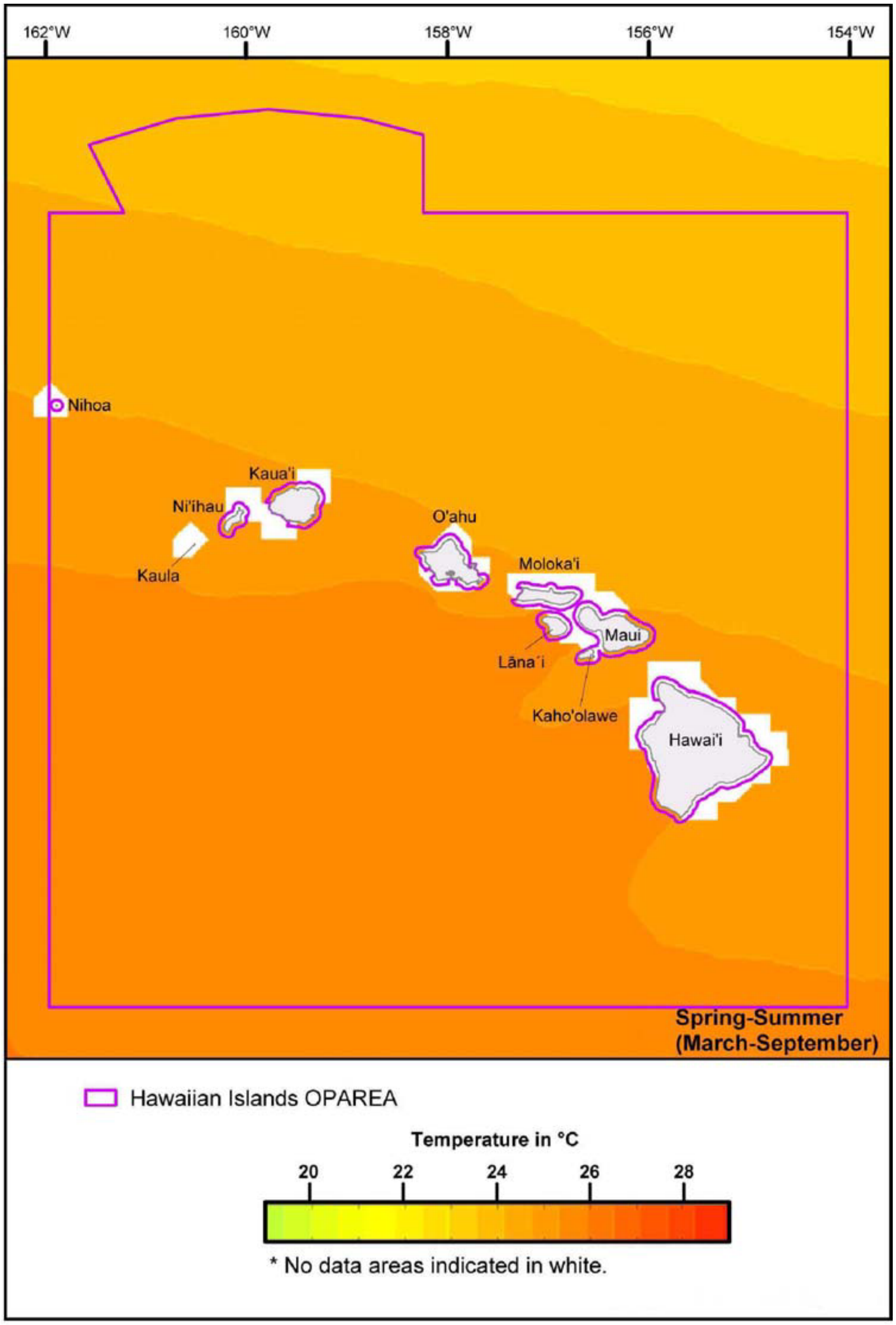

Figure 3-2: Sea Surface Temperatures of Hawaiian Waters

The study area is located within the center of the North Pacific Subtropical Gyre (NPSG).The NPSG encompasses $2X10^7$ km^2 of ocean and is bound by the North Pacific Current to the north, the Northern Equatorial Current (NEC) to the south, the California Current to the east, and the Kuroshi Current to the west. The NPSG consists of warm (>24 °C) nutrient depleted surface waters, low abundance of living organisms, and a persistent deep-water chlorophyll maximum

(Karl, 1999). At the NPSG circulation is roughly east to west, reinforcing wind driven surface currents. The NEC forks at and the northern branch of the current becomes the North Hawaiian Ridge Current (NHRC) which intensifies near the islands with a typical width of 65 miles (100 km) and a speed of 25cm/s (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006).

The Hawaiian Lee Counter Current (HLCC) extends from 175 to 158ºW between two elongated circulations resulting from wind driven surface currents flowing between the islands (Yu et al., 2003). The HLCC flows to the east at an average speed of 15 cm/sec (Qiu and Durland, 2002) and it is strongest from the summer through winter with weaker flows occurring in the spring (Kobashi and Kawamura, 2002).

Water circulating over the Penguin Bank is part of the Hawaii current system, and compared to coastal waters, the oceanic water mass at the bank is low in suspended particulate matter and is therefore very clear. Underwater visibility is normally between 80 to 165 feet (25 to 50 m), except during plankton blooms and storms. Currents are often strong and highly variable, extending from the surface to the maximum depth worked by divers (approximately 100 feet (30) m]). Large swells and wind chop are also very common at these exposed areas.

3.2. BIOLOGICAL ENVIRONMENT

This section describes the biological environment in the general region of the proposed action. The rationale for the selection of marine species to be analyzed for potential effects by the proposed action is discussed.

3.2.1. Marine Mammals

This section describes the marine mammals that have been observed or those species likely to be found within Penguin Bank. This section also provides estimates of marine mammal abundance and densities based on aerial surveys conducted by the Mobley et al (2002) from 1993 to 1998 and from the Marine Resource Assessment of the Hawaiian Operations Area (OPAREA) (Department of the Navy, 2005). At least 28 different marine mammal species have been observed in the Penguin Bank area. Of these, 26 species are whales and dolphins and 2 are pinnipeds. Table 3-1 shows the summary of cetaceans and pinnipeds at Penguin Bank.

3.2.1.1. Cetaceans

Twenty-six species of cetaceans have been identified from sightings or strandings along the coast of Hawaii (Department of the Navy, 2005). These include 7 species of baleen whales (mysticetes), and 18 species of toothed whales (odontocetes). At least 8 species are generally found in the study area in moderate to high numbers either year-round or during annual migrations into or through the proposed test area. These include humpback whale (*Megaptera novaeangliae*), Bryde's whale (*Balaenoptera edeni*), beaked whales (family *Zaiphiidae*), common bottlenose dolphin (*Tursiops truncatus*), Pantropical spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), false killer whale (*Pseudorca crassidens*), and short-finned pilot whale (*Globicephala macrorhynchus*) which are discussed below. Other cetacean species are represented during part of the year based on occasional sightings, or stranding records and include sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera* *physalus*), blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*), minke whale (*Balaenoptera acutorostrata*), pygmy and dwarf sperm whales (*Kogia breviceps* and *Kogia simas*), rough-toothed dolphin (*Steno bredanensis*), striped dolphin (*Stenella coeruleoalba*), Risso's dolphin (*Grampus griseus*), melon-headed whale (*Peponocephala electra*), Fraser's dolphin (*Lagenodelphis hosei*), pygmy killer whale (*Feresa attenuata*), and killer whale (*Orcinus orca*) which are discussed in Appendix A.

*3.2.1.1.a. North Pacific Right Whale (*Eubalaena japonica*)*

The North Pacific right whale is listed as endangered under Endangered Species Act (ESA) and the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List. The population in the eastern North Pacific is considered to be tens (Clapham et al., 2004) of animals and in the western North Pacific there may be about 100 right whales (Clapham et al., 2004). The current distribution and migration patterns of right whales are unknown. However, from sighting reports they have been seen in winter in the Bering Sea every year since 1996 (Shelden et al., 2005). Wintering grounds for the right whale is unknown but based on historical whaling data (Clapham et al., 2004) they may winter in the Pacific. There are very few recorded sightings of right whales in Hawaiian waters (Department of the Navy, 2005). Right whales may occur in the vicinity of the proposed test sites but their occurrence is considered to be rare (Department of the Navy, 2005).

3.2.1.1.b. Humpback Whale (Megaptera novaeangliae)

Humpback whales are listed as endangered under the ESA and vulnerable under the IUCN Red List (Reeves et al., 2003). Currently there are no designated critical habitats for humpbacks in the North Pacific. Penguin Bank is designated as a Humpback Whale National Marine Sanctuary Boundary by the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) (PMRF, 1998). Humpback whales that occur in Hawaiian waters are considered part of the North Pacific stock which has an estimated 4,005 individuals (Angliss and Lodge, 2004).

Humpbacks tend to prefer shallow, coastal waters over the continental shelf (Clapham and Mead, 1999) and shallow banks or ledges with high sea-floor relief for their feeding and breeding grounds (Hamazaki, 2002). Humpback whales utilize Hawaiian waters as breeding grounds during the winter and spring (December through April), with abundance peaking from February through April and declining in number in May as they migrate to their feeding grounds. The greatest densities of humpbacks during their breeding season in occur at Maui, Moloka'l, Kasho'olawa, Lāna'l, and Penguin Bank (Baker and Herman, 1981). In the summer months, humpbacks migrate from Hawaii to the Aleutian Islands, Kamchatka Peninsula, and the Bering and Chukchi seas (Calambokidis et al., 2001). During the spring-summer period humpbacks are expected to have an uncommon occurrence around Penguin Bank, which accounts for the possible occurrence of humpbacks at the end of their breeding season in April and May (Department of the Navy, 2005).

3.2.1.1.c. Bryde's whale (Balaenoptera edeni)

Bryde's whales are seen year-round in tropical and subtropical waters both offshore and near coastal regions (Kato, 2002). They seem to have a preference for water temperature at or around 15 and 20 ºC (Yoshida and Kato, 1999). They generally do not move poleward of 40º in both hemispheres (Jefferson et al., 1993).

Bryde's whale does not appear to have a defined breeding season. In the winter Bryde's whales are mainly distributed around the western North Pacific around the Mariana, Ogasawara, Kazan, and Phillippine Islands, and near New Guinea (Ohizumi et al., 2002). In the summer, their distribution in the western North Pacific ranges from 5ºN to 40ºN. The winter and summer grounds may overlap in the central North Pacific (Ohizumi et al., 2002), which accounts for the expected uncommon occurrence of the whale at Penguin Bank.

3.2.1.1.d. Beaked whales (family Zaiphiidae)

Beaked whales that may occur in Penguin Bank include Cuvier's beaked whale, Blainville's beaked whale, and Longman's beaked whale. Abundance for Cuvier's beaked whales is estimated at 12,728 whales, 2,138 for Blainville's beaked whales, and 766 for Longman's beaked whales (Carretta et al., 2005).

Beaked whales tend to inhabit deep, oceanic waters (>2,000 m) or continental slops (200 to 2,000 m) (Pitman, 2002). Cuvier's beaked whales tend to be associated with bottom depths of over 200m (MacLeod et al., 2004) as well as around seamounts, escarpments, and canyons (Department of the Navy, 2005). Blainville's beaked whale occurs in temperate and tropical waters in all oceans (Jefferson et al., 1993). Longman's beaked whale may have a preference for warm tropical water with SST around 26 ºC (Pitman et al., 1999) and deeper, oceanic waters. Due to their preference for deep waters beaked whales are not expected to be found at Penguin Bank in the summer months which takes into account that the deep waters of this area are close to the shore (Department of the Navy, 2005). Deeper waters surrounding Penguin Bank are expected to have a common occurrence of beaked whales (Department of the Navy, 2005)

3.2.1.1.e. Sperm whale (Physeter macrocephalus)

The sperm whale is classified as endangered under the ESA and the Hawaiian stock is estimated to have 7082 individuals. Sperm whales show a strong preference for deep waters (Rice, 1989) with high sea floor relief and areas with high secondary productivity and steep underwater topography (Jaquet and Whitehead, 1996). Sperm whales are highly distributed throughout the Hawaiian Islands year round (Mobley et al., 2000). They primarily inhabit the area seaward of the shelf break in Hawaiian water, therefore they are not expected to occur at Penguin Bank.

3.2.1.1.f. Pygmy and dwarf sperm whales (Kogia breviceps and Kogia simas)

Sperm whales, although listed as endangered under the ESA and vulnerable under the IUCN Red List and are considered to be the most abundant of the large whale species, with an estimated 1,900,000 animals worldwide (Rice, 1989). The Hawaiian stock of pygmy sperm whale is estimated to have 7,251 individuals and the dwarf sperm whales stock is estimated at 19,172 individuals (Carretta et al., 2005). Berzin (1971) reported that they are restricted to waters deeper than 300 m (984 ft), while Watkins (1977) and Whitehead (2003) reported that they are usually not found in waters less than 1000 m (3281 ft) deep. During summer, sperm whales migrate to higher latitudes, with mature males migrating much farther north than females and younger males. In the Pacific Ocean, females and younger whales usually remain in tropical and temperate waters (between 40° N and 45° S latitude) (Rice, 1978), while males continue north to the Gulf of Alaska, Aleutian Islands, and the Bering Sea, or south to the Antarctic. Due to their migration patterns sperm whales are not expected to occur at Penguin Bank during the proposed test time.

3.2.1.1.g. Common bottlenose dolphin (Tursiops truncatus)

The common bottlenose dolphin occurs as two forms: a nearshore or coastal form and a offshore form (Hoelzel et al., 1998). Common bottlenose dolphins have an estimated stock of 3,263 individuals in Hawaii (Carretta et al., 2005). Common dolphins live in coastal areas worldwide in tropical to temperate waters. They generally do not range poleward of 45º.

Bottlenose dolphins are regularly found in both nearshore and offshore areas of the Hawaiian Islands (Baird et al., 2002). Bottlenose dolphins in nearshore habitats tend to associate with a specific island and movement between islands is considered to be very rare (Baird et al., 2002). Bottlenose dolphins are excepted to be common in the waters surrounding the Hawaiian Islands (Department of the Navy, 2005).

3.2.1.1.h. Pantropical spotted dolphin (Stenella attenuata)

Pantropical spotted dolphins are born without spots. They develop their spots as they age and in some population remain spotless (Jefferson et al., 1993). There is an estimated population size of 10,260 individuals in the waters of the Hawaiian Islands (Carretta et al., 2005).

Pantropical spotted dolphins are distributed in tropical and subtropical waters worldwide (Perrin and Hohn, 1994). In the central Pacific they range from the Hawaiian Islands south to the Marquesas (Perrin and Hohn, 1994). Spotted dolphins tend to prefer more offshore areas, so an uncommon occurrence of spotted dolphins is expected from the shore to about the 100 m isobath (Department of the Navy, 2005).

