DRAFT REQUEST FOR AN INCIDENTAL HARASSMENT AUTHORIZATION UNDER SECTION 101 (a)(5)(A) OF THE MARINE MAMMAL PROTECTION ACT

OFFICE OF NAVAL RESEARCH ACOUSTIC TECHNOLOGY EXPERIMENTS

OFFICE OF NAVAL RESEARCH

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EXECUTIVE SUMMARY

In the spring or summer of 2013, the Office of Naval Research (ONR) is planning to conduct the ONR Acoustic Technology Experiments (ATE) in the international waters of one of nine provinces comprising the western North Pacific Ocean. The nine provinces are discrete areas identified with the following geographic titles as presented in the analysis results herein: Sea of Japan, East China Sea, South China Sea, North Philippine Sea, West Philippine Sea, East of Japan, Offshore Guam, Northwest Pacific Ocean: 25º to 40º North latitude, and Northwest Pacific Ocean: 10º to 25º North latitude.. No more than four underwater acoustic sources will be employed during the experiments, with none of the ONR ATE sources transmitting concurrently, and with all sources operating below 1.5 kilohertz (kHz) and a sound pressure level (SPL) less than 220 decibels (dB) for a total of no more than 69 hours of acoustic transmissions over six days.

The ONR ATE will require underwater acoustic sound transmissions in waters in which marine mammals are known to exist. The ONR ATE timing, duration, and activities have been analyzed for their potential to result in incidental taking of marine mammals protected under Marine Mammal Protection Act (MMPA) due to underwater sound transmitted by the sonar systems being tested and that the reception of underwater sound has the potential to result in MMPA incidental harassment.

The analysis conducted on the ONR ATE activities to assess the potential for effects on marine mammals has shown that the possibility of marine mammals being exposed to MMPA Level A harassment is not reasonably foreseeable. Marine mammals may potentially be exposed to sound pressure levels that could result in MMPA Level B incidental harassment. Of the 34 species or species groups of marine mammals that may potentially be found in the experiment areas of the western North Pacific Ocean, eight species, the blue, fin, gray (Western North Pacific stock), humpback, North Pacific right, sei, and sperm whales, as well as the Hawaiian monk seal, are listed under the ESA, with no critical habitat designated in the region. Considering the planned monitoring and mitigation measures, any potential adverse impacts to the marine environment are expected to be transitory in nature and geographically limited. Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

ONR requests an Incidental Harassment Authorization (IHA) for incidental harassment of marine mammals due to the potential MMPA Level B incidental harassment of 34 marine mammal species or species groups that may occur in one of nine provinces in which ONR ATE may occur, including: the blue whale, Bryde's whale, common minke whale, fin whale, gray whale, humpback whale, North Pacific right whale, sei whale, Baird's beaked whale, Blainville's beaked whale, common bottlenose dolphin, Cuvier's beaked whale, Dall's porpoise, false killer whale, Fraser's dolphin, gingko-toothed beaked whale, Hubbs' beaked whale, killer whale, *Kogia* spp., Longman's beaked whale, melon-headed whale, Pacific white-sided dolphin, pantropical spotted dolphin, pygmy killer whale, Risso's dolphin, rough-toothed dolphin, short-beaked common dolphin, short-finned pilot whale, sperm whale, spinner dolphin, Stejneger's beaked whale, striped dolphin, and Hawaiian monk seal.

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LIST OF ACRONYMS AND ABBREVIATIONS

°	degrees
<	less than
>	greater than
%	percentage
µPa	micro-Pascal
AIM	Acoustic Integration Model
ATOC	Acoustic Thermometry of Ocean Climate
C	Celsius (Centigrade)
dB 1µPa @1m	decibels relative to one micro-Pascal measured at one meter from center of source
DoD	Department of Defense
DoN	Department of the Navy
EA	Environmental Assessment
EEZ	exclusive economic zone
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ETP	eastern tropical Pacific
F	Fahrenheit
FM	frequency modulation
ft	feet
hr	hour(s)
Hz	Hertz
IHA	Incidental Harassment Authorization
in	inch(es)
kg	kilogram(s)
kHz	kiloHertz
km	kilometer(s)
km^2	square kilometers
kph	kilometer(s) per hour
kt	knot(s)
LMR	Living Marine Resources
LOA	Letter of Authorization
m	meter(s)
min	minute(s)
MMPA	Marine Mammal Protection Act
m/sec	meters per second
N	North
nmi	nautical mile(s)
nmi^2	square nautical miles
NGDC	National Geophysical Data Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
OAML	Oceanographic and Atmospheric Master Library
OEA	Overseas Environmental Assessment
ONR	Office of Naval Research

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

ONR ATE	ONR Acoustic Technology Experiments
PTS	permanent threshold shift
R&D	Research and Development
RAC	Regional Advisory Committee
RL	received level
rms	root mean squared
sec	second(s)
SEL	sound exposure level
SL	source level
SPL	sound pressure level
Spp.	species
TD	test director
TTS	temporary threshold shift
U.S.	United States of America

1 DESCRIPTION OF ACTIVITY

<u>REQUIREMENT 1</u>*: *A detailed description of the specific activity or class of activities that can be expected to result in the incidental taking of marine mammals.

In the spring or summer of 2013, the Office of Naval Research (ONR) is planning to conduct the Acoustic Technology Experiments (ATE) in one of nine provinces comprising the western North Pacific Ocean (Figure 1). The nine provinces are discrete areas identified with the following geographic titles as they are presented in the analysis results herein: Sea of Japan, East China Sea, South China Sea, North Philippine Sea, West Philippine Sea, East of Japan, Offshore Guam, Northwest Pacific Ocean: 25° to 40º north latitude, and Northwest Pacific Ocean: 10º to 25º north latitude. ONR ATE will take place in international waters during the spring or summer of 2013 and will have a duration not longer than two weeks. No more than four underwater acoustic sources will be employed from a vessel during the experiments, with none of the ONR ATE sources transmitting concurrently, and with all active sources transmitting below 1.5 kilohertz (kHz) and a sound pressure level (SPL) less than 220 decibels (dB) for a total duration of no more than 69 hours (hr) over six at-sea days.

ONR ATE will require underwater acoustic sound transmissions in waters in which marine mammals are known to exist. The Federal Marine Mammal Protection Act (MMPA) prohibits the taking of marine mammals, defined as to "harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill," except under certain situations.

The ONR ATE timing, duration, and activities have been analyzed for their potential to result in incidental taking of marine mammals protected under MMPA. The analysis determined that there is the potential for marine mammal incidental harassment due to underwater sound transmitted by the sonar systems being tested, and the reception of underwater sound has the potential to result in MMPA Level B incidental harassment (TTS or behavioral effects). The analysis verified that the possibility of marine mammals being exposed to MMPA Level A incidental harassment is not reasonably foreseeable in all nine provinces. Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

ONR requests an IHA for incidental harassment of marine mammals due to the potential MMPA Level B incidental harassment of 34 marine mammal species or species groups that may occur in one of nine provinces in which ONR ATE may occur, including: the blue whale, Bryde's whale, common minke whale, fin whale, gray whale, humpback whale, North Pacific right whale, sei whale, Baird's beaked whale, Blainville's beaked whale, common bottlenose dolphin, Cuvier's beaked whale, Dall's porpoise, false killer whale, Fraser's dolphin, gingko-toothed beaked whale, Hubbs' beaked whale, killer whale, *Kogia* spp., Longman's beaked whale, melon-headed whale, Pacific white-sided dolphin, pantropical spotted dolphin, pygmy killer whale, Risso's dolphin, rough-toothed dolphin, short-beaked common dolphin, short-finned pilot whale, sperm whale, spinner dolphin, Stejneger's beaked whale, striped dolphin, and Hawaiian monk seal.