3.2.1.1.i. Spinner dolphin (Stenella longirostris)

There is an estimated 2,805 spinner dolphins in the Hawaiian stock (Carretta et al., 2005). They occur in both oceanic and coastal environments. They tend to be associated with inshore waters, islands or banks (Perrin and Gilpatrick Jr., 1994). Spinner dolphins that inhabit islands rest during the day in shallow, protected nearshore areas and forage in deep waters at night (Lammers, 2004). Therefore, a common occurrence of spinner dolphins is expected around the Hawaiian Islands with populations moving inshore during the day and offshore at night year round (Department of the Navy, 2005).

3.2.1.1.j. False killer whale (Pseudorca crassidens)

The Hawaiian stock of false killer whales is listed by NMFS as strategic. This stock is estimated to have 268 individuals. False killer whales are found in tropical and temperate waters, preferring areas between 50ºS and 50ºN latitude (Odell and McClune, 1999). They are primarily found in offshore or oceanic waters but can occasionally occur close to shore near oceanic islands (Baird, 2002). In waters surrounding the Hawaiian Islands false killer whales were reported to occur in depths of 40 m to 4,000 m year round. A common occurrence of false killer whales is expected in Penguin Bank (Department of the Navy, 2005).

3.2.1.1.k. Short-finned pilot whale (Globicephala macrorhynchus)

The Hawaiian stock of short-finned pilot whales is estimated at 8,846 whales (Carretta et al., 2005). These animals are found in tropical and warm-temperate waters worldwide. They tend to prefer deep, offshore habitats over the continental shelf break, in slope water, and areas of high topographical relief (Olson and Reilly, 2002). They are commonly found in deep waters with steep btoom topography, including the deep water channels between the Hawaiian Islands, such as the Alenuihaha Channel between Maui and (Balcomb, 1987). They are expected to be uncommon in Penguin Bank and common in waters farther offshore (Department of the Navy, 2005).

3.2.1.2. Pinnipeds

Two species of pinnipeds occur in the proposed test site. The Hawaiian monk seal (*Monachus schauinslandi*) is considered to be uncommon in the summer at the proposed test sites, whereas the northern elephant seal (*Mirounga angustirostris*) is considered to be a rare inhabitant of Hawaiian waters. Both species are discussed in detail below.

3.2.1.2.a. Hawaiian monk seal (Monachus schauinslandi)

The Hawaiian monk seal is listed as endangered under the ESA and as depleted under the MMPA (Ragen and Lavigne, 1999). The area from the shore to 37 nmi from the northwestern Hawaiian Islands is designated as Hawaiian monk seal critical habitat. Hawaiian monk seals only occur in the central North Pacific and their population is estimated to have 1,304 animals (Carretta et al., 2005).

The highest counts of monk seals in the vicinity of the proposed test site have been reported for the western islands of Ni'ihau and Kaua'i with numbers decreasing moving southeast along the island chain (Carretta et al., 2005). Monk seals tend to show site fidelity to their natal islands and only about 10% of them move to other islands during their lifetime (Gilmartin and Forcada, 2002). They breed between February and August, with peaks occurring between March and June (Gilmartin and Forcada, 2002). They prefer sandy beaches, hard substrate beaches, and exposed reefs for breeding habitats (Gilmartin, 1983). They feed in waters approximately 100 m in depth near the breeding atolls and seamounts. The inner reef waters adjacent to the islands are critical to weaned pups for feeding (Gilmartin, 1983). The Hawaiian monk seal is considered to be uncommon at Penguin Bank (Department of the Navy, 2005).

3.2.1.2.b. Northern elephant seal (Mirounga angustirostris)

The northern elephant seal occur almost exclusively in the eastern and central North Pacific, with the California stock numbering at 60,547 seals (Carretta et al., 2005). They breed on islands and mainland rookeries from central Baja California, Mexico to northern California and feed in deep waters thousands of kilometers offshore of their breeding areas (Stewart and Huber, 1993).

Northern elephant seals rarely occur in Hawaiian waters. There are currently only a few unconfirmed sightings of the species reported from Midway Atoll, Pearl and Hermes Reef, and Kure Atoll. The first sighting of the seal occurred in January of 2002 off the Kona coast.

Table 3-1: Summary of Cetaceans and Pinnipeds at Penguin Bank

Species	ESA Status	MMPA Status	Abundance at Penguin Bank	Population Trend	Seasonality	Habitat Preference
Cetaceans						
Northern Pacific right whale (*Eubalaena japonica*)	Endangered		Rare	NA	year round	Bottom depth of 50-80m in the Bering sea, otherwise unknown
Humpback whale (*Megaptera novaeangliae*)	Endangered		Common	northern stock has increased in recent years	High populations in winter and spring; peak in Feb/March	shallow banks or ledges with high sea-floor relief
Bryde's whale (*Balaenoptera edeni*)			Uncommon	NA	possible winter and summer	tropical and subtropical waters offshore and near coastal regions
Cuvier's beaked whale (*Ziphius cavirostris*)			Common	12,728 individuals	year round	deep oceanic waters; continental slopes
Blainville's beaked whale (*Mesoplodon densirostris*)			Common	2,138 individuals	year round	deep oceanic waters; continental slopes
Longman's beaked whale (*Indopacetus pacificus*)			Common	766 individuals	year round	deep oceanic waters; continental slopes
Sei whale (*Balaenoptera borealis*)	Endangered		Rare	77 individuals	year round	deep, oceanic waters over steep bathymetric relief
Fin whale (*Balaenoptera physalus*)	Endangered		Rare	174 individuals	possible summer	deeper, oceanic waters
Blue whale (*Balaenoptera musculus*)	Endangered		Rare	NA	migrate through the area in the winter	cold, productive waters and fronts
Sperm whale (*Physeter macrocephalus*)	Endangered	depleted	Common	7,082 individuals	seaward of shelf break year-round	deep waters with high sea floor relief
Minke Whale (*Balaenoptera acutorostrata*)			Rare	NA	November through March	waters over continental shelf
Pygmy sperm whale (*Kogia breviceps*)			Common	7,251 individuals	year round	continental shelf break and slope
Dwarf Sperm whale (*Kogia simas*)			Common	19,172 individuals	year round	continental shelf break and slope
Common bottlenose dolphin (*Trusiops truncatus*)			Common	3,263 individuals	year round	coastal areas of all continents
Pantropical spotted dolphin (*Stenella attenuata*)			Uncommon	10,260 individuals	year round	offshore waters
Spinner dolphin (*Stenella longirostris*)			Common	2,805 individuals	year round	oceanic and coastal environments
False Killer whale (*Pseudorca crassidens*)		strategic	Common	268 individuals	year round	offshore or oceanic waters
Short-finned pilot whale (*Globicephala macrorhynchus*)			Uncommon	8,846 individuals	year round	deep, offshore habitats over continental shelf break
Rough-toothed dolphin (*Steno bredanensis*)			Rare	19,904 individuals	year round	deep waters; islands with steep drop-offs
Striped dolphin (*Stenella coeruleoalba*)			Rare	10,385 individuals	year round	over the continental slope
Risso's dolphin (*Grampus griseus*)			Rare	2,351 individuals	year round	offshore watesr with a step shelf-edge
Melon-headed whale (*Peponocephala electra*)			Rare	2,947 individuals	year round	deep, oceanic waters
Fraser's dolphin (*Lagenodelphis hosei*)			Rare	268 individuals	year round	tropical waters deeper than 1000 m
Pygmy killer whale (*Feresa attenuata*)			Rare	817 individuals	year round	deep, oceanic waters
Killer whale (*Orcinus orca*)			Rare	430 individuals	year round	cold temperate to sub-polar waters
Pinnipeds						
Hawaiian monk seal (*Monachus schauinslandi*)	Endangered	depleted	Uncommon	1,304 individuals	year round	feed in 100m depth; breed on atolls and seamounts
Northern elephant seal (*Mirounga angustirostris*)			Rare	NA	rare sightings in winter	feeding:deep, offshore waters-breeding: sandy beaches on offshore islands

Source: {Department of the Navy, 2005 #12108}

3.2.2. Sea Turtles

Five species of sea turtles may occur at Penguin Bank: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), olive ridley turtle (*Lepidochelys olivacea*), and leatherback turtle (*Dermochelys coriacea*). Each of these species are protected by the ESA: the green turtle is listed as threatened throughout its range except in Mexico where it is endangered, hawksbill turtles are listed as endangered, loggerhead turtles are listed as endangered, olive ridley turtles are listed as threatened, and leatherback turtles are listed as endangered. No critical habitat has been designated in the Pacific for any of these species of sea turtles.

3.2.2.1. Green turtle (Chelonia mydas)

Green turtles are distributed worldwide in tropical and subtropical waters, showing a preference for water at or above 20 ºC (NMFS and USFWS, 1998a). Not much is known about juvenile habitat preference. They seem move into the convergence zones in the open ocean after hatching and remain in the pelagic environment for an undetermined amount of time (Balazs, 2004). Adults and late juveniles spend the majority of their time in nearshore, shallow coastal environments feeding on sea grass.

At the Hawaiian Islands, green turtles typically forage in waters less than 10 m deep, however they have been sighted foraging at depths of 20 to 50 m (Balazs, 1980). They are found in Hawaiian waters year round. Every year they migrate to the northwestern Hawaiian Islands to breed and nest. The nesting season starts in April or May, peaks between mid-June and early August, then tapers off in September and October. Due to the timing of this migration green turtles may occur at Penguin Bank.

3.2.2.2. Hawksbill turtle (*Eretmochelys imbricata*)

Hawksbill turtles generally occur from 30ºN to 30ºS latitude in the Atlantic, Pacific, and Indian Oceans (NMFS and USFWS, 1993). Like the green turtle, not much is known about the habitat of juvenile hawksbills. However, they may occur in areas of advection where flotsam accumulates (Hawai'i Department of Land and Natural Resources, 2002). When juveniles reach about 20 to 25 cm in length they migrate to adult foraging grounds (Meylan, 1988). These foraging grounds include coral reefs, mangroves, and other hardbottom habitats in open bays and coastal zones in about 12 to 24 m of water (Eckert, 1993). Here they feed mainly on sponges, which can account for up to 95% of the turtles' diet (Meylan, 1988).

Hawkbills tend to occur in the coastal waters of the Hawaiian Islands, where they are more abundant in shallow, nearshore waters than they are in deeper, offshore waters. Nesting occurs in late May to early December with a peak from late July to early September (Eckert, 1993). Due to their nearshore preference in waters around 24 m in depth, it is unlikely that hawksbills will occur at Penguin Bank.

3.2.2.3. Loggerhead turtle (Caretta caretta)

Loggerhead turtles inhabit temperate, subtropical, and tropical waters of the Atlantic, Pacific, and Indian oceans (Ernst et al., 1994) occurring in coastal estuaries, bays, lagoons, and waters beyond the continental shelf (Dodd Jr., 1988). Juveniles inhabit pelagic convergence zones where they drift through dominant currents (Carr, 1987) and feed on Sargassum, zooplankton, jellyfish, and larval shrimp and crabs (Witherington, 1994). Adult loggerheads tend to be associated with reefs and other hardbottom habitats (Dodd Jr., 1988). Nesting grounds occur in warm, temperate, and subtropical regions. Nesting in the Pacific Ocean primarily occurs in Japan and Australia.

In the central Pacific loggerheads generally occur in deep, oceanic waters. Only four sightings and one stranding record of loggerhead sea turtles marks their presence at the Hawaiian Islands; no other records or sightings of the species has occurred. Due to this and their preference for deep, oceanic environments in the central Pacific, loggerhead turtles are not likely to be encountered at Penguin Bank.

3.2.2.4. Olive ridley turtle (Lepidochelys olivacea)

Olive ridley turtles occur in tropical and warm temperate waters worldwide. They typically occur in offshore waters and forage at the surface or at depths up to 200 m. They forage on fish, crabs, shrimp, snails, oysters, sea urchins, jellyfish, salps, fish eggs, and vegetation (NMFS and USFWS, 1998b). Nesting occurs throughout the year, with peak time varying with location. In the eastern Pacific peak nesting occurs between August and December, in Malaysia it peaks between February and July, and nesting peaks from October to February in Tailand.

Olive ridley turtles rarely occur in Hawaiian waters, but have been recorded as becoming entangled in fishing gear off of , Molokai, Maui, and O’ahu (Eckert, 1993). It is likely that they traverse through Hawaiian waters during foraging and developmental migrations (Nitta and Henderson, 1993). Due to their rare occurrence, it is unlikely that olive ridley sea turtles will be encountered at Penguin Bank.

3.2.2.5. Leatherback turtle (Dermochelys coriacea)

Leatherback turtles are distributed in tropical, subtropical, and warm-temperate waters throughout the year and tend to migrate to cooler, temperate waters during the late summer and early fall (James et al., 2005). Juveniles (defined as having less than 100 cm in curved carapace length) reside in waters with temperatures greater than 26 ºC. Adults range from the mid-ocean to the continental shelf as well as nearshore waters (Shoop and Kenney, 1992). Leatherbacks show a preference for convergence zones and areas of upwelling in the open ocean, along continental margins, and near large archipelagos (Hawai'i Department of Land and Natural Resources, 2002).

Leatherbacks do not nest at the Hawaiian Islands or anywhere in the central Pacific. They tend to prefer oceanic waters when in the central Pacific. Leatherbacks are unlikely to occur at Penguin Bank, due to their preference for deep, oceanic waters.

3.2.3. Marine Fish and Crustaceans

Bottomfishes, pelagic fishes, and crustaceans all occur at Penguin Bank. Bottomfish are fish species that live their lives on the ocean floor, whereas pelagic fish are species that live in the upper layers of the ocean. Crustaceans are aquatic invertebrates typically having a hard outer protective shelf. The three types of species are discussed in more detail below.

The Western Pacific Regional Fishery Management Council (WPRFMC) manages major fisheries within the EEZ around and the territories and possessions of the U.S. in the Pacific Ocean (Western Pacific Regional Fishery Management Council, 1998). The Magnuson-Steven Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act (SFA), contains provisions for the identification and protection of habitat essential to production of federally managed species. The act requires the National Marine Fishery Service (NMFS) to assist regional FMCs in including Essential Fish Habitats (EFHs) in their respective Fish Management Plan (FMP). The EFH for all life history stages (eggs, larvae, juvenile and adult) of bottomfish, pelagic fish, and crustacean species are shown in (Table 3-2),

Table 3-3, and Table 3-4.

3.2.3.1. Bottomfish

Bottomfishes that occur in Hawaiian waters include the gray jobfish (*Aprion virescens*), thick lipped trevally (*Pseudocaranx dentex*), giant trevally (*Caranx ignoblis*), black jack (*Caranx lugubris*), amberjack (*Seriola dumerili*), blue stripe snapper (*Lutjanus kasmira*), squirrelfish snapper (*Etelis carbunculus*), longtail snapper (*Etelis coruscans*), pink snapper (*Pristipomoides filamentosus*), yellowtail snapper (*Pristipomoides auricilla*), pink snapper (*Pristipomoides sieboldii*), yellow-barred snapper (*Pristipomoides zonatus*), Hawaiian grouper (*Epinephelus quemus*), and silver jaw jobfish (*Aphareus rutilansi*) (Department of the Navy, 2005). None of these species are listed as threatened or endangered by the ESA, however the Hawaiian grouper is listed as nearly threatened by the IUCN Red List (Cornish, 2004).

Bottomfishes occur in shallow water (0-100m) and deep water (100-400m) and are distributed throughout the tropical and subtropical waters of coastal shelves and slopes in the Hawaiian archipelago (Western Pacific Regional Fishery Management Council, 1998). In the waters surrounding the Hawaiian Islands bottomfish density seems to correlate with areas of high relief and current flow (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006). Commercially important species tend to inhabit the deep slopes of island coasts and banks at depths of 100 to 400 m (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006), which include the snappers and groupers.

Bottomfishes prefer sandy bottoms and rocky areas of high structural complexity at depth ranging from 60 to 350 m (Western Pacific Regional Fishery Management Council, 1998). Habitats for bottomfish in the western central Pacific include shallow water, deep water, and seamount areas (Western Pacific Regional Fishery Management Council, 1998). Snappers prefer hard substrate with relatively large numbers of holes and crevices that serve as cover (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006).

Essential fish habitat (EFH) for the egg and larval stage of bottomfishes consists of the water column extending from the shoreline to the outer limit of the EEZ down to a depth of about 400 m and encompasses both shallow and deep water complexes. EFH for adult bottomfishes is the water column and all bottom habitat which encompasses steep-slope and high relief habitat extending form the shoreline to a depth of 400m and also includes both shallow and deep water complexes (Department of the Navy, 2005).

Table 3-2 Bottomfishes Essential Fish Habitat Designations.

Species	Ma	La	Es	SB	Ss	Cr/ Hs	Pr	Sz	DST	Pe	Depth
BOTTOMFISH											
Shallow-water Species (0-100m)											
Gray Jobfish		A		J	J	AJ	AJ		A	EL	Adult depth 3-180m
Thicklip trevally		A	A		J	AJ			A	EL	Adult depth 18-183m
Giant tevally			J		J					EL	Adult depth 80m
Black jack									A	AJLE	Adult depth 12-354m
Amberjack						J	AJ		A	AJLE	Adult depth 0-250m
Blue strip snapper		A		J		AJ			A	EL	Adult depth 0-265m
Deep water Species (100-400m)											
Squirrelfish snapper						A			A	EL	Adult depth 90-350m
Longtail snapper						A			A	EL	Adult depth 164-293m
Pink snapper (P. filamentosus)					J				A	EL	Juvenile depth 65-100m Adult depth 100-200m
Yellowtail snapper									A	EL	Adult depth 180-270m
Pink snapper (P. sieboldii)									A	EL	Adult depth 180-360m
Yellow-barred snapper									A	EL	Adult depth 100-200m
Hawaiian grouper				J	A	A				EL	Adult depth 20-380m
Silver jaw jobfish						A			A	El	Adult depth 6-100m

Notes: Habitats: Mangrove (Ma), Lagoon (La), Estuarine (Es), Seagrass beds (SB), Soft Substrate (Ss), Coral Reef/Hard Substrate (Cr/Hs), Patch Reefs (Pr), Surge Zone (Sz), Deep-slope Terraces (DST), Pelagic/Open Ocean (Pe). Life State: Egg (E), Larvae (L), Juvenile (J), Adult (A).
Source: (Western Pacific Regional Fishery Management Council, 1998)

3.2.3.2. Pelagic fish

Pelagic fishes that occur in Hawaiian waters include striped marlin (*Tetrapurus audax*), broadbill swordfish (*Xiphias gladius*), northern bluefin tuna (*Thunnus thynnus*), albacore (*Thunnus alalunga*), Bigeye tuna (*Thunnus obesus*), mackerel (Scomber spp.), sickle pomfret (*Tatactichthys steindachnen*), lustrous pomfret (*Eumegistus illustris*), yellowfin tuna (*Thunnus albacares*), kawakawa (*Euthynnus affinis*), skipjack tuna (*Katsuwonus pelamis*), frigate tuna

(*Auxis thazard*), bullet tuna (*Auxis rochei*), slender tuna (*Allothunnus fallai*), Indo-Pacific blue marlin (*Makaira nigricans*), black marlin (*Makaira indica*), shortbill spearfish (*Tetrapturus angustirostris*), sailfish (*Istiophorus platypterus*), dolphinfish (*Coryphaena hippurus*), pompano dolphinfish (*Coryphaena equiselas*), wahoo (*Acanthocybium solandri*), moonfish (*Lampris guttatus*), escolar (*Lepidocybium flavobrunneum*), oilfish (*Ruvettus pretiosus*), crocodile shark (*Pseudocarcharias kamoharai*), common thresher shark (*Alopias vulpinus*), pelagic thresher shark (*Alopias pelagicus*), Bigeye thresher shark (*Alopias superciliousus*), shortfin mako shark (*Isurus oxyrinchus*), longfin mako shark (*Isurus paucus*), salmon shark (*Lamna ditropis*), silky shark (*Carcharhinus falciformis*), Oceanic whitetip shark (*Carcharhinus longimanus*), and blue shark (*Prionace glauca*) (Department of the Navy, 2005). None of these species are currently listed as threatened or endangered by the ESA. However, the IUCN Red list lists the albacore tuna, common thresher shark, and salmon shark as data deficient (Goldman and Human, 2000), the Shortfin mako shark, oceanic whitetip shark, crocodile shark, blacktip shark, and blue shark as near threatened (Smale, 2000), and the bigeye tuna and the great white shark as vulnerable (Uozumi, 1996).

Pelagic fishes are usually found in epipelagic to pelagic waters. However, some shark species can be found in inshore benthic habitats, neritic to epipelagic, and mesopelagic waters. Skipjack tuna, yellowfin tuna, and Indo-Pacific blue marlin tend to prefer warm surface layers where the water is well-mixed and relatively uniform in temperature (Western Pacific Regional Fishery Management Council, 1998). However, species such as bigeye tuna, striped marlin, broadbill swordfish, and albacore tune tend to prefer temperate waters associated with higher latitudes and greater depths (Western Pacific Regional Fishery Management Council, 1998). The broadbill swordfish and bigeye tuna are found at depths up to 800 m during the day and migrate to the surface at night (Western Pacific Regional Fishery Management Council, 1998). Most pelagic species make this daily vertical migration (National Marine Fisheries Service-Pacific Islands Region, 2001). Tuna and related species migrate towards the poles during warm months and migrate to the equator during cooler months (Western Pacific Regional Fishery Management Council, 1998).

EFH for eggs and larvae of pelagic fishes includes the epipelagic zone down to a depth of 200 m from the shoreline to the outer limits of the EEZ. EFH for adult pelagic fishes is the water column down to a depth of 1,000 m and from the shoreline to the outer limits of the EEZ (Department of the Navy, 2005).

Table 3-3 Pelagic Fishes Essential Fish Habitat Designations.

Species	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe	Depth
Temperate Species											
Striped marlin										AJLE	Depth distribution; goverened by temperature & stratification
Broadbill swordfish										AJLE	Surface-1000m
Northern bluefin tuna										AJLE	No data
Albacore tuna										AJL	Surface-300m
Bigeye tuna										AJLE	Surface-600m
Mackerel										AJLE	No data
Sickle pomfret										AJLE	Surface-300m
Lustrous pomfret										AJLE	Surface-549m
Tropical Species											
Yellowfin tuna										AJLE	Upper 100m with marked oxyclines
Kawakawa										AJLE	36-200m
Skipjack tuna										AJLE	Surface-263m
Frigate tuna										AJLE	No data
Bullet tuna										AJLE	No data
Indo-Pacific blue marlin										AJLE	80-100m
Black marlin										AJLE	457-914m
Shortbill spearfish										AJLE	40-1830m
Sailfish										AJLE	10-20m to 200-260m
Dolphinfish			AJ							AJLE	No data
Pompano dolphinfish										AJLE	No data
Wahoo										AJLE	<200m
Moonfish										AJ	Surface-700m
Non-marketable Species											
Escolar										AJLE	Surface-200m
Oilfish										AJLE	Surface-700m
Shark Species											
Crocodile shark										AJ	Surface-300m
Common thresher shark		J								AJ	Surface-366m
Pelagic thresher shark		A				A				AJ	Surface-152m
Bigeye thresher shark										AJ	Surface-500m
Shorftin mako shark										AJ	Surface-500m
Longfin mako shark										AJ	No data
Salmon shark										AJ	Surface-152m
Silky shark									A	AJ	Adult depth 18-500m
Oceanic whitetip shark										AJ	Adult depth 37-152m
Blue shark										AJLE	Surface-152m

Notes: Habitats: Mangrove (Ma), Lagoon (La), Estuarine (Es), Seagrass beds (SB), Soft Substrate (Ss), Coral Reef/Hard Substrate (Cr/Hs), Patch Reefs (Pr), Surge Zone (Sz), Deep-slope Terraces (DST), Pelagic/Open Ocean (Pe). Life State: Egg (E), Larvae (L), Juvenile (J), Adult (A).
Source: (Western Pacific Regional Fishery Management Council, 1998)

3.2.3.3. Crustaceans

Important crustaceans that may occur at Penguin Bank include Hawaiian spiny lobster (*Panulirus marginatus*), spiny lobster (*Panulirus penicillatus* and *Panulirus* spp.), ridgeback spiny lobster (*Scyllarides haani*), Chinese slipper lobster (*Parribacus antarcticus*), and the Kona crab (*Ranina ranina*). None of these species are listed on the ESA or the IUCN Red list.

These crustaceans occur in the Indo-Pacific region, however there are not many known studies on the distribution of these species in the tropical Pacific. There are about 13 species of spiny lobster that appear to occur in tropical and subtropical waters of the Pacific between 35ºN and 35ºS (Western Pacific Regional Fishery Management Council, 1998).

These species tend to prefer sheltered areas with rocky substrate and sandy bottoms. Spiny lobsters mainly inhabit windward surf zones of oceanic reefs. Spiny lobster adults are found on rocky substrate in well-protected areas, such as under rocks or in crevices and prefer water depths less than 10m but can be found at depths around 110m (Western Pacific Regional Fishery Management Council, 2001). Chinese slipper lobsters are found at depths between 20 and 70 m and around coral or stone reefs with sandy bottoms (Polovina, 1993). The Kona crab can be found in a variety of habitats, including sheltered bays, lagoons, surf zones, and especially in sandy habitats with depths between 24 and 115m (Western Pacific Regional Fishery Management Council, 1998).

The EFH for the larvae of these species includes the water column from the shoreline to the outer limit of the EEZ down to a depth of 150m. The adult EFH for these species includes all of the bottom habitat from the shore to a depth of 100m (Department of the Navy, 2005).

Table 3-4 Crustacean Essential Fish Habitat Designations

Species	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe	Depth
CRUSTACEANS											
Spiny and Slipper Lobsters											
Hawaiian spiny lobster		AJLE			AJ	AJLE	AJLE		AJLE	L	9-183m
Spiny lobster		AJLE			AJ	AJLE	AJLE		AJLE	L	9-183m
Ridgeback slipper lobster						A					10-135m
Chinese slipper lobster						A					0-20m
Kona crab					A						24-115m

Notes: Habitats: Mangrove (Ma), Lagoon (La), Estuarine (Es), Seagrass beds (SB), Soft Substrate (Ss), Coral Reef/Hard Substrate (Cr/Hs), Patch Reefs (Pr), Surge Zone (Sz), Deep-slope Terraces (DST), Pelagic/Open Ocean (Pe). Life State: Egg (E), Larvae (L), Juvenile (J), Adult (A).
Source: (Western Pacific Regional Fishery Management Council, 1998)

3.3. SOCIOECONOMICS

Major socioeconomic activities that may occur at Penguin Bank include fishing (both recreational and commercial), recreational boating, and SCUBA diving. Commercial fishing, recreational fishing, and SCUBA diving are discussed below.

3.3.1. Commercial Fisheries

The fisheries of Hawaii mainly consist of bottomfish fisheries and pelagic fish fisheries and operate from shore and state waters to beyond the United State boundaries. Hawaii's commercial fisheries grossed $52.4 million in 2003 and averaged $60.1 million from 1994 to 2003 (National Marine Fisheries Service, 2004). However, the actual economic value of commercial fisheries is far greater than this, because it generates important goods, jobs, and services. Figure 3-3, Figure 3-4 and Figure 3-5 show the fishing areas of the Hawaiian Islands.

3.3.1.1. *Pelagic fishery*

Pelagic fishery is the most popular among the fisheries of the Hawaiian Islands with 22 million pounds landed in 2002, which accounted for nearly 91% of all marine fishery landings in 2002 (Simonds, 2003). Pelagic fishing is directed at open ocean fishes found primarily in the mid and upper water column. A variety of hook-and-line gears and longlines are usually used to target swordfish, tunas, billfishes, pelagic sharks, dolphinfish, wahoo, moonfish, and pomfret (Department of the Navy, 2005).

The longline fishery, which mainly targets large tunas (yellowfin and bigeye), includes the entire EEZ and beyond, beginning at 50NM from shore around the islands of Maui, Molokai, Lāna'i, Kaho'olawe, and and beginning at 75NM from shore around the islands of Kaua'i and O'ahu. Longline landings represent 74% of all pelagic fisheries with 17 million lbs landed in 2003 (Western Pacific Regional Fishery Management Council, 2004).

The handline fishery, which mainly targets yellowfin and bigeye tunas occurs within the U.S. EEZ beyond 20 nm off shore, primarily at seamounts, FADs, and weather buoys (Simonds, 2003). Handline fisheries accounts for 9% of all pelagic fishery landings from 1987-2001 in the Hawaiian Islands (Western Pacific Regional Fishery Management Council, 2004).

The trolling fishery, which mainly targets yellowfin tuna, dolphinfish, and wahoo, occurs off of every Hawaiian island within roughly 20 nm from shore (Boggs and Ito, 1993). It accounts for 11% of all pelagic fishery landings from 1987-2001 in the Hawaiian Islands (Western Pacific Regional Fishery Management Council, 2004).

The pole and line fishery, which mainly targets skipjack and juvenile yellowfin tuna (Western Pacific Regional Fishery Management Council, 2004), occurs around all of the major Hawaiian Islands out to 20 nm from shore (Western Pacific Regional Fishery Management Council, 2005). Pole and line fishery accounts for only 7% of all pelagic fisheries in Hawaiian waters (Western Pacific Regional Fishery Management Council, 2004).