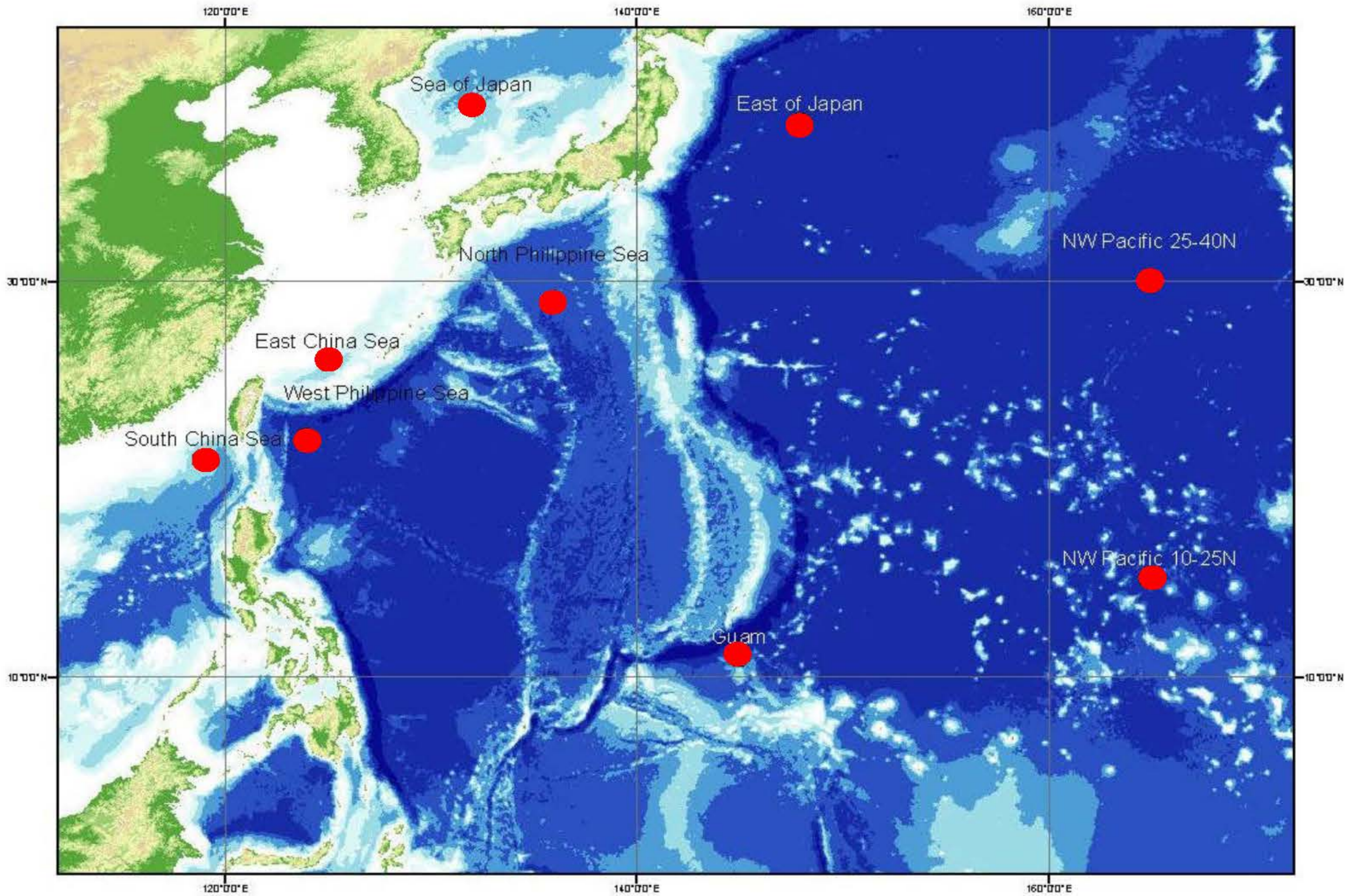

Figure 1. Nine provinces of the western North Pacific. ONR ATE will occur in one of the provinces.

1.1 PURPOSE AND NEED

The overall purpose of ONR ATE is to collect data and test underwater acoustic technology in a realistic at-sea environment. ONR ATE fulfills a need of the Navy's for measured in situ scientific data on underwater acoustic technology from which the performance of the acoustic systems and their conceptual foundation can be assessed.

1.2 PROPOSED ACTIVITY

During spring or summer seasons of 2013, the ONR ATE is planned to be conducted in international waters of one of nine provinces comprising the western North Pacific Ocean. The nine provinces are discrete areas identified with the following geographic titles as presented herein: Sea of Japan, East China Sea, South China Sea, North Philippine Sea, West Philippine Sea, East of Japan, Offshore Guam, Northwest Pacific Ocean: 25º to 40º north latitude, and Northwest Pacific Ocean: 10º to 25º north latitude. The experiment's duration will not be longer than two weeks. No more than four underwater acoustic sources will be employed from a vessel during the experiment, and none of these ONR ATE acoustic sources will transmit concurrently. All active sources will transmit below 1.5 kHz and a SPL less than 220 dB for a total duration of no more than 69 hours (hr) over six at-sea days (Table 1). An environmental survey of the waters of the proposed test area will also be conducted employing an oceanographic acoustic source. All equipment deployed during ONR ATE will be recovered once data collection has been completed.

Inherent in any experimental work is a degree of flexibility to respond to weather fluctuations and hardware conditions. As such, a detailed schedule of events is difficult to define at this early stage, but a nominal outline of a schedule, including the amount of time each source would be expected to be used, and the possibility of temporal overlap in source transmissions have been planned. It is planned that at most, two of the acoustic sources would operate at the same time during specific experiment events. In all cases of concurrent source operations, there is sufficient horizontal and vertical separation between the active acoustic sources so that potential environmental effects associated with the operation of the sources is no more than the sources considered individually.

Table 1. Nominal schedule of ONR ATE activities and events.

DAY	ACTIVITY	EQUIPMENT	ACOUSTIC TRANSMISSION
1	Environmental Survey	Oceanographic Source	One 24-hr event
	Experimental Transmissions	Sources 1 or 2 or 3	Maximum 1 hr per source
2	Experimental Transmissions	Source 1	Two 9-hr events
3	Experimental Transmissions	Source 2	One 5-hr event
4	Experimental Transmissions	Source 3	Two 10-hr events
5	Experimental Transmissions	Source 2	Two 5-hr events
6	Experimental Transmissions	Source 2	One 5-hr event
		Sources 1 or 3 (contingency day)	Two 4-hr events

2 DATES, DURATION, AND REGION OF ACTIVITY

***REQUIREMENT 2*: Date(s) and duration of such activity and the specific geographic region where it will occur.**

During the spring or summer of 2013, over six days, ONR is planning to conduct the ONR ATE in one of nine provinces comprising the western North Pacific Ocean (Figure 1). ONR ATE will take place in the international waters of one of the nine provinces, which range in areal extent from 360,000 to 800,000 square kilometers (km^2) (104,959 to 233,242.7 square nautical miles [nmi^2]) and in water depth from 100 to 9,000 meters (m) (328 to 29,527.6 feet [ft]) (Table 2).

Table 2. Estimated size and water depth range of the nine western North Pacific provinces in which ONR ATE may occur.

WESTERN NORTH PACIFIC PROVINCE	AREA IN KM^2 (NMI^2)	WATER DEPTH RANGE IN M (FT)
Sea of Japan	360,000 (104,959)	1,000 to 3,500 (3,281 to 11,482.9)
East China Sea	370,000 107 (107,875)	100 to 2,500 (328 to 8,202)
South China Sea	800,000 (233,243)	100 to 4,500 (328 to 14,764)
North Philippine Sea	500,000 (145,777)	1,000 to 5,500 (3,281 to 18,045)
West Philippine Sea	400,000 (116,621)	1,500 to 7,500 (4,921 to 24,606)
East of Japan	600,000 (174,932)	5,000 to 6,000 (16,404 to 19,685)
Offshore Guam	470,000 (137,030)	500 to 9,500 (1,640 to 31,168)
Northwest Pacific Ocean—25° to 40°N	560,000 (163,270)	2,500 to 6,000 (8,20 to 19,685)
Northwest Pacific Ocean—10° to 25°N	450,000 (131,199)	1,500 to 6,000 (4,921 to 19,685)

3 MARINE MAMMAL SPECIES AND NUMBERS

***REQUIREMENT 3:* Species and numbers of marine mammals likely to be found within an activity area.**

Information is presented in this chapter on each marine mammal species or species group protected under the MMPA that may potentially occur in at least one of the nine provinces comprising the western North Pacific Ocean in which the ONR ATE may occur (Figure 1). Since ONR ATE will take place in international waters, the only marine mammal species that potentially would be encountered in any of the nine provinces of the western North Pacific Ocean in which the experiment may occur are cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals). No sirenians are expected in any of the nine provinces.