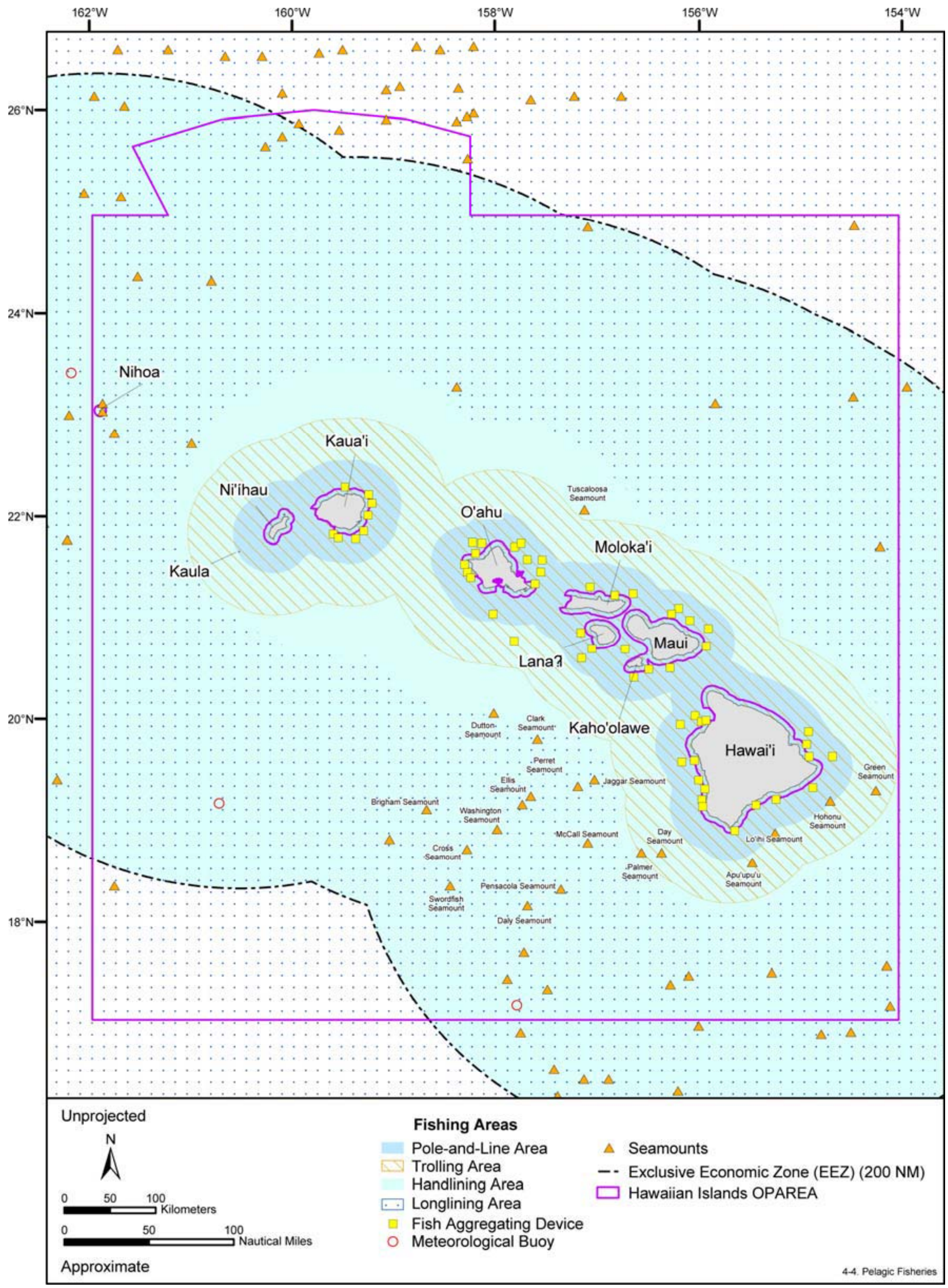

Figure 3-3. Pelagic fisheries of the Hawaiian Islands

Source information: (Boggs and Ito, 1993),(Western Pacific Regional Fishery Management Council, 2005).

3.3.1.2. Bottomfish fishery

The bottomfish fishery has declined since 1950 and does not currently represent a major fishery in Federal waters (Simonds, 2003). The fishery targets the following species: pink snapper, grey snapper or jobfish, longtail red snapper, shorttail red snapper, and seabass (Department of the Navy, 2005). About 80% of the fishing locations occur within 3NM from the shore. These grounds include Middle Bank, Penguin Bank, and waters around Maui, Lāna'i, and Molokai (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006). Penguin Bank is one of the most important bottomfish fishing grounds in the Hawaiian Island waters due to its extensive shallow shelf (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006). The monthly landings for Penguin Bank decline during the summer months lasting from April to September (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006).

Landings for the bottomfish fishery have fluctuated since 1983, peaking at around 66000lbs in 1996 and declining to 42,000lbs in 2003 (Western Pacific Regional Fishery Management Council, 2005). Bottomfish represent 13% of Hawaii fishermen catch, 25% of Oahu and Kauai fishermen catch, and 75% of the Maui fishermen catch (National Oceanic and Atmospheric Administration and Western Pacific Regional Fishery Management Council, 2006).

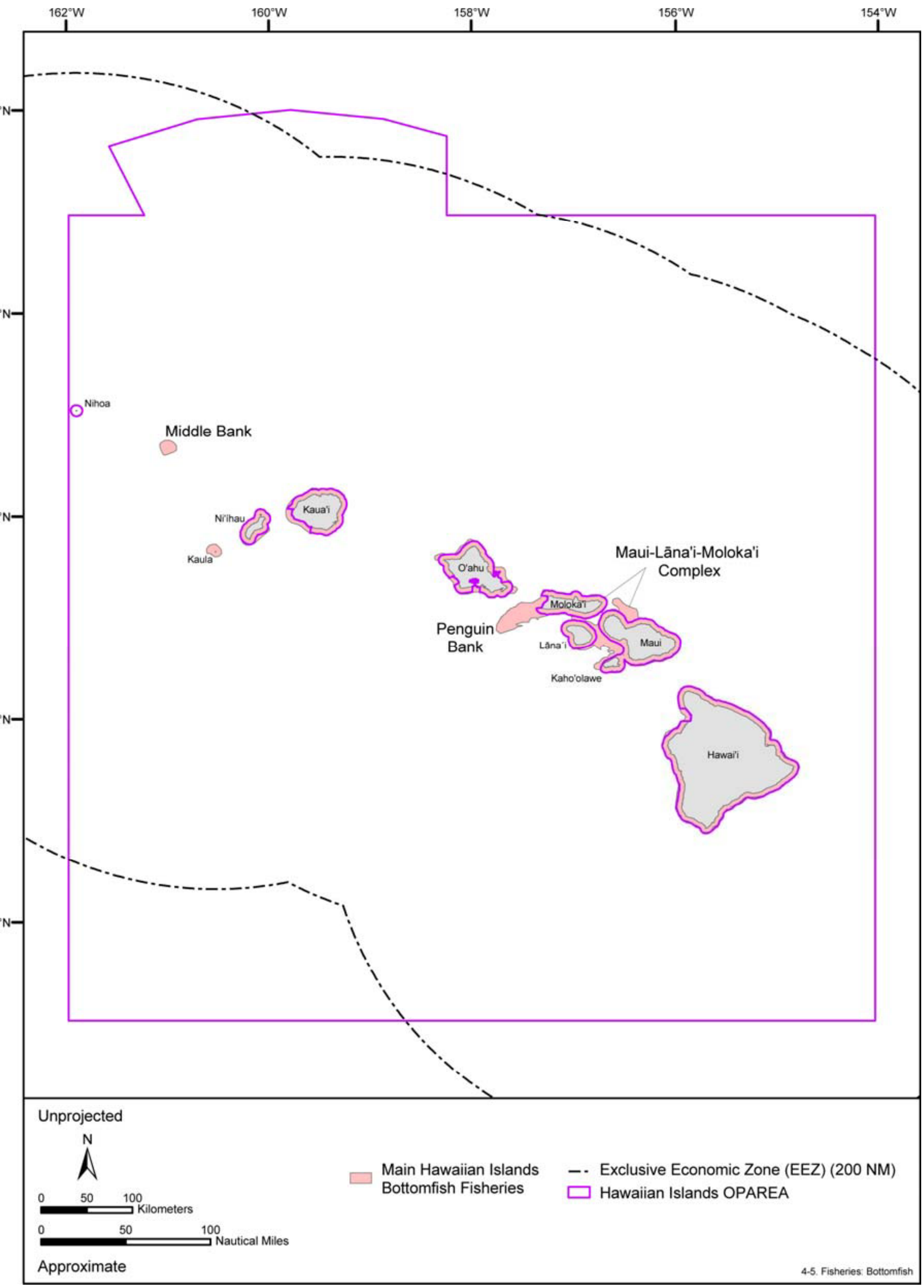

Figure 3-4. Bottomfish fisheries of the Hawaiian Islands

Source information: (Simonds, 2003) and (Western Pacific Regional Fishery Management Council, 2005).

3.3.1.3. *Crustacean fishery*

The crustacean fishery around the Hawaiian Islands mainly targets spiny lobsters and slipper lobsters using traps. These lobsters typically live on shallow reefs and banks with broken uneven bottoms and crevices in nearshore habitats. Lobsters are generally fished within 3NM of the shore. Lobsters are not allowed to be removed from Hawaiian waters from May to August (Department of the Navy, 2005).

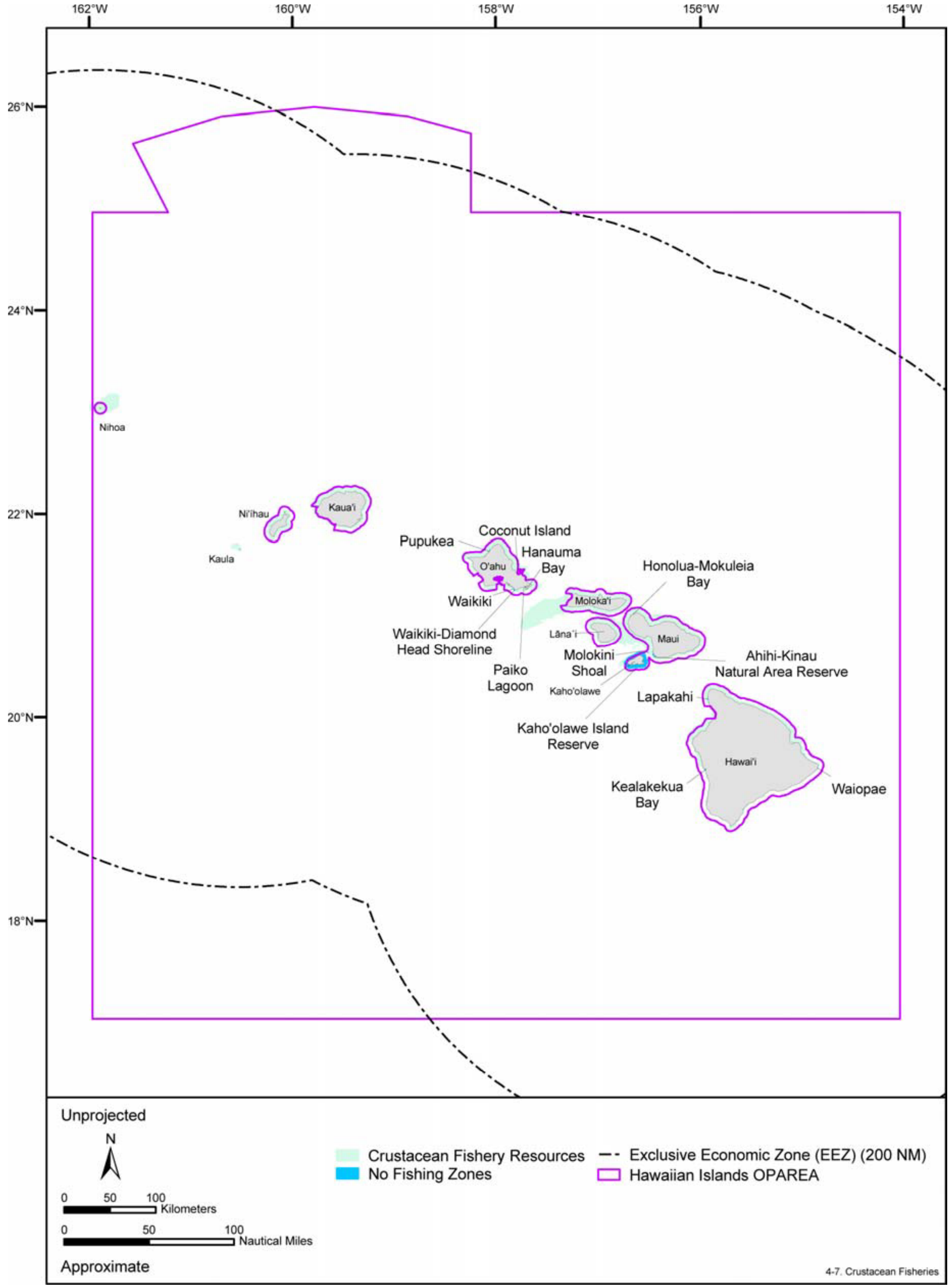

Figure 3-5. Crustacean fisheries of the Hawaiian Islands

Source information: (Simonds, 2003)

3.3.2. Recreational fishing

A wide variety of fishing tournaments take place in the Hawaiian Islands each year. These range from small locally organized tournaments to international tournaments such as the Hawaiian International Billfish Tournament. The maximum distance typically traveled by offshore tournament participants is no more than 75 nm from the tournament host site. Among the different tournaments, the level of participation varies between individual events, seasons, and years. Therefore the exact dates and weigh-in locations of annual tournaments will vary slightly year to year. As many as 50 fishing events may occur in a year at various locations throughout the Hawaiian Islands. However, they are usually concentrated around O'ahu Hawaii. They occur year round, but most occur between June and July (Department of the Navy, 2005).

3.3.3. SCUBA Diving

Along the entire South side of Molokai is the longest barrier reef in Hawaii. Due to high winds and large sea swells, Molokai is rarely used by recreational divers. There are dive operators that offer excursions to Molokai but only when ocean conditions allow. Oahu, which is more popular for recreational divers, offers a variety of dive sites that range from offshore lava formations and grottoes to plane and shipwrecks, many with large schools of fish and sea turtles (Hawaii Scuba Diving, 2007). Recreational SCUBA diving occurs mainly within 30m of shore (Hawaii Scuba Diving, 2007) and will most likely not occur at Penguin Bank.

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the environmental effects of the proposed action on the physical environment, biological environment, and EFH. The various aspects of conducting a TORPEX that may contribute to environmental effects include:

- Sonar effects from the proposed torpedo runs and end-of-run torpedo locators,
- Expended material from the torpedo and launch accessories,
- Vessel movement, and
- Low flying aircraft noise

The items listed above will be presented with respect to their effect on the existing environment accounting for seasonal variation (where applicable). Participating vessels will not be transmitting mid-frequency sonar during the proposed action.

4.1. SONAR EFFECTS

Sonar is transmitted by torpedoes and end-of-run pingers. The potential effects of each of these sources are discussed below.

4.1.1. Torpedo Sonar

4.1.1.1. Effects to the Physical Environment

Due to the relatively low source level characteristic and the transitory nature of Mk 48 torpedo sonar transmissions, the characteristics of the water column (e.g., chemical components, wave action) would be unaffected by sonar. Therefore, no effects from the transmission of torpedo sonar are expected on the physical environment at the TORPEX sites.

4.1.1.2. Effects to the Biological Environment

Marine Mammal Densities

Density estimates from Hawaiian waters rely primarily on: "Distribution and Abundance of Odontocete Species in Hawaiian Waters: Preliminary Results of 1993-1998 Aerial Surveys", October 2002, an aerial survey conducted within 25 nmi (46 km) of the main islands between 1993 and 1998 by Mobley, Spitz, Forney, Grotefendt and Forestell, and "Results of Marine Mammal Surveys on U.S Navy Underwater Ranges in Hawaii and Bahamas", March 2004, by Mobley. For the main Hawaiian Islands 16 survey were conducted between February 21 and April 5, 2003 (Table 4-1). Species for which no density estimates are available indicate that the species was not observed or that data did not support the generation of density statistics, not that an absence of species presence is expected.

Table 4-1: Marine Mammal Densities at Penguin Bank

Common Name	Density (Animals/km^2)	CV (%)
Small cetaceans:		
Melon-headed whale	0.0021	88.3
Spinner dolphin	0.0443	36.5
Spotted dolphin	0.0407	45.1
Striped dolphin	0.0016	118.5
Fraser's dolphin		
Stenella spp.	0.0076	64.6
Unidentified dolphin	0.0134	41.0
Tursiops/Steno:		
Bottlenose dolphin	0.0103	55.7
Rough-toothed dolphin	0.0017	62.8
Medium cetaceans:		
Risso's dolphin		
Short-finned pilot whale	0.0237	32.2
Blainville's beaked whale	0.0009	59.6
Cuvier's beaked whale	0.0006	51.2
False killer whale	0.0017	47.3
Dwarf sperm whale		
Pygmy sperm whale		
Longman's beaked whale		
Unidentified beaked whale	0.00005	97.1
Pygmy killer whale		
Bryde's whale		
Killer whale		
Fin whale		
Sei whale		
Blue whale		
Minke whale		
Unidentified cetacean	0.0004	72.3
Large cetacean:		
Sperm whale	0.0010	56.0
Humpback whale	0.1959	13.5

(Source: (Mobley Jr., 2004)

Marine Mammal Acoustic Effects Analysis

In assessing the potential effects to biological resources, a variety of factors must be considered, including source characteristics, animal presence and density, duration of exposure, and impact thresholds for the different types of species that may be present. Torpedo sonar transmissions have a high frequency range which is above 10 kHz. Criteria and thresholds used in this OEA/EA are based on those applied in previous Navy NEPA documents (NOAA, 2001, NOAA 2002). All thresholds are given in terms of an energy metric which is energy flux energy density level (EFD) and its unit are dB re 1 μPa^2-sec (Urick, 1983,). Auditory thresholds are presented in the tables below for marine mammals with regard to Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS), and a component of Level B harassment (behavioral harassment) due to the accumulation of total EFD.

Harassment criteria for marine mammals are evaluated based on developed thresholds from observations of trained cetaceans exposed to intense underwater sound under controlled conditions (Schlundt et al., 2000; Finneran and Schlundt, 2003; Finneran et al., 2005). These data are the most applicable because they are based on controlled, tonal sound exposures within the tactical sonar frequency range, and because the species studied are closely related to the animals expected at the location of the proposed action. Behavioral alterations, or deviations from a subject's normal trained behavior, and the exposure levels above which they were observed to exhibit behavioral deviations were reported (Schlundt et al., 2000; Finneran and Schlundt, 2003).

PTS and TTS are used as the criteria for determining injurious and non-injurious harassment. The onset of TTS in marine mammals was used as the lowest level of non-behavioral effects, and was derived from the results of the empirical studies on small cetaceans. These studies indicated the onset of TTS occurred around 195 dB re 1 μPa^2-sec (Ridgway et al., 1997; Schlundt et al., 2000). While it has not been measured in marine mammals, the criterion for onset PTS (auditory injury) is a positive difference of 20 dB of exposure from that of onset-TTS (or 215 dB re 1 μPa^2-sec), and was derived from the difference between onset-TTS and onset-PTS observed during experiments on terrestrial species (Yelverton, 1981; Richardson et al., 1995). If the received EFD level exceeds 215 dB re 1 μPa^2-sec, PTS would be predicted. Similarly, if the total received EFD level exceeds 195 dB re 1 μPa^2-sec but is less than 215 dB re 1 μPa^2-sec, TTS would be predicted. If the total received EFD level exceeds 190 dB re 1 μPa^2-sec but is less than 195 dB re 1 μPa^2-sec, a behavioral exposure (sometimes known as Sub-TTS) may be expected.

An analysis of the potential effects to marine mammals from a torpedo sonar system during MK48 TORPEX at the location of the proposed action was conducted using a methodology that calculates the total EFD that a marine mammal may receive from the acoustic transmissions. Environmental characteristics (e.g., bathymetry and SSPs) and operational source characteristics (such as source level, source frequency, transmit length and interval, run profile, and horizontal beam width) are used to determine the propagation loss of the acoustic energy, which was completed using the PCIMAT version of CASS. The propagation loss was then used in an acoustic energy model to create acoustic footprints, model source movements, and calculate received energy levels around the source. The received energy is calculated into an EFD, which is compared to the harassment criteria. For cetaceans and pinnipeds the criteria used are shown in Table 4-2, Table 4-3, and Table 4-4 as follows: 215 dB re 1 μPa^2 sec for Level A harassment, 195 dB re 1 μPa^2 sec for Level B harassment, and 190 dB re 1 μPa^2 sec for behavioral harassment (Department of the Navy Chief of Naval Operations, 2006).

Table 4-2: MMPA Level A Thresholds.

Marine Mammal Group	PTS Threshold (total energy) EFD (dB re 1 μPa^2-sec)
Cetaceans	215
California sea lions	226
Elephant seals	224
Harbor seals	203

Source: Derived from (Ridgway et al., 1997; Schlundt et al., 2000)

Table 4-3: MMPA Level B Onset TTS Thresholds.

Marine Mammal Group	Onset TTS Threshold (total energy) EFD (dB re 1 μPa²·-sec)
Cetaceans	195
California sea lions	206
Elephant seals	204
Harbor seals	183

Note: TTS thresholds for other pinnipeds are unknown.
Source: Derived from (Ridgway et al., 1997; Schlundt et al., 2000)

Table 4-4: MMPA Level B Behavioral Threshold.

Marine Mammal Group	Sub-TTS Threshold (total energy) EFD (dB re 1 μPa²·-sec)
Cetaceans	190

Source: Derived from (Ridgway et al., 1997; Schlundt et al., 2000)

The acoustic effect modeling results were totaled for the Level A and Level B exposures (Appendix B). The probability of a Level A exposure is negligible due to acoustic conditions at the location of the proposed action, the relative movement of the acoustic source, and the short duration of the proposed action. Predicted Level B behavioral exposure for conducting a practical estimate of seven TORPEXs in a single day for the most abundant species would be zero (Appendix Table B-3).

An analysis of the data indicated shows no exposures of marine mammals estimated. Taking a conservative approach and applying a consideration of the protective measures that would be in place, led to the conclusion that no actual exposures would occur due to the resulting estimates and for the following reasons:

1. In the model, species are artificially distributed evenly across the area, although in reality, all marine mammals tend to have patchy distribution patterns. The TORPEXs would occur only during daylight hours; therefore, marine mammals appearing near the participating command/recovery ship can be seen.

2. Trained observers would be posted on the command/recovery ship during TORPEXs.

3. The pelagic delphinids, such as common dolphins and offshore bottlenose dolphins typically pod in large groups and are readily spotted on the surface (Jefferson et al., 1993). Since the species is easily spotted, protection of this species would be straightforward.

4. Should marine animals be visible within or seen moving toward the test area, the test shall be either delayed or moved as required to avoid interference with the animals.

Given that the model produced no estimated exposure to marine mammals, the MK 48 torpedoes are highly mobile with a focused transmission beam pattern, the limited number of firings in one day, and the short duration of testing (no more than three days) it is unlikely that transiting marine mammals would be exposed to any sonar pulses. While unanticipated exposure to pulses from torpedo sonar may cause temporary behavioral reactions such as startling, diving, or surfacing, these disturbances would be of short duration and would not rise to the level of being biologically significant. Therefore, no reasonably foreseeable “takes” to marine mammals will result from the proposed action in conformity with the MMPA. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

Concerning sea turtles, investigations on auditory sensitivity suggest that it is limited to low-frequency ranges. Maximal sensitivity for green sea turtles occurs between 300 to 400 Hz, with a rapid decline in sensitivity for lower and higher tones (Ridgway et al., 1969). Similarly, a hearing range of about 250 to 1000 Hz was reported for loggerheads (Moein et al., 1994) and around 250 Hertz (Hz) for juvenile loggerheads (Bartol et al., 1999). The effective frequency range for useful hearing in marine turtles is probably between 100 to 1000 Hz (Ridgway et al., 1969; Lenhardt, 1994; Moein et al., 1994; Bartol et al., 1999). The frequency range of the MK 48 torpedo is well above the known hearing range of sea turtles. Based on this data, no effects from torpedo sonar to sea turtles are anticipated.

Based on current knowledge, all fish are able to perceive lower frequency sounds, from below 50 Hz to 1,500 Hz, whereas some fish have developed accessory hearing structures enabling them to detect higher frequencies over 3,000 Hz (Fay 1988; Ramcharitar and Popper 2004). A select few can even detect sounds over 120 kHz (Mann et al. 2001). Broadly, fishes can be categorized as hearing specialists or hearing generalists (Scholik and Yan, 2002). Fishes in the hearing specialist category (e.g. carps, catfishes, and mormyrids) have a broad hearing frequency range with a low auditory threshold due to a mechanical connection between an air filled cavity, such as a swimbladder, and the inner ear. Specialists detect both the particle motion and pressure components of sound and can hear at levels above 1,000 Hz, whereas generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). The best hearing sensitivity of many hearing generalists is at or around 300 Hz (Popper 2003). Hearing specializations are most often found in freshwater species, while in marine species, specializations are quite rare (Amoser and Ladich 2005). A search of the literature regarding cowcod has not shown them to be hearing specialists. Since most marine fish are anticipated to be hearing generalists, torpedo sonar transmission would not fall within their hearing range. Based on this data, no effects from torpedo sonar to fish are anticipated.

4.1.1.3. Effects to EFH

Due to the localized nature of the TORPEX and its relatively short duration, overall impact to EFH is judged to be insignificant. It is therefore concluded that no significant effects to EFH would result from the torpedo sonar.

4.1.1.4. Effects to Socioeconomics

Effects to Commercial and Recreational Fishing

The proposed action entails test operations in the waters on Penguin Banks off of Molokai, which are used for recreational and commercial fishing. Of the pelagic fisheries, longline landings represent the largest in Hawaiian waters but would not be impacted due to the proposed action because the fishery generally beings at 50 nm from shore and beyond, while the proposed action is proposed within 12 nm of shore. Similarly the crustacean fishery would not be impacted by the proposed action because lobsters are not permitted to be removed from Hawi'ian waters from May to August. Bottom fishing at Penguin Bank is one of the most important fishing grounds in the Hawaiian Island waters due to its extensive shallow shelf. However, during TORPEXs, the test area would be cleared of fishing activity. Despite the inconvenience of site unavailability, consequences to commercial and recreational fishing from TORPEXs are considered minimal due to the very brief nature of the exercise. There would be no significant impact on recreational and commercial fishing from the proposed action.

Effects to SCUBA Divers
Diving and swimming activities may occur within these waters. However, due to high winds and large sea swells, Molokai is rarely used by recreational divers. Recreational diving mainly occurs within 30m (98 ft) of shore while the proposed action would operate in waters greater than 200 feet in depth, therefore, divers would not likely dive in the area of the proposed action. Due to a Notice to Mariners message issued prior to the exercise, the unlikely occurrence of divers in the exercise area, and surface vessels employing lookouts that would spot dive flags and boats, there would be no significant impact on SCUBA divers.

4.1.2. End-of-Run Locator Sonar Effects

An end-of-run locator, or pinger, is installed on MK 48 torpedoes to facilitate their localization for recovery. The pinger is activated upon completion of the run and propulsion shutdown.

4.1.2.1. Effects to the Physical Environment

The signal emitted by the pinger to facilitate recovery would have no effect to the physical environment, due to the transient nature of the sound and the lack of alterations to the water characteristics.

4.1.2.2. Effects to the Biological Environment

The pinger emits an omni-directional pulsed signal at approximately 7.2 kHz at source levels up to 175 dB re 1 μPa at 1 m from the source. The pulse length of a single ping is a maximum of 10 millisecond (msec) with a 1 sec repetition rate. One ping has an EFD level of 155 dB re 1μPa^2 -sec at 1 m from the source. In order for an animal to be exposed to an EFD level above the TTS threshold criterion of 195 dB re 1μPa^2 -sec, the animal would have to be exposed to 10,000 pings at a range of 1 m from the pinger. Farther from the pinger, even more pings would be required for an animal to be exposed to an EFD level greater than the TTS criterion. Therefore, the low source level and duty cycle of these pingers would preclude them from affecting marine mammals. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat. Additionally, the frequencies at which the pinger operates are above the hearing threshold for sea turtles and fish as discussed in Section 4.1.1.

4.1.2.3. Effects to EFH

Due to the localized nature of the test and its short duration, overall impact to EFH would be insignificant. No significant effects to the aforementioned EFH would result from the end-of-run pinger.

4.1.2.4. Effects to Socioeconomics

Effects to commercial and recreational fishing and SCUBA divers are the same as described in Section 4.1.1.4.

4.1.3. Countermeasures

A small number of acoustic countermeasures (seven or less) would be launched during the proposed action. Once launched countermeasures will produce sound for time periods up to several tens of minutes. Expected characteristics of the acoustic emission from each launch are classified.

4.1.3.1. Effects to the Physical Environment

The acoustic emissions from countermeasures would have no effect to the physical environment, due to the transient nature of the sound and the lack of alterations to water column characteristics.