3.1 MARINE MAMMAL OCCURRENCE

The distribution and densities of cetaceans and pinnipeds are not random but are highly "patchy". Patchy distributions are characterized by irregular clusters (patches) of occurrence that can frequently be correlated with that of their prey, which often are associated with productive continental shelves, ocean fronts, upwelling areas, bathymetric relief, or water mass convergence areas (Katona and Whitehead, 1988). Movements of marine mammals are often related to feeding or breeding activity. Some baleen whale species, such as humpback whales, make extensive annual migrations to low-latitude mating and calving grounds in the coldest months and to high-latitude feeding grounds in the warmest season (Corkeron and Connor, 1999). Several cetacean species undergo seasonal north-south migrations that track peaks in prey availability while others reside year-round in specific areas. Some of the cetacean species potentially occurring in one of the nine provinces of the western North Pacific, such as the North Pacific right whale, only occur seasonally while most others occur year-round.

Although 34 species of marine mammals may potentially be found in the waters of the nine western North Pacific provinces in which ONR ATE may occur, often the two species of *Kogia* are considered together as *Kogia* spp. due to the difficulty in identifying these animals to species at sea and the sparse information that is known about the individual species. The 34 species considered include eight mysticetes, 25 odontocete species, and one pinniped species (Table 3).

3.2 MARINE MAMMAL DENSITY ESTIMATES

Although the distribution of many marine mammal species is irregular and highly dependent upon geography, oceanography, and seasonality, density estimates for each marine mammal species that may be in an activity area is a critical component to analyzing the potential effects of proposed activities. Density estimates were derived for each marine mammal species potentially occurring in the nine provinces of the western North Pacific in which the ONR ATE may occur during the spring or summer (Tables 4 to 12)[1]. The process for developing density estimates was a multi-step procedure. Direct estimates from line-transect surveys that occurred in or near the experiment area were utilized first (e.g., Buckland et al., 1992). However, density estimates from line-transect surveys in the western North Pacific were not always available for each species. When density estimates were not available from a survey in

1 In Tables 4 through 11, a blank space during a season indicates that the species does not occur in those waters during that season. A density of <0.00001 in any of the tables indicates that there are no occurrence data for that species sufficient to quantify or from which to extrapolate a density; in these instances, a "default" density of <0.00001 was used so that harassment estimates could be quantified.

Table 3. Marine mammals potentially occurring in the nine provinces of the western North Pacific where the ONR ATE may be conducted and their status under the ESA and MMPA.

SPECIES	ESA AND MMPA STATUS
Mysticetes	
Blue Whale (*Balaenoptera musculus)*	Endangered/Depleted
Bryde's Whale (*Balaenoptera edeni)*	
Common Minke Whale (*Balaenoptera acutorostrata*)	
Fin Whale (*Balaenoptera physalus)*	Endangered/Depleted
Gray Whale (*Eschrichtius robustus*)	Endangered/Depleted[2]
Humpback Whale (*Megaptera novaeangliae*)	Endangered/Depleted
North Pacific Right Whale (*Eubalaena japonica)*	Endangered/Depleted
Sei Whale (*Balaenoptera borealis*)	Endangered/Depleted
Odontocetes	
Baird's Beaked Whale (*Berardius bairdii)*	
Blainville's Beaked Whale (*Mesoplodon densirostris)*	
Common Bottlenose Dolphin (*Tursiops truncatus*)	
Cuvier's Beaked Whale (*Ziphius cavirostris*)	
Dall's Porpoise (*Phocoenoides dalli*)	
False Killer Whale (*Pseudorca crassidens*)[3]	
Fraser's Dolphin (*Lagenodelphis hosei*)	
Ginkgo-toothed Beaked Whale (*Mesoplodon ginkgodens)*	
Hubbs' Beaked Whale (*Mesoplodon carhubbsi)*	
Killer Whale (*Orca orcinus*)	
Kogia spp.	
Longman's Beaked Whale (*Indopacetus pacificus*)	
Melon-headed Whale (*Peponocephala electra*)	
Pacific White-sided Dolphin (*Lagenorhynchus obliquidens)*	
Pantropical Spotted Dolphin (*Stenella attenuata*)	
Pygmy Killer Whale (*Feresa attenuata*)	
Risso's Dolphin (*Grampus griseus*)	
Rough-toothed Dolphin (*Steno bredanensis*)	
Short-beaked Common Dolphin (*Delphinus delphis*)	
Short-finned Pilot Whale (*Globicephala macrorhynchus)*	
Sperm Whale (*Physeter macrocephalus*)	Endangered/Depleted
Spinner Dolphin (*Stenella longirostris)*	
Stejneger's Beaked Whale (*Mesoplodon stejnegeri)*	
Striped Dolphin (*Stenella coeruleoalba)*	
Pinnipeds	
Hawaiian Monk Seal (*Monachus schauinslandi*)	Endangered/Depleted

2 Only the western Pacific population is listed as endangered under the ESA.

3 As a species, the false killer whale is not listed under the ESA; however, the insular Main Hawaiian Islands distinct population segment (DPS) of false killer whales is listed as endangered under the ESA.

Table 4. Marine mammal species potentially occurring during spring and/or summer in the Sea of Japan province in which ONR ATE may occur and their density estimated for this region in each season.

SEA OF JAPAN			
SPECIES	**SPRING DENSITY ESTIMATE (ANIMALS/KM^2)**	**SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)**	**REFERENCES FOR DENSITY ESTIMATES**
Mysticetes			
Bryde's Whale	0.0004	0.0004	Ferguson and Barlow, 2001 and 2003
Common Minke Whale	0.0002	0.0002	Ferguson and Barlow, 2001 and 2003
Common Minke Whale—J Stock	0.0009	0.0009	Pastene et al., 1998
Fin Whale	0.0001	0.0001	Ferguson and Barlow, 2001 and 2003
Gray Whale	<0.00001	<0.00001	
North Pacific Right Whale	<0.00001		
Odontocetes			
Baird's Beaked Whale	0.0003	0.0003	Ferguson and Barlow, 2001 and 2003
Common Bottlenose Dolphin	0.0008	0.0008	LGL, 2011
Cuvier's Beaked Whale	0.0031	0.0031	Ferguson and Barlow, 2001 and 2003
Dall's Porpoise	0.0520	0.0520	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0027	0.0027	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0017	0.0017	Ferguson and Barlow, 2001 and 2003
Pacific White-sided Dolphin	0.0030		Ferguson and Barlow, 2001 and 2003
Risso's Dolphin	0.0073	0.0073	Miyashita, 1993
Rough-toothed Dolphin	0.00355	0.00355	Barlow, 2006
Short-beaked Common Dolphin	0.0860	0.0860	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0014	0.0014	Miyashita, 1993
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin		0.00083	Barlow, 2006
Stejneger's Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Striped Dolphin	0.0058	0.0058	LGL, 2011

Table 5. Marine mammal species potentially occurring during spring and summer in the East China Sea province in which ONR ATE may occur and their density estimated for this region in each season.