4.1.3.2. Effects to the Biological Environment

The effects of acoustic countermeasures on marine life have been calculated. For the maximum source level available for countermeasure use, the numbers of exposures to marine animals fall below the minimal "take" threshold by a significant amount (Lazauski, 2002). Therefore no significant impacts are anticipated to the biological environment at the TORPEX sites. Further details can not be presented due to classification levels. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.1.3.3. Effects to EFH

Due to the localized nature of the test and its short duration, overall impact to EFH would be insignificant. No significant effects to the aforementioned EFH would result from countermeasures.

4.1.3.4. Effects to Socioeconomics

Effects to commercial and recreational fishing and SCUBA divers are the same as described in Section 4.1.1.4.

4.2. RELEASE OF CHEMICAL PRODUCTS

For the purposes of this analysis, marine water quality is evaluated with respect to possible releases of constituents of concern from TORPEX activities at Penguin Bank. The Clean Water

Act prohibits discharge of hazardous substances into waters out to 200 nmi (370 km). The by-products produced during the testing of the torpedo would be rapidly diluted and would not effect water quality.

4.2.1. Otto Fuel II and Combustion Byproducts

Chemicals that could be released as a result of the proposed action are Otto Fuel II (OF II) and combustion byproducts. The MK 48 torpedo uses OF II to propel itself from the launch point to the target. OF II is combusted in the torpedo engine and the combustion products are exhausted into the ocean. A typical MK 48 exercise torpedo firing would consume no more than 448 lbs (203.2 kg) of fuel.

4.2.1.1. Effects to the Physical Environment

The major combustion products of OF II and the quantities produced during a successful test run of a MK 48 torpedo have been analyzed (Table 4-5) (Qadir et al., 1994). These products are exhausted into the torpedo wake, which is extremely turbulent and would cause rapid gas diffusion and absorption. Utilizing a conservative approach (i.e., assuming the mix zone for the exhaust products in the torpedo wake to be twice the diameter of the torpedo), the volume of the seawater representative of the wake for the worst-case torpedo run is calculated to be 5.397×10^6 gallons (2.043×10^7 liters). Based on this calculation, the expected gaseous discharge or expected percentages by weight, potential effects can be determined.

Table 4-5: Analysis of Combustion Products of Otto Fuel II

Exhaust Products	% by Weight	Exhaust Concentration (ppb)	Remarks/Potential Effects
Carbon Dioxide (CO_2)	17.1	1710	Naturally occurs in seawater; bioactive
Carbon Monoxide (CO)	44.6	4430	Ocean concentrations from 10-1000 ppb; excess would bubble to surface
Water (H_2O)	16.0	1590	Component of seawater
Hydrogen (H_2)	0.2	20	Low solubility in seawater; bubble to surface
Nitrogen (N_2)	16.8	1670	Ocean concentrations from 8,700 – 13,100 ppb; nitrogen fixation by blue green algae to micronutrient
Methane (CH_4)	3.8	380	Naturally occurs in seawater; bioactive; excess would bubble to surface
Ammonia (NH_3)	0.1	10	Micronutrient; bioactive
Hydrogen Cyanide (HCN)	1.4	140	Above EPA National cyanide discharge recommendations for marine waters of 1 μg/l (approx 1 ppb).
Nitrogen Oxide (NO_x)	Trace	N/A	Micronutrient; bioactive

Concentrations of up to 140 parts per billion (ppb) of HCN are discharged from the MK 48 torpedo. The Environmental Protection Agency's (EPAs) acute and chronic national recommendation for maximum HCN concentration in marine waters is 1 μg/L, or approximately 1 ppb (Ballentine, 1995; Department of the Navy, 2001), making exhaust emissions above the recommended level. Since the torpedo's wake is 42 inches (in) (1.07 m) in diameter, the range within which the HCN concentration is above 1 μg/L is estimated at 20.67 ft (6.3 m) around the torpedo's path. HCN is extremely soluble in seawater, and would rapidly diffuse to levels below 1 μg/L. Therefore, no significant impacts to the physical environment from combustion byproducts would occur at the location of the proposed action.

4.2.1.2. Effects to the Biological Environment

The Navy has determined that marine organisms that cannot vacate the area (e.g., plankton species such as copepods) can withstand OF II concentrations to the point where they become anaesthetized. While in-situ concentrations of OF II are not anticipated at levels near those required to anaesthetize marine organisms at sea, the Navy has found these organisms, under experimental conditions, do recover when OF II dissipates. Additionally, the Navy has determined that five types of common marine bacteria (*Pseudomonas, Flavobacterium, Vibrio, Achromobacte*r, and *Arthrobacter*) attack and ultimately process OF II, thereby removing trace amounts that may remain. Therefore, the impact of OF II on the biological environment is judged extremely low at the location of the proposed action (Department of the Navy, 1997).

Effects to the biological environment from the release of combustion products would be governed by the amount of harmful substances remaining in the water following the torpedo run. HCN would be the constituent of most concern because initial concentrations following a torpedo run would be above EPA discharge recommendations for marine waters. However, HCN is extremely soluble in seawater and would rapidly diffuse to levels below 1 μg/L; therefore, the release of OF II would have no significant impact to the biological environment at the TORPEX sites. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.2.1.3. Effects to EFH

Many of the combustion byproducts occur naturally in seawater in greater amounts than those potentially released by the torpedo. In addition, the rapid dilution of OF II and combustion byproducts would result in chemical concentrations returning to background levels quickly after detonation. Therefore, the potential effects of OF II and combustion byproducts would result in no adverse impacts to EFH at any of the test sites. Therefore, no impacts are anticipated to EFH at the location of the proposed action.

4.2.1.4. Effects to Socioeconomics

Due to the localized nature of the TORPEX, the rapid dilution of chemical by-products produced during a TORPEX, and its relatively short duration, overall impact to socioeconomics are judged to be insignificant.

4.3. EXPENDED MATERIALS

Marine debris that would be introduced to the environment as a result of this TORPEX would be from countermeasures and torpedo components (guidance wire, and improved flex hose). Because this debris would be introduced to the TORPEX sites, there is a potential impact on marine mammals and threatened and endangered species through ingestion or entanglement.

4.3.1. Countermeasures

4.3.1.1. Effects to the Physical Environment

Over time, countermeasures would degrade, corrode, and become incorporated into the bottom sediments. The constituents found in countermeasures typically include compressed air from the depth control system, hydrogen gas and effluent from the seawater battery, and aluminum, steel, and magnesium from hardware components. The main chemical constituent of concern is silver. Based on the calculations performed for this type of battery, no substantial degradation of marine water quality would occur from the release of metals from batteries. Other metal and non-metal components that could potentially affect marine water quality include metal and non-metal components such as the metal housing and internal wiring.

Solid metal components of the countermeasures are corroded by seawater at slow rates, which translates into slow release rates. Once the metal surfaces corrode, the rate of metal released into the environment would decrease. Releases of constituents from metal and non-metal countermeasures components would be further reduced as a result of natural encrustation of exposed surfaces. In addition, the outside metal case would become encrusted as a result of natural seawater processes that would slow the rate of further corrosion. Therefore, no impacts are anticipated to the physical environment at the TORPEX sites.

4.3.1.2. Effects to the Biological Environment

Countermeasures would not be recovered and would sink to the ocean floor. They are relatively large, negatively buoyant, and not likely to be ingested by marine animals because of their size. Due to the calculations resulting in small areas of influence and the small number of countermeasures proposed to be launched, no significant impacts are anticipated to the biological environment at the TORPEX sites. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.3.1.3. Effects to EFH

The potential effects to EFH from countermeasures would be similar to those described for the physical environment (Section 4.3.1.1). Eventual encrustation would prevent would prevent release of metal and non-metal constituents into the environment. The use of countermeasures would result in no adverse impacts to EFH at the TORPEX sites. Therefore, no impacts are anticipated to EFH at the TORPEX sites.

4.3.1.4. Effects to Socioeconomics

The release of constituents from un-recovered countermeasures that sink to the ocean floor would be minor, rapidly diluted, and localized. Due to the relatively short duration of the TORPEX and minor localized release of constituents, overall impacts to socioeconomics are judged to be insignificant.

4.3.2. Torpedo Components

Torpedo component material that is expended into the marine environment includes guidance wire and an improved flex hose (IFH). Guidance wire used by the MK 48 torpedo is a maximum of 0.043 in (0.11 cm) in diameter and is composed of a copper-cadmium core with a polyolefin coating. Up to 15 nmi (28 km) of the wire may be deployed during a run, which would sink to the sea floor at a rate of 0.5 ft (0.15 m) per second (Department of the Navy, 1997). The IFH minimizes the possibility of entanglement of the guidance wire as the torpedo departs the submarine. Upon completion of a torpedo launch from a submarine, the IFH is released into the sea.

4.3.2.1. Effects to the Physical Environment

The guidance wire is coated with polyolefin, thereby rendering the metal wire unavailable for reaction in the environment. Therefore, the wire is not likely to readily degrade. The guidance wire is not expected to have an effect upon the physical environment at the TORPEX sites.

The IFH contains 52.68 lbs (23.9 kg) of metallic lead. Lead occurs naturally in seawater and enters through weathering of igneous materials and from undersea magmatic sources. It is removed naturally from seawater through biological, chemical, and physical processes. Upon release to the marine environment, the lead in the IFH would be subject to oxidation and corrosion. Existing conditions that would retard or eliminate the lead from entering marine waters includes: (1) burial by sediment resulting in an anaerobic environment and thus no oxidation of lead; (2) anaerobic bottom conditions and thus no oxidation of lead; (3) aerobic conditions with initial ionization of lead which is dispersed by water movement and then development of an oxidation layer; and (4) marine growth. It is reasonable to expect that only small amounts of lead would be released to the marine environment and would be dispersed quickly. Therefore, the IFH is not expected to have a significant effect upon the physical environment at any of the test sites.

4.3.2.2. Effects to the Biological Environment

The potential effects to the biological environment would be from the ingestion of or entanglement in expended materials. The tensile strength of the guidance wire is a maximum of 42 lbs (19.05 kg). In comparison, recent regulations promulgated to reduce fishing related effects to marine mammals require that lobster gear buoy lines employ a weak link with a breaking strength of 600 lbs (272 kg) for near shore waters (Department of the Navy, 2001). Given the low breaking strength of the wire, entanglement would not pose a serious threat of harm to a protected marine animal, particularly after the wire settles on the sea floor. The guidance wire is expected to sink to the sea floor following the test event. Due to the length of the guidance wire, ingestion of guidance wire is not expected and, therefore, would not have an effect upon protected marine mammals or sea turtles.

The IFH is designed to prevent entanglement of the guidance wire when the torpedo is launched, and therefore is somewhat rigid. The stiffness of the IFH would prevent it from forming loops and creating entanglement problems with marine mammals and sea turtles. Therefore, entanglement in the IFH is not expected at the TORPEX sites. Because of the relative large size of this debris, the potential risk of ingestion by marine animals, including sea turtles, is considered small. As such, the potential impact from ingestion on the survivability of these marine animals is also considered to be insignificant.

The IFH would not pose an ingestion or entanglement threat to protected species and therefore would result in no effects to these species at the TORPEX sites. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.3.2.3. Effects to EFH

The potential effects to EFH from torpedo components would be similar to those described for the physical environment (Section 4.3.2.1). Although the IFH does contain lead, lead salts that have limited solubility would form on exposed surfaces, minimizing the potential effects on the environment, and subsequently on EFH. The use of guidance wire and IFH would result in no adverse impacts to EFH at the TORPEX sites. Therefore, no impacts are anticipated to EFH at the TORPEX sites.

4.3.2.4. Effects to Socioeconomics

There would be no release of constituents from coated IFH. The un-recovered guidance wire that sinks to the ocean floor would be minor and localized. Due to the relatively short duration of the TORPEX and minor localized release of potential lead constituents, overall impacts to socioeconomics are judged to be insignificant.

4.4. VESSEL MOVEMENT

4.4.1. Vessel Movement Effects to the Physical Environment

Vessel traffic associated with the proposed action is minimal and is no more concentrated than commercial or recreational traffic. Vessel movement is not expected to have an effect upon the physical environment at the location of the proposed action.

4.4.2. Vessel Movement Effects to the Biological Environment

Collisions with commercial and Navy ships can cause major wounds and may occasionally cause fatalities to sea turtles and cetaceans. The most vulnerable marine mammals are slow-moving cetaceans or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale). Accordingly, the Navy has adopted protective measures to reduce the potential for collisions with surfaced marine mammals and sea turtles. These protective measures include the use of lookouts trained to detect objects on the surface of the water, including marine mammals and sea turtles, and reasonable and prudent actions to avoid the close interaction of Navy assets and marine mammals and sea turtles. Additional protective measures are detailed in Chapter 5.

The short duration of the proposed TORPEX, posting of watch standers, and low animal densities in the exercise areas significantly reduce the potential for collisions with marine mammals and sea turtles; vessel movements are not expected to result in impacts to the biological environment at the location of the proposed action.

There is negligible risk that a marine mammal could be struck by a torpedo. This conclusion is based on: (1) a review of ASW torpedo design features, and (2) a review of a large number of previous U.S. Navy exercise torpedo events.

ASW torpedo design features: The acoustic homing programs of U.S. Navy ASW torpedoes are designed to detect either active sonar returns from the metal hull/large internal air volume interface or the mechanical machinery noise signature of a submerged submarine. They are specifically designed to disregard false targets. As a result, their homing logic ignores the relatively small air volume associated with the lungs of marine mammals. They do not home on marine mammals.

Review of previous U.S. Navy exercise torpedo events: The Navy's instrumented underwater acoustic range at the Pacific Missile Range Facility (PMRF) has been conducting ASW exercise torpedo events since 1968. The PMRF, located in Hawaiian waters, is host to many marine mammals. The proposed action is similar to testing conducted at PMRF during the past four decades. Of the 14,322 exercise torpedo runs conducted at PMRF, no recorded/reported instances of a marine mammal strike by an exercise torpedo have occurred. This review of exercise torpedo events included both interviews with supervisory personnel who have been on scene for the torpedo firing events since 1971 and a record review of the 5,298 events that have occurred since 1990. These records include data on the actual exercise event and the post-exercise inspection of the exercise torpedo.

Based on the information above, the likelihood of a torpedo striking a marine mammal or sea turtle is negligible. Therefore, torpedo movements are not expected to result in impacts to the biological environment at the northwest and southeast TORPEX sites. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.4.3. Vessel Movement Effects to EFH

Vessel movement would have no significant impact on the EFH at the location of the proposed action due to the transiting nature of the vessel through the habitat.

4.4.4. Effects to Socioeconomics

Effects to commercial and recreational fishing and SCUBA divers are the same as described in Section 4.1.1.4.

4.5. LOW FLYING AIRCRAFT NOISE

4.5.1. Low Flying Aircraft Effects to the Physical Environment

Low flying aircraft would not have an effect upon the physical environment at the location of the proposed action due to the lack of changes to the characteristics of water below the proposed aircraft.

4.5.2. Low Flying Aircraft Effects to the Biological Environment

Airborne sound from a low-flying helicopter or airplane may be heard by marine mammals and sea turtles. Noise from aircraft would not cause physical effects but was reviewed for the potential to affect species' behaviors. The primary factor that may influence abrupt movements of animals is engine noise; specifically, changes in engine noise (Hain et al., 1999). Variable responses to aircraft are partly a result of differences in altitude and flight pattern (Smith, 1989; Hubbard, 1994). Responsiveness of cetaceans to these factors may include hasty dives or turns, slapping the water with flukes or flippers, or swimming away from the aircraft track. These responses to aircraft noise are within the range of normal behaviors and would be much less than required to produce TTS. These disturbances would be of short duration and would not rise to the level of biological significance. Therefore, no significant effects are anticipated at the location of the proposed action from low flying aircraft. The proposed action would not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat.

4.5.3. Low Flying Aircraft Effects to EFH

Low flying aircraft would have no impact on EFH at the location of the proposed action due to the lack of changes to the characteristics of the water column below proposed aircraft.

4.5.4. Effects to Socioeconomics

Effects to commercial and recreational fishing and SCUBA divers from low flying aircraft would not be significant as described in Section 4.1.1.4.

4.6. CUMULATIVE IMPACTS

The CEQ regulations implementing the procedural provisions of NEPA defines cumulative effects as:

> *[T}he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions* (40 CFR §1508.7).

This action is the only known action occurring in the geographic area at the time. The action's protective measures will preclude other actions which might otherwise lead to significant cumulative impacts. Therefore, cumulative impacts from a combination of projects are not expected.

CHAPTER 5 PROTECTIVE MEASURES

The Navy has developed protective measures to minimize the probability that any protected marine species would be affected by the proposed action. Since the proposed action does not involve the operation of mid-frequency sonar, the measures listed in the National Defense Exception were considered but were not applicable in every case. The Protective Measures Plan would be promulgated to TORPEX participants during a pre-test briefing. In order to further preclude potential impacts to marine mammals or sea turtles, the following mitigation measures shall be adhered to:

A. All TORPEX firings would be conducted during the environmentally preferred months of June or July, during daylight hours, defined as local sunrise to sunset.

B. During the conduct of the TORPEX, a series of surveillance flights would be conducted prior to and during the conduct of TORPEXs to ensure that no visible protected species, obvious indicators of oceanic fronts, or non-participant vessel traffic are located within the test area. Survey protocol would be as follows:

(a) The test area would continually be monitored throughout the exercise. If protected species are observed outside but within close vicinity of the test area, the observing aircraft would track them. If a protected species is observed moving towards the test area, the Officer in Tactical Command (OTC) would be notified. The OTC would determine whether it is likely that the animal would enter the test area during the torpedo firing. If so, the OTC would suspend the test until the animal no longer appears likely to enter the test area. If a protected species is observed, the OTC would be notified, and torpedo firings would be suspended until the test area is clear of all visible protected species. If a species is observed diving within the test area the TORPEX would be delayed until the animal is re-sighted outside the test area, or 30 minutes has elapsed. After 30 minutes, if the animal has not been re-sighted, it is assumed to have left the test area. This is based on a typical dive time of 30 minutes for deep diving marine mammals.

(b) During breaks in the TORPEX lasting 30 minutes or more, the test area would again be surveyed for protected species. If any species are sighted within the test area, the OTC would be notified, and the procedure described above would be followed.

(c) Upon completion of the TORPEX, a final surveillance of the test area would be performed while retrieving the torpedo.

C. Visual surveys of the test area would be conducted by trained observers on the command vessel and aircraft involved in the exercise in order to search for marine mammals and sea turtles. Participants would be required to report sightings of any marine mammals, or provide negative reports, prior to torpedo firings. Reporting requirements would be outlined in the test plans and procedures written for the TORPEX and would be emphasized as part of pre-exercise briefings conducted with all participants and trained observers.

D. In addition to the visual surveillance discussed above, aerial surveys would be conducted. The aircraft used would be specified to facilitate a clear view of the test area. At least one trained observer, in addition to the pilot, would be on the aircraft. While conducting surveillance, the aircraft would not exceed a speed of 100 knots (kts, nautical miles per hour).

E. All observers would have received training in the field identification, distribution, and relevant behaviors of marine mammals of the Pacific. Observers would complete the Standard Sighting Forms that would be submitted to the Fisheries Science Center and any sightings of the Pacific right whale would be immediately communicated to the Sighting Advisory System.

F. No TORPEX would commence until trained observers from the vessel and aircraft involved in the exercise have reported to the Officer in Tactical Command (OTC) and the OTC has declared that the range is clear of visible marine mammals and sea turtles. Should protected animals be visible within or seen moving toward the test area, the TORPEX would be either delayed or moved as required to avoid interference with the animals.

G. The test would be suspended if the Beaufort Sea State exceeds 3 or if visibility precludes safe operations.

H. In the event of an animal strike, or if an animal is discovered that appears to be in distress, immediate reporting would be done through the appropriate Navy chain of command.

I. The proposed action would not commence unless the test area can be adequately monitored through visual surveillance. In addition to the aircraft conducting surveillance flights, observers aboard a surface command ship, would also be monitoring the test area throughout the test event.

J. In the unlikely event that protected species are observed in the area, a detailed description of the animal would be completed, the location would be noted, and, if possible, photos would be taken. In the event of an animal strike, or if an animal is discovered that appears to be in distress, immediate reporting would be done through the appropriate Navy chain of command.

Additionally, prior to conducting the exercise, a Notice to Mariners would be published identifying the TORPEX location and schedule. Range clearance operations would be conducted in the hours prior to commencement and throughout the exercise, ensuring that no shipping is located within the area of the test. Once the range is clear of all non-exercise traffic, the TORPEX would proceed.

CHAPTER 6 CONCLUSIONS

The proposed action would provide valuable opportunities and the necessary testing to determine the Mk 48 ADCAP torpedo performance in an environment representative of shallow water littoral threat environments, and to ascertain the requirement for improvements or modifications.

Analysis of the existing environment suggests that the location of the proposed action is characterized by areas of shallower water and diverse bathymetric relief. The potential effects to marine mammals from TORPEXs were quantitatively analyzed. Based on the analyses provided herein, it is concluded that, with the implementation of the protective measures plan, the proposed action as implemented in Alternative 3 would:

- not significantly affect the environment,
- not result in significant harm to natural resources in the global commons,
- not affect threatened or endangered species protected under the ESA, or modify or destroy their critical habitat,
- result in no reasonably foreseeable “takes” to marine mammals from the proposed action in conformity with the MMPA, and
- not adversely affect EFH.

The determination of which test box would be used would be based upon operational factors consisting of logistics and asset availability directly preceding the scheduled TORPEX. The Navy has determined that an Overseas Environmental Impact Statement is not required for the proposed action.

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APPENDIX A : MARINE MAMMAL AND SEA TURTLE SPECIES DESCRIPTIONS

The purpose of this appendix is to elaborate on cetacean species not discussed in sections 3.2.1.1.a through 3.2.1.1.i. These species are rare visitors to the Hawaiian waters based on occasional sightings, or stranding records. These species include the sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*), minke whale (*Balaenoptera acutorostrata*), pygmy and dwarf sperm whales (*Kogia breviceps* and *Kogia simas*), rough-toothed dolphin (*Steno bredanensis*), striped dolphin (*Stenella coeruleoalba*), Risso's dolphin (*Grampus griseus*), melon-headed whale (*Peponocephala electra*), Fraser's dolphin (*Lagenodelphis hosei*), pygmy killer whale (*Feresa attenuata*), killer whale (*Orcinus orca*) and common dolphin.

A.1. SEI WHALE (*BALAENOPTERA BOREALIS*)

Sei whales are listed as endangered under the ESA and the IUCN Red List. Currently there are about 77 sei whales in the Hawaiian Island stock (Carretta et al., 2005). Sei whales are usually found in deep, oceanic waters of cool temperate zones in areas over steep bathymetric relief such as continental shelf break, canyons, or basins (Best and Lockyer, 2002). They spend the summer foraging in subpolar latitudes and are not expected to occur in Penguin Bank during the proposed test period.

A.2. FIN WHALE (*BALAENOPTERA PHYSALUS*)

Five whales are listed as endangered under the ESA and the IUCN Red List. The Hawaiian stock is estimated at 174 whales (Carretta et al., 2005) and there are currently no designated critical habitats for this species within the North Pacific. Fin whales are distributed across the North Pacific during the summer (May through October) from the southern Chukchi Sea south to the Subarctic Boundary and to 30°N in the California Current (Mizroch et al., 1999). During the winter (November through April), fine whales are sparsely distributed from 60°N south to the northern edge of the tropics where mating and calving may occur (Mizroch et al., 1999). Due to their preference for deeper waters fin whales are not expected to occur in Penguin Bank.

A.3. BLUE WHALE (*BALAENOPTERA MUSCULUS*)

Blue whales are listed as endangered under the ESA, but no critical habitats are designated in the North Pacific for this species. No abundance estimates are available for the western Pacific stock of blue whales (Carretta et al., 2005). Blue whales in the western North Pacific stock appear to feed during the summer (May through October) southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Watkins et al., 2000). In the winter they migrate to lower latitudes in the western Pacific and in some cases to the central Pacific, including the Hawaiian Islands (Carretta et al., 2005). Due to their migration patterns blue whales are rarely seen in Hawaiian waters and are not expected to occur during the summer months.

A.4. SPERM WHALE (*PHYSETER MACROCEPHALUS*)

The sperm whale is classified as endangered under the ESA and the Hawaiian stock is estimated to have 7082 individuals. Sperm whales show a strong preference for deep waters (Rice, 1989) with high sea floor relief and areas with high secondary productivity and steep underwater topography (Jaquet and Whitehead, 1996). Sperm whales are highly distributed throughout the Hawaiian Islands year round (Mobley et al., 2000). They primarily inhabit the area seaward of the shelf break in Hawaiian waters, therefore they are not expected to occur at Penguin Bank.

A.5. MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA*)

The minke whale is listed as near threatened on the IUCN Red List. The stock structure of minke whales in the western North Pacific has been the topic of much research. The current hypothesis is that one stock (the O-stock) exists in the western North Pacific (Punt et al., 2000; Okamura et al., 2001), with some seasonal migrants from the J-stock off northern Japan (Pastene et al., 1998). They generally occupy waters over the continental shelf, including inshore bays and estuaries (Calambokidis et al. 2004). They are distributed in polar, temperate, and tropical waters of all oceans and are less common in the tropics than cooler waters. The summer range for Minke whales extends to the Chukichi Sea (Perrin and Brownell Jr., 2002). In the winter, minke whales are found south within 2 º of the equator (Perrin and Brownell Jr., 2002). Minke whales occur around the Hawaiian Islands from November to March, then migrate to cooler waters in the summer and therefore are not expected to occur within Penguin Bank during the proposed test time.

A.6. PYGMY AND DWARF SPERM WHALES (*KOGIA BREVICEPS AND KOGIA SIMAS*)

Sperm whales, although listed as endangered under the ESA and vulnerable under the IUCN Red List and are considered to be the most abundant of the large whale species, with an estimated 1,900,000 animals worldwide (Rice, 1989). The Hawaiian stock of pygmy sperm whale is estimated to have 7,251 individuals and the dwarf sperm whales stock is estimated at 19,172 individuals (Carretta et al., 2005). Berzin (1971) reported that they are restricted to waters deeper than 300 m (984 ft), while Watkins (1977) and Whitehead (2003) reported that they are usually not found in waters less than 1000 m (3281 ft) deep. During summer, sperm whales migrate to higher latitudes, with mature males migrating much farther north than females and younger males. In the Pacific Ocean, females and younger whales usually remain in tropical and temperate waters (between 40° N and 45° S latitude) (Rice, 1978), while males continue north to the Gulf of Alaska, Aleutian Islands, and the Bering Sea, or south to the Antarctic. Due to their migration patterns sperm whales are not expected to occur at Penguin Bank during the proposed test time.

A.7. ROUGH-TOOTHED DOLPHIN (*STENO BREDANENSIS*)

Rough-toothed dolphins are widely distributed throughout the world in tropical and warm temperate waters. Rough-toothed dolphins are normally observed in groups of 10 to 20 individuals, with groups seldom larger than 50 animals (Jefferson, 2002). They prefer deep waters and rarely are seen close to land, except around islands with steep drop-offs near shore (Department of the Navy, 2005). In pelagic waters they are frequently associated with other species, particularly bottlenose dolphins and short-finned pilot whales. Due to their preference for deep waters it is unlikely that rough-toothed dolphins will occur at Penguin Bank.

A.8. STRIPED DOLPHIN (*STENELLA COERULEOALBA*)

Striped dolphins are found worldwide in pelagic tropical to warm temperate waters. There are two concentrations in the western North Pacific, one south of 30° N and the other in the offshore waters north of 30° N (Miyashita, 1993). There is the potential for three populations in the area (one south of 30° N, one inshore north of 30° N, one offshore north of 30° N/east of 145° E), though the boundaries between these populations have not been resolved (Miyashita, 1993). Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters, often associated with convergence zones and waters influenced by upwelling (Au and Perryman, 1985). Because of their habitat preference it is unlikely striped dolphins will be encountered at Penguin Bank.

A.9. RISSO'S DOLPHIN (*GRAMPUS GRISEUS*)

Risso's dolphins are found worldwide in temperate to warm tropical waters. The Hawaiian stock is estimated to have 2,351 individuals (Carretta et al., 2005). Around Hawaii, they apparently prefer offshore waters with steep shelf-edge habitats between 400 and 1000 m (1312 to 3281 ft) and therefore are not expected to be encountered at Penguin Bank.

A.10. MELON-HEADED WHALE (*PEPONOCEPHALA ELECTRA*)

Melon-headed whales are found in tropical to subtropical latitudes in deep, oceanic waters. The Hawaiian stock of melon-headed whales is estimated at 2,947 individuals (Carretta et al., 2005). Extremely gregarious, melon-headed whales are often found in large aggregations, commonly in mixed herds with Fraser's dolphins, spinner dolphins, and bottlenose dolphins (Perryman, 2002). Leatherwood and Reeves (1983) reported that melon-headed whales are not observed frequently anywhere except in the Philippine Sea, especially near Cebu Island. This fact and the fact that melon-headed whales prefer deep, oceanic waters means that they are not expected to be encountered at Penguin Bank.

A.11. FRASER'S DOLPHIN (*LAGENODELPHIS HOSEI*)

Fraser's dolphins are found worldwide in tropical waters generally deeper than 1,000 m (3281 ft). The Hawaiian stock for Fraser's dolphins is estimated at 268 individuals (Carretta et al., 2005). A highly gregarious species, groups of a hundred to a thousand have been observed. Fraser's dolphins are occasionally found mixed in herds of spotted dolphins, and have been observed in company of false killer whales, sperm whales, striped dolphins, and spinner dolphins. Fraser's dolphins typically eat mesopelagic fish, crustaceans, and cephalopods (Leatherwood and Reeves, 1983). Due to their preference for deep water habitats they are not expected to occur at Penguin Bank.