EAST CHINA SEA			
SPECIES	**SPRING DENSITY ESTIMATE (ANIMALS/KM^2)**	**SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)**	**REFERENCES FOR DENSITY ESTIMATES**
Mysticetes			
Bryde's Whale	0.0006	0.0006	Ohsumi, 1977
Common Minke Whale	0.0044	0.0044	Buckland et al., 1992
Common Minke Whale-J Stock	0.0018	0.0018	Pastene et al., 1998
Fin Whale	0.0002	0.0002	Tillman, 1977
Gray Whale	<0.00001		
North Pacific Right Whale	<0.00001		
Odontocetes			
Blainville's Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Common Bottlenose Dolphin	0.0008	0.0008	LGL, 2011
Cuvier's Beaked Whale	0.0003	0.0003	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0011	0.0011	Fulling et al., 2011
Fraser's Dolphin	0.00417	0.00417	Barlow, 2006
Ginkgo-toothed Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0017	0.0017	Ferguson and Barlow, 2001 and 2003
Longman's Beaked Whale	0.00025	0.00025	LGL, 2011
Melon-headed Whale	0.0043	0.0043	Fulling et al., 2011
Pacific White-sided Dolphin	0.0028		Ferguson and Barlow, 2001 and 2003
Pantropical Spotted Dolphin	0.0137	0.0137	Miyashita, 1993
Pygmy Killer Whale	0.0001	0.0001	Fulling et al., 2011
Risso's Dolphin	0.0106	0.0106	Miyashita, 1993
Rough-toothed Dolphin	0.00355	0.00355	Barlow, 2006
Short-beaked Common Dolphin	0.0461	0.0461	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0016	0.0016	Fulling et al., 2011
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin	0.00083	0.00083	Barlow, 2006
Striped Dolphin	0.0058	0.0058	LGL, 2011

Table 6. Marine mammal species potentially occurring during spring and summer in the South China Sea province in which the ONR ATE may occur and their density estimated for this region in each season.

SOUTH CHINA SEA			
SPECIES	SPRING DENSITY ESTIMATE (ANIMALS/KM^2)	SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)	REFERENCES FOR DENSITY ESTIMATES
Mysticetes			
Bryde's Whale	0.0006	0.0006	Ohsumi, 1977
Common Minke Whale	0.0033	0.0033	Buckland et al., 1992
Fin Whale	0.0002	0.0002	Tillman, 1977
Gray Whale	<0.00001		
North Pacific Right Whale	<0.00001		
Odontocetes			
Blainville's Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Common Bottlenose Dolphin	0.0008	0.0008	LGL, 2011
Cuvier's Beaked Whale	0.0003	0.0003	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0011	0.0011	Fulling et al., 2011
Fraser's Dolphin	0.00417	0.00417	Barlow, 2006
Ginkgo-toothed Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0017	0.0017	Ferguson and Barlow, 2001 and 2003
Longman's Beaked Whale	0.00025	0.00025	LGL, 2011
Melon-headed Whale	0.0043	0.0043	Fulling et al., 2011
Pantropical Spotted Dolphin	0.0137	0.0137	Miyashita, 1993
Pygmy Killer Whale	0.0001	0.0001	Fulling et al., 2011
Risso's Dolphin	0.0106	0.0106	Miyashita, 1993
Rough-toothed Dolphin	0.00355	0.00355	Barlow, 2006
Short-finned Pilot Whale	0.0016	0.0016	Fulling et al., 2011
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin	0.00083	0.00083	Barlow, 2006
Striped Dolphin	0.0058	0.0058	LGL, 2011

Table 7. Marine mammal species potentially occurring during spring and summer in the North Philippine Sea province in which ONR ATE may occur and their density estimated for this region in each season.

North Philippine Sea			
Species	**Spring Density Estimate (animals/km^2)**	**Summer Density Estimate (animals/km^2)**	**References for Density Estimates**
Mysticetes			
Blue Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Bryde's Whale	0.0006	0.0006	Ohsumi, 1977
Common Minke Whale	0.0044	0.0044	Buckland et al., 1992
Fin Whale	0.0002		Tillman, 1977
Humpback Whale	0.00089		LGL, 2008
North Pacific Right Whale	<0.00001		
Odontocetes			
Blainville's Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Common Bottlenose Dolphin	0.0146	0.0146	Miyashita, 1993
Cuvier's Beaked Whale	0.0054	0.0054	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0029	0.0029	Miyashita, 1993
Fraser's Dolphin	0.00417	0.00417	Barlow, 2006
Ginkgo-toothed Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0031	0.0031	Ferguson and Barlow, 2001 and 2003
Longman's Beaked Whale	0.00025	0.00025	LGL, 2011
Melon-headed Whale	0.00428	0.00428	Fulling et al., 2011
Pacific White-sided Dolphin	0.0119		Ferguson and Barlow, 2001 and 2003
Pantropical Spotted Dolphin	0.0137	0.0137	Miyashita, 1993
Pygmy Killer Whale	0.0021	0.0021	Ferguson and Barlow, 2001 and 2003
Risso's Dolphin	0.0106	0.0106	Miyashita, 1993
Rough-toothed Dolphin	0.0059	0.0059	Ferguson and Barlow, 2001 and 2003
Short-beaked Common Dolphin	0.0562	0.0562	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0153	0.0153	Miyashita, 1993
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin	0.00083	0.00083	Barlow, 2006
Striped Dolphin	0.0329	0.0329	Miyashita, 1993

Table 8. Marine mammal species potentially occurring during spring and summer in the West Philippine Sea province in which ONR ATE may occur and their density estimated for this region in each season.

WEST PHILIPPINE SEA			
SPECIES	**SPRING DENSITY ESTIMATE (ANIMALS/KM^2)**	**SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)**	**REFERENCES FOR DENSITY ESTIMATES**
Mysticetes			
Blue Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Bryde's Whale	0.0006	0.0006	Ohsumi, 1977
Common Minke Whale	0.0033	0.0033	Buckland et al., 1992
Fin Whale	0.0002		Tillman, 1977
Humpback Whale	0.00089		LGL, 2008
Odontocetes			
Blainville's Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Common Bottlenose Dolphin	0.0146	0.0146	Miyashita, 1993
Cuvier's Beaked Whale	0.0003	0.0003	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0029	0.0029	Miyashita, 1993
Fraser's Dolphin	0.00417	0.00417	Barlow, 2006
Ginkgo-toothed Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0017	0.0017	Ferguson and Barlow, 2001 and 2003
Longman's Beaked Whale	0.00025	0.00025	LGL, 2011
Melon-headed Whale	0.00428	0.00428	Fulling et al., 2011
Pantropical Spotted Dolphin	0.0137	0.0137	Miyashita, 1993
Pygmy Killer Whale	0.0021	0.0021	Ferguson and Barlow, 2001 and 2003
Risso's Dolphin	0.0106	0.0106	Miyashita, 1993
Rough-toothed Dolphin	0.0059	0.0059	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0076	0.0076	Miyashita, 1993
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin	0.00083	0.00083	Barlow, 2006
Striped Dolphin	0.0164	0.0164	Miyashita, 1993

Table 9. Marine mammal species potentially occurring during spring and summer in the East of Japan province in which ONR ATE may occur and their density estimated for this region in each season.

EAST OF JAPAN			
SPECIES	SPRING DENSITY ESTIMATE (ANIMALS/KM^2)	SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)	REFERENCES FOR DENSITY ESTIMATES
Mysticetes			
Bryde's Whale	0.0006	0.0006	Ohsumi, 1977
Common Minke Whale	0.0022	0.0022	Buckland et al., 1992
Fin Whale		0.0002	Tillman, 1977
North Pacific Right Whale	<0.00001		
Sei Whale	0.0006	0.0006	Tillman, 1977
Odontocetes			
Baird's Beaked Whale	0.0029	0.0029	Kasuya, 1986
Common Bottlenose Dolphin	0.0171	0.0171	Miyashita, 1993
Cuvier's Beaked Whale	0.0031	0.0031	Ferguson and Barlow, 2001 and 2003
False Killer Whale	0.0036	0.0036	Miyashita, 1993
Ginkgo-toothed Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Hubbs' Beaked Whale	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0001	0.0001	LGL, 2011
Kogia spp.	0.0031	0.0031	Ferguson and Barlow, 2001 and 2003
Pacific White-sided Dolphin	0.0082	0.0082	Ferguson and Barlow, 2001 and 2003
Pantropical Spotted Dolphin		0.0259	Miyashita, 1993
Pygmy Killer Whale	0.0021	0.0021	Ferguson and Barlow, 2001 and 2003
Risso's Dolphin	0.0097	0.0097	Miyashita, 1993
Rough-toothed Dolphin	0.0059	0.0059	Ferguson and Barlow, 2001 and 2003
Short-beaked Common Dolphin	0.0761	0.0761	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0128	0.0128	Miyashita, 1993
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin		0.00083	Barlow, 2006
Striped Dolphin	0.0111	0.0111	Miyashita, 1993

Table 10. Marine mammal species potentially occurring during spring and summer in the Offshore Guam province in which ONR ATE may occur and their density estimated for this region in each season.