A.12. PYGMY KILLER WHALE (*FERESA ATTENUATA*)

Pygmy killer whales are found worldwide in tropical and subtropical waters. The Hawaiian stock of pygmy killer whales is estimated at 817 individuals (Carretta et al., 2005). They are most often found in small herds of 12 to 50 animals (Donahue and Perryman, 2002). Pygmy killer whales are found mostly in deep, oceanic waters and therefore are not expected to occur at Penguin Bank.

A.13. KILLER WHALE (*ORCINUS ORCA*).

The killer whale is perhaps the most cosmopolitan of all marine mammals, found in all the world's oceans from about 80° N to 77° S (Leatherwood and Dahlheim, 1978). However, they appear to be more common within 800 km (430 nmi) of major continents in cold temperate to sub-polar waters (Mitchell, 1975). Pods, consisting of up to about 30 individuals, have been characterized as "resident," "transient," or "offshore" based on morphology, ecology, genetics and behavior in the eastern North Pacific (Loughlin et al., 1982; Baird and Stacey, 1988; Hoelzel et al., 1998). Killer whales are rare in the region of the proposed test site, and are not likely to be encountered there.

APPENDIX B: MODEL METHODOLOGY AND RESULTS

Penguin Bank TORPEX Acoustic Effects Analysis June - July 2007

A Marine Mammal Acoustic Effects Analysis (MMAEA) was performed for the TORPEX proposed to occur in June or July 2007 at Penguin Bank. The NUWC Division Newport Code 70 MMAEA model was implemented. The acoustic energy for the proposed action would be transmitted by a total of seven (7) torpedoes, using an average of five firings per day with one analysis of eight firings for a more practical scenario. The densities used in the analysis are presented in the tables below. Since the event is taking place in June or July, warm season density numbers where applied. Many of these sonar characteristics are classified confidential, thus not presented in this report. However, they are available if requested.

The following tables contain both raw and rounded exposures presented per species. The criterion of 0.5 defined for the Marine Mammal Protection Act (MMPA) was applied to all species. For final exposures a result of 0.5 would be rounded to 1 animal; a result of 0.49 would be rounded to 0. The criterion of 0.05 for the Endangered Species Act (ESA) was applied to applicable species and final exposures did not reach this threshold.

Details in regard to torpedo firings are classified. The exact locations for these events are shown in Tables 1-2 and 1-2 in the body of the OEA. A propagation modeling system (which uses the CASS/GRAB model) was chosen for generating propagation loss curves for input to the Energy Flux Density (EFD) model. CASS/GRAB has received full Oceanographic & Atmospheric Master Library (OAML) approval for frequencies above 150 Hz. The CASS/GRAB model input parameters are details about the acoustic source and environment in the area of interest. The output of interest is the sound pressure loss as a function of distance from the source for a specified depth. Data from the propagation modeling system databases were used as input to the model. Environmental input parameters, such as sound speed profiles (GDEMV, General Digital Environmental Model, Variable resolution), bathymetry, and bottom loss curves, as well as source characteristics such as depth, frequency, and vertical beamwidth were used to produce propagation loss curves for this acoustic effects assessment (Jette, 2002; Jette et al., 2005). Propagation loss curves in increments of 90 degrees for a 360-degree area were examined. Since there are negligible differences between radials out to the 1000-meter range, a footprint with a radius of 1000 meters was generated for each configuration of the source by using a single radial to fill the 360-degree, 25 m resolution footprint. The footprint was then modified to reflect the horizontal bandwidth or sector size used during this exercise.

Once the footprint was created it was moved through a range grid that also has a resolution of 25-meter increments. The movement through the range grid observed the remaining source characteristics of ping duration and repetition cycle and speed. The duration of the run and shape of the run was done in accordance to the run geometries. As the footprint was moved through the range grid, any energy that ensonified a range cell was accumulated (Jette et al., 2005).

After the proposed run or event geometry was simulated, the energy accumulated in each range cell was summed and compared to the harassment threshold. Criteria and thresholds used in this OEA/EA are based on those applied in previous Navy NEPA documents (NOAA, 2001, NOAA 2002). All thresholds are given in terms of an energy metric which is energy flux energy density level (EFD) and its unit are dB re 1 μPa^2-sec (Urick, 1983,). For cetaceans a threshold of 215 EFD (dB re 1 μPa^2 –sec) was used for Level A harassment. A threshold of 195 dB EFD was used for Level B harassment. For behavioral effects, a component of Level B harassment, a threshold of 190 dB EFD was used (Department of the Navy Chief of Naval Operations, 2006). For California sea lions, elephant seals, and harbor seals threshold values of 226 dB EFD, 224 dB EFD, and 203 dB EFD respectively was used for Level A harassment ((Ridgway et al., 1997), (Schlundt et al., 2000). Threshold values of 206 dB EFD, 204 dB EFD and 183 dB EFD were used for Level B harassment. Level A harassment is injurious and is based on determined acoustic levels, which denote the onset of Permanent Threshold Shift (PTS). Level B is non-injurious harassment and is based on studies using an acoustic level that reflects behavior disruptions and includes the onset of Temporary Threshold Shift (TTS). Any range cell above or equal to the respective thresholds were counted and converted to an area by simply multiplying the cell count by the cell area. The resultant product is called the exposure area or zone of exposure. This was determined for each test event, for each threshold. The exposure area was then multiplied by the density estimates to yield the exposure estimate for each event.

Appendix B - 1: Table of Marine Mammal Exposure Estimates for Seven Firings at the Northeast Site (Box A) at Penguin Bank – June 2007

Penguin Banks Density Estimates for June 2007		Penguin Banks Box A 21°05'N - 21°11'N and 157°24'W - 157°30'W 7 Shots: ST (4) & R (3)							
		Raw Numbers				Rounded Numbers			
		Level B			Level A	Level B			Level A
	Density	Behavioral	TTS	Total		Behavioral	TTS	Total	
Species	(animals per sq km)	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215
Melon-headed whale	0.0021	0.004079	0.000821625	0.004900875	0.000000	0.000000	0.000000	0.000000	0.000000
Spinner dolphin	0.0443	0.086053	0.017332	0.103385	0.000000	0.000000	0.000000	0.000000	0.000000
Spotted dolphin	0.0407	0.079060	0.015924	0.094984	0.000000	0.000000	0.000000	0.000000	0.000000
Striped dolphin	0.0016	0.003108	0.000626	0.003734	0.000000	0.000000	0.000000	0.000000	0.000000
Fraser's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Stenella spp.	0.0076	0.014763	0.002974	0.017737	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified dolphin	0.0134	0.026030	0.005243	0.031272	0.000000	0.000000	0.000000	0.000000	0.000000
Bottlenose dolphin	0.0103	0.020008	0.004030	0.024038	0.000000	0.000000	0.000000	0.000000	0.000000
Rough-toothed dolphin	0.0017	0.003302	0.000665	0.003967	0.000000	0.000000	0.000000	0.000000	0.000000
Risso's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Short-finned pilot whale	0.0237	0.046037	0.009273	0.055310	0.000000	0.000000	0.000000	0.000000	0.000000
Blainville's beaked whale	0.0009	0.001748	0.000352	0.002100	0.000000	0.000000	0.000000	0.000000	0.000000
Cuvier's beaked whale	0.0006	0.001166	0.000235	0.001400	0.000000	0.000000	0.000000	0.000000	0.000000
False killer whale	0.0017	0.003302	0.000665	0.003967	0.000000	0.000000	0.000000	0.000000	0.000000
Dwarf sperm whale (*Kogia*)		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy sperm whale (*Kogia*)		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Longman's beaked whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified beaked whale	0.0005	0.000971	0.000196	0.001167	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Bryde's whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Fin whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Sei whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Blue whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Minke whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified cetacean	0.0004	0.000777	0.000157	0.000934	0.000000	0.000000	0.000000	0.000000	0.000000
* Sperm whale	0.001	0.001943	0.000391	0.002334	0.000000	0.000000	0.000000	0.000000	0.000000

Appendix B-2: Table of Marine Mammal Exposure Estimates for Seven Firings at the Southwest Site (Box B) at Penguin Bank – June 2007

Penguin Banks Density Estimates for June 2007		Penguin Banks Box B 20°55'N - 21°01'N and 157°26'W - 157°33'W 7 Shots: ST (4), R (3)							
		Raw Numbers				Rounded Numbers			
		Level B			Level A	Level B			Level A
	Density	Behavioral	TTS	Total		Behavioral	TTS	Total	
Species	(animals per sq km)	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215
Melon-headed whale	0.0021	0.004291	0.000000	0.004291	0.000000	0.000000	0.000000	0.000000	0.000000
Spinner dolphin	0.0443	0.090510	0.000000	0.090510	0.000000	0.000000	0.000000	0.000000	0.000000
Spotted dolphin	0.0407	0.083155	0.000000	0.083155	0.000000	0.000000	0.000000	0.000000	0.000000
Striped dolphin	0.0016	0.003269	0.000000	0.003269	0.000000	0.000000	0.000000	0.000000	0.000000
Fraser's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Stenella spp.	0.0076	0.015528	0.000000	0.015528	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified dolphin	0.0134	0.027378	0.000000	0.027378	0.000000	0.000000	0.000000	0.000000	0.000000
Bottlenose dolphin	0.0103	0.021044	0.000000	0.021044	0.000000	0.000000	0.000000	0.000000	0.000000
Rough-toothed dolphin	0.0017	0.003473	0.000000	0.003473	0.000000	0.000000	0.000000	0.000000	0.000000
Risso's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Short-finned pilot whale	0.0237	0.048422	0.000000	0.048422	0.000000	0.000000	0.000000	0.000000	0.000000
Blainville's beaked whale	0.0009	0.001839	0.000000	0.001839	0.000000	0.000000	0.000000	0.000000	0.000000
Cuvier's beaked whale	0.0006	0.001226	0.000000	0.001226	0.000000	0.000000	0.000000	0.000000	0.000000
False killer whale	0.0017	0.003473	0.000000	0.003473	0.000000	0.000000	0.000000	0.000000	0.000000
Dwarf sperm whale (*Kogia*)		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy sperm whale (*Kogia*)		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Longman's beaked whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified beaked whale	0.0005	0.001022	0.000000	0.001022	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Bryde's whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Fin whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Sei whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Blue whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Minke whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified cetacean	0.0004	0.000817	0.000000	0.000817	0.000000	0.000000	0.000000	0.000000	0.000000
* Sperm whale	0.001	0.002043	0.000000	0.002043	0.000000	0.000000	0.000000	0.000000	0.000000

Appendix B-3: Table of Marine Mammal Exposure Estimates for Seven Firings at both the Northeast and Southwest Sites (Boxes A and B) at Penguin Bank – June 2007

Penguin Banks Density Estimates for June 2007		Penguin Banks Boxes A & B 7 Shots: ST (2 each, A & B), R (2 from A, 1 from B)							
		Raw Numbers				Rounded Numbers			
		Level B			Level A	Level B			Level A
	Density	Behavioral	TTS	Total		Behavioral	TTS	Total	
Species	(animals per sq km)	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215	173 < EL <195	195 ≤ EL < 215	173 < EL < 215	EL ≥ 215
Melon-headed whale	0.0021	0.004178	0.000475	0.004653	0.000000	0.000000	0.000000	0.000000	0.000000
Spinner dolphin	0.0443	0.088129	0.010023	0.098152	0.000000	0.000000	0.000000	0.000000	0.000000
Spotted dolphin	0.0407	0.080968	0.009208	0.090176	0.000000	0.000000	0.000000	0.000000	0.000000
Striped dolphin	0.0016	0.003183	0.000362	0.003545	0.000000	0.000000	0.000000	0.000000	0.000000
Fraser's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Stenella spp.	0.0076	0.015119	0.001720	0.016839	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified dolphin	0.0134	0.026658	0.003032	0.029689	0.000000	0.000000	0.000000	0.000000	0.000000
Bottlenose dolphin	0.0103	0.020491	0.002330	0.022821	0.000000	0.000000	0.000000	0.000000	0.000000
Rough-toothed dolphin	0.0017	0.003382	0.000385	0.003767	0.000000	0.000000	0.000000	0.000000	0.000000
Risso's dolphin		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Short-finned pilot whale	0.0237	0.047148	0.005362	0.052510	0.000000	0.000000	0.000000	0.000000	0.000000
Blainville's beaked whale	0.0009	0.001790	0.000204	0.001994	0.000000	0.000000	0.000000	0.000000	0.000000
Cuvier's beaked whale	0.0006	0.001194	0.000136	0.001329	0.000000	0.000000	0.000000	0.000000	0.000000
False killer whale	0.0017	0.003382	0.000385	0.003767	0.000000	0.000000	0.000000	0.000000	0.000000
Dwarf sperm whale (*Kogia)*		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy sperm whale (*Kogia)*		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Longman's beaked whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified beaked whale	0.0005	0.000995	0.000113	0.001108	0.000000	0.000000	0.000000	0.000000	0.000000
Pygmy killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Bryde's whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Killer whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Fin whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Sei whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
* Blue whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Minke whale		0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Unidentified cetacean	0.0004	0.000796	0.000091	0.000886	0.000000	0.000000	0.000000	0.000000	0.000000
* Sperm whale	0.001	0.001989	0.000226	0.002216	0.000000	0.000000	0.000000	0.000000	0.000000

APPENDIX C: LIST OF PREPARERS

DEPARTMENT OF THE NAVY, Naval Sea Systems Command, Warfare Centers

Name	Role	Education and Experience
Ellen M. Peoples	Project Lead, NUWCDIVNPT Environmental Engineer	J.D. Law, M.S. Env. Eng., B.A. Env. Science and Technology, Navy NEPA and E.O. 12114 doc.& analysis, 4 years
Dave Mercier	NUWCDIVNPT Associate Counsel; legal/editorial review: all chapters and appendices	LL.M. Environmental Law; Navy Office of General Counsel; Retired Marine Corps Judge Advocate; Legal support to the DoN, 27 years; Environmental law, 15 years
Thomas Fetherston	NUWC Biologist/ technical/editorial review: Chapters 2 and 3	B.S., Zoology, M.M.A. (Marine Affairs); Navy NEPA and E.O. 12114 doc. & analysis, 15 years
Glenn Mitchell	NUWCDIVNPT Engineer; technical review: Chapters 2, 3, and 4	B.S. Zoology/Electrical Eng., sonar design, model development, biological oceanography,14 years
Colin Lazauski	Engineer; technical review of acoustic analysis	MSOE Ocean Engineering Underwater Acoustics Marine Mammal Acoustic Exposure analysis, 25 years