OFFSHORE GUAM			
SPECIES	SPRING DENSITY ESTIMATE (ANIMALS/KM^2)	SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)	REFERENCES FOR DENSITY ESTIMATES
Mysticetes			
Blue Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Bryde's Whale	0.00041	0.00041	Fulling et al., 2011
Common Minke Whale	0.0003		Ferguson and Barlow, 2001 and 2003
Fin Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Humpback Whale	0.00089		LGL, 2008
Sei Whale	0.00029		Fulling et al., 2011
Odontocetes			
Blainville's Beaked Whale	0.00117	0.00117	Barlow, 2006
Common Bottlenose Dolphin	0.00131	0.00131	Barlow, 2006
Cuvier's Beaked Whale	0.0062	0.0062	Barlow, 2006
Dwarf Sperm Whale	0.0071	0.0071	Barlow, 2006
False Killer Whale	0.00111	0.00111	Fulling et al., 2011
Fraser's Dolphin	0.00417	0.00417	Barlow, 2006
Ginkgo-toothed Beaked Whale	0.00093	0.00093	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.00014	0.00014	Barlow, 2006
Longman's Beaked Whale	0.00041	0.00041	Barlow, 2006
Melon-headed Whale	0.00428	0.00428	Fulling et al., 2011
Pantropical Spotted Dolphin	0.0226	0.0226	Fulling et al., 2011
Pygmy Killer Whale	0.00014	0.00014	Fulling et al., 2011
Pygmy Sperm Whale	0.0029	0.0029	Barlow, 2006
Risso's Dolphin	0.00097	0.00097	Barlow, 2006
Rough-toothed Dolphin	0.00335	0.00335	Barlow, 2006
Short-finned Pilot Whale	0.00362	0.00362	Barlow, 2006
Sperm Whale	0.0012	0.0012	Fulling et al., 2011
Spinner Dolphin	0.0008	0.0008	Barlow, 2006
Striped Dolphin	0.00616	0.00616	Fulling et al., 2011

Table 11. Marine mammal species potentially occurring during spring and summer in the Northwest Pacific Ocean (25° to 40°N) province in which ONR ATE may occur and their density estimated for this region in each season.

NORTHWEST PACIFIC OCEAN—25° TO 40°N			
SPECIES	**SPRING DENSITY ESTIMATE (ANIMALS/KM^2)**	**SUMMER DENSITY ESTIMATE (ANIMALS/KM^2)**	**REFERENCES FOR DENSITY ESTIMATES**
Mysticetes			
Bryde's Whale	0.00041	0.00041	Fulling et al., 2011
Common Minke Whale	0.0003	0.0003	Buckland et al., 1992
Fin Whale		0.0001	Tillman, 1977
Sei Whale	0.00029	0.00029	Fulling et al., 2011
Odontocetes			
Baird's Beaked Whale	0.0001	0.0001	Kasuya, 1986
Blainville's Beaked Whale	0.0007	0.0007	LGL, 2011
Common Bottlenose Dolphin	0.0008	0.0008	LGL, 2011
Cuvier's Beaked Whale	0.0037	0.0037	LGL, 2011
Dwarf Sperm Whale	0.0043	0.0043	LGL, 2011
False Killer Whale	0.0001	0.0001	Miyashita, 1993
Hubbs' Beaked Whale	0.0007	0.0007	Ferguson and Barlow, 2001 and 2003
Killer Whale	0.0008	0.0008	LGL, 2011
Longmans' Beaked Whale	0.0037	0.0037	LGL, 2011
Melon-headed Whale	0.0043	0.0043	LGL, 2011
Mesoplodon spp.	0.0005	0.0005	Ferguson and Barlow, 2001 and 2003
Pacific White-sided Dolphin	0.0048	0.0048	Ferguson and Barlow, 2001 and 2003
Pantropical Spotted Dolphin	0.0113	0.0113	LGL, 2011
Pygmy Killer Whale	0.0001	0.0001	LGL, 2011
Pygmy Sperm Whale	0.0018	0.0018	LGL, 2011
Risso's Dolphin	0.0005	0.0005	LGL, 2011
Rough-toothed Dolphin	0.0019	0.0019	LGL, 2011
Short-beaked Common Dolphin	0.0863	0.0863	Ferguson and Barlow, 2001 and 2003
Short-finned Pilot Whale	0.0021	0.0021	LGL, 2011
Sperm Whale	0.0022	0.0022	LGL, 2011
Spinner Dolphin	0.0019	0.0019	LGL, 2011
Striped Dolphin	0.0058	0.0058	LGL, 2011
Pinnipeds			
Hawaiian Monk Seal	<0.00001	<0.00001	

Table 12. Marine mammal species potentially occurring during spring and summer in the Northwest Pacific Ocean (10° to 25°N) province in which ONR ATE may occur and their density estimated for this region in each season.

Northwest Pacific Ocean—10° to 25°N			
Species	**Spring Density Estimate (animals/km^2)**	**Summer Density Estimate (animals/km^2)**	**References for Density Estimates**
Mysticetes			
Blue Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Bryde's Whale	0.0003	0.0003	LGL, 2011
Fin Whale	0.00001		Ferguson and Barlow, 2001 and 2003
Sei Whale	0.0001		LGL, 2011
Odontocetes			
Blainville's Beaked Whale	0.0007	0.0007	LGL, 2011
Common Bottlenose Dolphin	0.0008	0.0008	LGL, 2011
Cuvier's Beaked Whale	0.0037	0.0037	LGL, 2011
Dwarf Sperm Whale	0.0043	0.0043	LGL, 2011
False Killer Whale	0.0006	0.0006	LGL, 2011
Fraser's Dolphin	0.0025	0.0025	LGL, 2011
Killer Whale	0.0001	0.0001	LGL, 2011
Longman's Beaked Whale	0.00025	0.00025	LGL, 2011
Melon-headed Whale	0.0027	0.0027	LGL, 2011
Pantropical Spotted Dolphin	0.0113	0.0113	LGL, 2011
Pygmy Killer Whale	0.0001	0.0001	LGL, 2011
Pygmy Sperm Whale	0.0018	0.0018	LGL, 2011
Risso's Dolphin	0.0005	0.0005	LGL, 2011
Rough-toothed Dolphin	0.0019	0.0019	LGL, 2011
Short-finned Pilot Whale	0.0021	0.0021	LGL, 2011
Sperm Whale	0.0022	0.0022	LGL, 2011
Spinner Dolphin	0.0019	0.0019	LGL, 2011
Striped Dolphin	0.0058	0.0058	LGL, 2011

the western North Pacific, then density estimates from a region with similar oceanographic characteristics were extrapolated to those provinces. For example, the eastern tropical Pacific has been extensively surveyed and provides a comprehensive understanding of marine mammals in warm temperate oceanic waters, so density estimates from this well-studied ocean region were sometimes used to derive density estimates for the nine provinces (Ferguson and Barlow, 2001, 2003). Further, density estimates are sometimes pooled for species of the same genus if sufficient data are not available to compute a density for individual species or the species are difficult to distinguish at sea. This is often the case for pygmy and dwarf sperm whales (*Kogia* spp.). Density estimates are available for these species groups rather than the individual species. The process by which these density estimates were derived as well as the density estimates themselves have been accepted by the National Marine Fisheries Service (NMFS) in previous Navy environmental compliance documentation and have been utilized as the basis for regulatory decisions related to effects on protected and ESA-listed species.

4 STATUS AND DISTRIBUTION OF POTENTIALLY AFFECTED MARINE MAMMAL SPECIES AND STOCKS

***REQUIREMENT 4*: Description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals likely to be affected by such activities.**

The focus of this chapter is information on the status, abundance, distribution, seasonal movements where known, diving behavior, and hearing/vocalizations of each of the 34 cetacean species that potentially may occur in at least one of the nine provinces of the western North Pacific Ocean in which the ONR ATE may occur. The status of marine mammal populations is impacted by their biological characteristics, natural phenomenon, and interaction with anthropogenic activity. Many cetacean and pinniped populations have been reduced due to the exploitation of commercial whaling and harvesting, incidental fisheries bycatch, harmful algal blooms, and habitat destruction over the last centuries. The reduction in some marine mammal populations has led to the risk of extinction. The protected status of a marine mammal species is designated as threatened or endangered under the Endangered Species Act for species at risk of extinction while an addition status, depleted, is designated under the MMPA for species or stocks that are not at the optimal sustainable population level.

The distribution of marine mammals is difficult to predict as these highly mobile animals are capable of traveling long distances, usually during seasonal migrations between foraging and calving/breeding grounds. At nearly 16,093 km (8,690 nmi) round trip, the migratory movements of the humpback whale represent the longest migration of any mammal (Clapham, 2009). Despite this mobility, however, the distribution of marine mammals is not typically random or homogeneous but is often characterized by irregular clusters (patches) of occurrence that frequently correlate with locations of high prey abundance. Additionally, little of the vast expanse of the North Pacific Ocean has been surveyed to determine marine mammal occurrence or population estimates. Thus, for many marine mammal species, especially those that exhibit cryptic behavior or are sparsely-occurring, little is known about seasonal movements or regional distribution. For many such marine mammal species, much of the distributional and occurrence information that is available comes from stranding and drive- or coastal-whale fishery records.

4.1 MYSTICETES POTENTIALLY OCCURRING IN THE WESTERN NORTH PACIFIC PROVINCES DURING SPRING OR SUMMER

Mysticetes, or baleen whales, potentially affected by the activities of the ONR ATE include eight species of whales, six of which, the blue whale, fin whale, gray whale, humpback whale, North Pacific right whale, and sei whale, are classified as endangered under the ESA and depleted under the MMPA (see Table 2). Mysticetes are characterized by paired blowholes, large body size, and the baleen plates used to capture zooplankton and small fishes. Due to decades of commercial whaling, many mysticete species are imperiled throughout their worldwide ranges.

All mysticetes produce low frequency sounds, although no direct measurements of auditory (hearing) thresholds have been made for the majority of species as most tests for auditory measurements are impractical for such large animals (Clark, 1990; Richardson et al., 1995; Tyack, 2000; Evans and Raga, 2001). The vocalizations of a few mysticete species are known to be communication signals, but the function of other mysticete low-frequency sounds are not fully understood and may be used for functions such as orientation, navigation, or detection of predators and prey. Based on a morphology study of cetacean auditory mechanisms, Ketten (1994) hypothesized that mysticete hearing is in the low to infrasonic range. It is generally believed that baleen whales have frequencies of best hearing where their calls have the greatest energy—below 5,000 Hz (Ketten, 2000).

4.1.1 BLUE WHALE (*BALAENOPTERA MUSCULUS*)

The blue whale is currently listed as endangered under the ESA and depleted under the MMPA. The global population is estimated between 8,000 to 9,000 individuals (Jefferson et al., 2008), and 1,368 blue whales are estimated to occur in the eastern North Pacific (Carretta et al., 2009).

Blue whales are distributed in subpolar to tropical continental shelf and deeper waters of all oceans and migrate between higher latitudes in summer and lower latitudes in winter (Jefferson et al., 2008; Sears and Perrin, 2009). Blue whales in the North Atlantic migrate as far north as Jan Mayen Island and Spitsbergen, Norway, in the summer but during the winter, they may migrate as far south as Florida or Bermuda (Jefferson et al., 2008). In the North Pacific, blue whales can be found as far north as the Gulf of Alaska but are mostly observed in California waters in the summer and Mexican and Central American waters in the winter (Jefferson et al., 2008; Sears and Perrin, 2009). Blue whales are also commonly found in the Southern Ocean (Jefferson et al., 2008).

The swimming and diving behavior of blue whales has been relatively well characterized. The average surface speed for a blue whale is 4.5 kph (2.4 kt) but can reach a maximum speed of 45 kph (18.9 kt) (Mate et al., 1999; Sears and Perrin, 2009). General dive times range from 4 to 15 min with average depths of 140 m (460 ft) (Croll et al., 2001a; Sears and Perrin, 2009). The longest dive recorded was 36 min (Sears and Perrin, 2009).

There is no direct measurement of the hearing sensitivity of blue whales (Ketten, 2000; Thewissen, 2002). In one of the few studies to date, no change in blue whale vocalization pattern or movements relative to an LFA sound source was observed for received levels (RLs) of 70 to 85 dB (Aburto et al., 1997). Croll et al. (2001b) studied the effects of anthropogenic low-frequency noise on the foraging ecology of blue and fin whales off San Nicolas Island, California and observed no responses or change in foraging behavior that could be attributed to the low-frequency sounds.

Blue whales produce a variety of LF vocalizations ranging from 10 to 200 Hz (Edds, 1982; Thompson and Friedl, 1982; Alling and Payne, 1990; Clark and Fristrup, 1997; Rivers, 1997; Stafford et al., 1998, 1999a, 1999b, 2001; Frankel, 2009). These low frequency calls may be used as communicative signals (McDonald et al., 1995). Short sequences of rapid FM calls below 90 Hz are associated with animals in social groups (Moore et al., 1999; Mellinger and Clark, 2003). The most typical blue whale vocalizations are infrasonic sounds in the 15 or 17 to 20 Hz range (Sears and Perrin, 2009). The seasonality and structure of the vocalizations suggest that these are male song displays for attracting females and/or competing with other males. At SLs ranging 180 to 190 dB re 1 µPa @ 1 m, blue whale vocalizations are among the loudest made by any animal (Cummings and Thompson, 1971; Aroyan et al., 2000).

Blue whales produce long, patterned hierarchically organized sequences of vocalizations that are characterized as songs. Blue whales produce songs throughout most of the year with a peak period of singing overlapping with the general period of functional breeding. Blue whales also produce a variety of transient sound (i.e., they do not occur in predictable patterns or have much interdependence of probability) in the 30 to 100 Hz band (sometimes referred to as “D” calls). These usually sweep down in frequency or are inflected (up-over-down), occur throughout the year, and are assumed to be associated with socializing when animals are in close proximity (Mellinger and Clark, 2003; Clark and Ellison, 2004).

The call characteristics of blue whales vary geographically and seasonally (Stafford et al., 2001). It has been suggested that song characteristics could indicate population structure (McDonald et al., 2006b). In temperate waters, intense bouts of long, patterned sounds are common from fall through spring, but these also occur to a lesser extent during the summer in high-latitude feeding areas.

4.1.2 BRYDE'S WHALE (*BALAENOPTERA EDENI*)

The Bryde's whale is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. There are no global estimates for Bryde's whale. In the western North Pacific, the population of Bryde's whales is estimated by the International Whaling Commission (2009) as 20,501 whales. Bryde's whales occur roughly between 40°N and 40°S throughout tropical and warm temperate (>16.3°C [61.3°F]) waters of the Atlantic, Pacific, and Indian Oceans year round (Omura, 1959; Kato and Perrin, 2009). Bryde's whales occur in some semi-enclosed waters such as the Gulf of California, Gulf of Mexico, and East China Sea (Kato and Perrin, 2009). These whales migrate seasonally toward the lower latitudes near the equator in winter and to high latitudes in summer (Kato and Perrin, 2009). There is some evidence that Bryde's whales remain resident throughout the year in some areas, such as off South Africa and California, migrating only short distances (Best, 1960; Tershy, 1992).

The breeding season for the Byrde's whale is not well defined and births occur throughout the year (Jefferson et al., 2008). Peaks in both births and conception occur in the winter among pelagic Bryde's (Kato and Perrin, 2009). Bryde's whales are known to breed off South Africa (Best, 1960 and 1975). Foraging grounds are not well known for this species.

Bryde's whales are relatively fast swimming whales. The maximum swim speed reached by a Bryde's whale was recorded at 20 to 25 kph (10.8 to 13.5 kt), with average swim speeds reported between 2 and 7 kph (1.1 and 3.8 kt) (Kato and Perrin, 2009). Bryde's whales can dive to a water depth of about 300 m but dive durations are not well known (Kato and Perrin, 2009).

There is no direct measurement of the hearing sensitivity of Bryde's whales (Ketten, 2000). Bryde's whales are known to produce a variety of LF sounds ranging from 20 to 900 Hz, with the higher frequencies being produced between calf-cow pairs (Cummings, 1985; Edds et al., 1993). Oleson et al. (2003) reported call types with a fundamental frequency below 60 Hz. These lower frequency call types have been recorded from Bryde's whales in the Caribbean, eastern tropical Pacific, and off the coast of New Zealand. Calves produce discrete pulses at 700 to 900 Hz (Edds et al., 1993). Source levels (SLs) have been measured between 152 and 174 dB re 1 µPa @ 1 m (Frankel, 2009). Although the function of Bryde's whale vocalizations is not known, communication is the assumed purpose.

4.1.3 COMMON MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA*)

The minke whale is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. Populations are estimated at 180,000 in the Northern Hemisphere (Jefferson et al., 2008). Based on line-transect data from Buckland et al. (1992), an estimated abundance of O stock minke whales in the western North Pacific is 25,049 whales. The International Whaling Commission (IWC) recognizes three stocks of minke whales in the North Pacific Ocean: the Sea of Japan/East China Sea stock, the northwestern Pacific stock west of 180°N, and the Pacific remainder stock (Donovan, 1991). The Sea of Japan/East China Sea stock is referred to as the J stock and also includes minke whales distributed in the Yellow Sea. The northwestern Pacific stock is more simply referred to as the O stock, which is distributed in the waters of the western North Pacific Ocean west of 180°N and in the Sea of Okhotsk. Some minke whales of the J stock migrate into the Sea of Okhotsk in summer (Miyashita et al., 1995).

The J stock is an autumn-breeding population that occurs in the Yellow Sea, East China Sea, and Sea of Japan, with some penetration into the Okhotsk Sea in summer, while the O stock, like most baleen whales, breeds in winter and occurs in summer in the northwestern Pacific, including the northeastern coasts of Japan and in the Okhotsk Sea (Omura and Sakiura, 1956; Kato, 1992). The timing of the arrival of minke whales in Korean and western Japanese waters is suggestive of migration from the south in spring and return in autumn (Ohsumi, 1983). Minke whales are generally found in waters over the continental shelf, but in California and Washington, appear to have established home ranges in inland waters (Dorsey et al., 1990).

Some populations of minke whales in both the northern and southern hemispheres migrate seasonally beginning in spring from high latitude summer feeding grounds to tropical winter breeding grounds, where they overwinter; the migrational patterns of minke whales is not as well defined as those of the larger baleen whales (Jefferson et al., 2008; Glover et al., 2010). Calving is thought to occur in dispersed low latitude areas during winter to spring months following a gestational period of about 10 to 11 months. Peak birthing months are July and August (Perrin and Brownell, 2009). Lockyer (1981) recorded average swimming speeds of 6.1 kph (3.3 kt). Maximum dive duration in minke whales is 15 min, with an average dive time of 6 to 12 min.

There is no direct measurement of the hearing sensitivity of minke whales (Ketten, 2000; Thewisson, 2002). Minke whales produce a variety of sounds, primarily moans, clicks, downsweeps, ratchets, thump trains, and grunts in the 80 Hz to 20 kHz range (Winn and Perkins, 1976; Thompson et al., 1979; Edds-Walton, 2000; Mellinger and Clark, 2000; Frankel, 2009). The signal features of their vocalizations consistently include low frequency, short-duration downsweeps from 250 to 50 Hz. Thump trains may contain signature information, and most of the energy of thump trains is concentrated in the 100 to 400 Hz band (Winn and Perkins, 1976; Mellinger et al., 2000). Complex vocalizations recorded from Australian minke whales involved pulses ranging between 50 Hz and 9.4 kHz, followed by pulsed tones at 1.8 kHz and tonal calls shifting between 80 and 140 Hz (Gedamke et al., 2001). The minke whale was identified as the elusive source of the North Pacific “boing” sound during a research cruise off Hawaii (Rankin and Barlow, 2005).

Both geographical and seasonal differences have been found among the sounds recorded from minke whales. Sounds recorded in the Northern Hemisphere, include grunts, thumps, and ratchets from 80 to 850 Hz, and pings and clicks from 3.3 to 20 kHz. Most sounds recorded during the winter consist of 10 to 60 sec sequences of short 100 to 300 microsecond LF pulse trains (Winn and Perkins, 1976; Thompson et al., 1979; Mellinger and Clark, 2000), while Edds-Walton (2000) reported LF grunts recorded during the summer. Recordings in mid- to high latitudes in the Ross Sea, Antarctica, have short sounds, sweeping down in frequency from 130 to 60 Hz over 0.2 to 0.3 sec. Similar sounds with a frequency range from 396 to 42 Hz have been recorded in the Saint Lawrence Estuary (Edds-Walton, 2000). The function of the sounds produced by minke whales is unknown, but they are assumed to be used for communication such as maintaining space among individuals (Richardson et al., 1995).

4.1.4 FIN WHALE (*BALAENOPTERA PHYSALUS*)

The fin whale is listed as endangered under the ESA and depleted under the MMPA. The global population estimate is roughly 140,000 whales, while 2,636 whales and 174 whales, respectively, are estimated for waters of the eastern North Pacific and Hawaii (Jefferson et al., 2008; Carretta et al., 2009).

Fin whales are widely distributed in all oceans of the world. They are primarily found in temperate and cool waters. Fin whales migrate seasonally between higher latitudes for foraging and lower latitudes for mating and calving (Jefferson et al., 2008). Specific breeding areas are unknown and mating is assumed to occur in pelagic waters, presumably some time during the winter when the whales are in mid-latitudes. Foraging grounds tend to be near coastal upwelling areas and data indicate that some whales remain year round at high latitudes (Clark and Charif, 1998).

Swimming speeds average between 9.2 and 14.8 kph (5 to 8 kt) (Aguilar, 2009). Fin whales dive for a mean duration of 4.2 min at depths averaging 60 m (197 ft) (Croll et al., 2001a; Panigada et al., 2004). Maximum dive depths have been recorded deeper than 360 m (1,181 ft) (Charif et al., 2002). Fin whales forage at dive depths between 100 and 200 m (328 to 656 ft), with foraging dives lasting from 3 to 10 min (Aguilar, 2009).

There is no direct measurement of fin whale hearing sensitivity (Ketten, 2000; Thewissen, 2002). Fin whales produce a variety of LF sounds that range from 10 to 200 Hz (Watkins, 1981; Watkins et al., 1987; Edds, 1988; Thompson et al., 1992). Short sequences of rapid FM calls from 20 to 70 Hz are associated with animals in social groups (Watkins, 1981; Edds, 1988; McDonald et al., 1995). The most common fin whale vocalization is what is referred to as the "20-Hz signal", which is a low frequency (18 to 35 Hz) loud and long (0.5 to 1.5 sec) patterned sequence signal (Patterson and Hamilton, 1964; Watkins et al., 1987; Clark et al., 2002). The pulse patterns of the 20-Hz signal vary geographically and with seasons (Clark et al., 2002; Croll et al., 2002). Regional differences in vocalization production and structure have been found between the Gulf of California and several Atlantic and Pacific Ocean regions. The 20-Hz signal is common from fall through spring in most regions, but also occurs to a lesser extent during the summer in high-latitude feeding areas (Clark and Charif, 1998; Clark et al., 2002). In the Atlantic region, 20-Hz signals are produced regularly throughout the year. Atlantic fin whales also produce higher frequency downsweeps ranging from 100 to 30 Hz (Frankel, 2009). Estimated SLs of the 20-Hz signal are as high as 180 to 190 dB re 1 µPa @ 1 m (Patterson and Hamilton, 1964; Watkins et al., 1987; Thompson et al., 1992; McDonald et al., 1995; Charif et al., 2002; Croll et al., 2002). Croll et al. (2002) verified the earlier conclusion of Watkins et al. (1987) that the 20-Hz vocalizations are only produced by male fin whales and likely are male breeding displays.

Croll et al. (2001b) studied the effects of anthropogenic low-frequency sound with RLs greater than 120 dB on the foraging ecology and vocalizations of blue and fin whales off San Nicolas Island, California. No obvious responses of either whale species was detected that could be attributable to the anthropogenic low-frequency sounds produced by SURTASS LFA sonar (Croll et al. 2001b).

4.1.5 GRAY WHALE (*ESCHRICHTIUS ROBUSTUS*)

The gray whale population is divided into two different stocks. The eastern North Pacific stock of gray whales was listed as endangered under the ESA but was de-listed in 1994. The western North Pacific stock is extremely small and is still listed as endangered under the ESA and as depleted under the MMPA. The western North Pacific stock was thought to be extinct, but a small group of less than 100 gray whales still remain (Jefferson et al., 2008). The eastern North Pacific stock of gray whales is estimated to be 18,178 whales along the west coast of the United States (Angliss and Allen, 2009).

Gray whales are confined to the shallow coastal waters of the North Pacific and adjacent seas. They are found as far south as the Baja of California in the eastern North Pacific, and to southern China in the western North Pacific (Jefferson et al., 2008). Every year most of the population makes a large north-south migration from high latitude feeding grounds to low latitude breeding grounds. Most gray whales in the eastern Pacific breed or calve during the winter in lagoons of Baja California (Jones and Swartz, 2009). There is no available information on breeding and calving areas of the western North Pacific gray whale.

Swim speeds during migration average 4.5 to 9 kph (2.4 to 4.9 kt) and when pursued may reach about 16 kph (8.64 kt) (Jones and Swartz, 2009). Gray whales generally are not long or deep divers. Traveling-dive times are 3 to 5 min with prolonged dives from 7 to 10 min, with a maximum dive time of 26 min, and a maximum dive depth recorded at 170 m (557 ft) (Jones and Swartz, 2009).

There are sparse data on the hearing sensitivity of gray whales. Dahlheim and Ljungblad (1990) suggest that free-ranging gray whales are most sensitive to tones between 800 and 1,500 Hz. Migrating gray whales showed avoidance responses at ranges of several hundred meters to LF playback SLs of 170 to 178 dB when the source was placed within their migration path at about 2 km (1.1 nmi) from shore.

However, this response did not occur when the source was moved out of their migration path but occurred when the SL increased to duplicate the animals' RL within their migration corridor (Clark et al., 1999).

Gray whales produce a variety of sounds from about 100 Hz, potentially up to 12 kHz (Jones and Swartz, 2009). The most common sounds recorded during foraging and breeding are knocks and pulses in frequencies from <100 Hz to 2 kHz, with most energy concentrated at 327 to 825 Hz (Richardson et al., 1995). Tonal moans are produced during migration in frequencies ranging between 100 and 200 Hz (Jones and Swartz, 2009). A combination of clicks and grunts has also been recorded from migrating gray whales in frequencies ranging below 100 Hz to above 10 kHz (Frankel, 2009). The seasonal variation in the sound production is correlated with the different ecological functions and behaviors of the gray whale. Whales make the least amount of sound when dispersed on the feeding grounds and are most vocal on the breeding-calving ground. The SLs for these sounds range between 167 and 188 dB (Frankel, 2009).

Moore and Clarke (2002) reviewed information on how offshore oil and gas activities, commercial fishing and vessel traffic, and whale watching and scientific research affected gray whales. The underwater noise sources played during these experiments included helicopter overflights, drill ship operations, drilling and production platforms, a semi-submersible drilling rig, and tripping operations. Malme et al. (1984, 1988) also conducted experiments using air gun arrays and single air guns. The gray whales' responses to the noise playback experiments and air gun shots include changes in swimming speed and changes in direction (away from the sound sources) (Malme et al., 1984). Changes in feeding with a resumption of feeding after exposure, changes in call rates and structure, and changes in surface behavior were also observed (Dahlheim, 1987; Malme et al., 1988; Moore and Clarke, 2002).

4.1.6 HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)

The humpback whale is listed as endangered under the ESA and depleted under the MMPA. The global population of the humpback whale is estimated to be between 35,000 to 40,000 whales (Jefferson et al., 2008). Calambokidis et al. (2008) recently estimated the population of humpback whales in the entire North Pacific as 18,302 individuals.

Humpback whales are distributed throughout the world's oceans, and are only absent from high Arctic and some parts of the equatorial region. They are a highly migratory species that can travel over 8,047 km (4,345 nmi) one way, which is the longest known migration of any mammal (Jefferson et al., 2008). The whales travel to high latitudes in the spring for feeding and to the tropics in the winter for calving and breeding. Humpback whales are found in coastal shelf waters when feeding and close to islands and reefs when breeding (Clapham, 2009). Data indicate that not all animals migrate during the fall from summer feeding to winter breeding sites and that some whales remain year round at high latitudes (Christensen et al., 1992; Clapham et al., 1993).

Barco et al. (2002) reported on humpback whale population site fidelity in the waters off the U.S. Mid-Atlantic States. Individual whales have shown a strong fidelity to specific feeding grounds, including the Gulf of Maine, Newfoundland/Labrador, the Gulf of Saint Lawrence, Greenland, Iceland, and Norway. Humpback whales migrate from their feeding grounds to a winter breeding range in the West Indies. The majority of whales engage in this seasonal migration, but some whales have also been observed in the high latitudes during winter (Barco et al., 2002).

Humpback whales have well-defined breeding areas in tropical waters that are usually located near isolated islands. In the North Atlantic, there are breeding areas near the West Indies and Trinidad in the west, and the Cape Verde Islands and off northwest Africa in the east. In the North Pacific, there are breeding grounds around the Mariana Islands, Bonin, Ogasawara, Okinawa, Ryukyu Island, and Taiwan

(Clapham, 2009). In the eastern North Pacific, breeding grounds occur around the Hawaiian Islands, off the tip of Baja California, and off the Revillagigedo Islands (Clapham, 2009).

Humpback whales travel long distances, with mean swim speeds near 4.5 kph (2.4 kt) (Gabriele et al., 1996). Dive times recorded off southeast Alaska are near 3 to 4 min in duration (Dolphin, 1987). In the Gulf of California, humpback whale dive times averaged 3.5 min (Strong, 1990). The deepest recorded humpback dive was 240 m (790 ft), with most dives between 60 and 120 m (197 to 394 ft) (Hamilton et al., 1997).

No direct measurements of the hearing sensitivity of humpback whales exist (Ketten, 2000; Thewissen, 2002). Due to this lack of auditory sensitivity information, Houser et al. (2001) developed a mathematical function to describe the frequency sensitivity by integrating position along the humpback basilar membrane with known mammalian data. The results predicted the typical U-shaped audiogram with sensitivity to frequencies from 700 Hz to 10 kHz with maximum sensitivity between 2 to 6 kHz. Humpback whales have been observed reacting to LF industrial noises at estimated RLs of 115 to 124 dB (Malme et al., 1985). They have also been observed to react to conspecific calls at RLs as low as 102 dB (Frankel et al., 1995).

Humpbacks produce a great variety of sounds that fall into three main groups: 1) sounds associated with feeding; 2) sounds made within groups on winter grounds; and 3) songs associated with reproduction. These vocalizations range in frequency from 20 to 10,000 Hz. Feeding groups produce distinct repeated sounds ranging from 20 to 2,000 Hz, with dominant frequencies near 500 Hz (Thompson et al., 1986; Frankel, 2009). These sounds are attractive and appear to rally animals to the feeding activity (D'Vincent et al., 1985; Sharpe and Dill, 1997). Feeding sounds were found to have SLs in excess of 175 dB (Thompson, et al., 1986; Richardson et al., 1995). Social sounds in the winter breeding areas are produced by males and range from 50 Hz to more than 10,000 Hz with most energy below 3,000 Hz (Tyack and Whitehead, 1983; Richardson et al., 1995). These sounds are associated with agonistic behaviors from males competing for dominance and proximity to females. They are known to elicit reactions from animals up to 9 km (4.9 nmi) away (Tyack and Whitehead, 1983).

During the breeding season, males sing long complex songs with frequencies between 25 and 5,000 Hz. Mean SLs are 165 dB (broadband), with a range of 144 to 174 dB (Payne and Payne, 1971; Frankel et al., 1995; Richardson et al., 1995; Tyack and Clark, 2000). The songs vary geographically among humpback populations and appear to have an effective range of approximately 10 to 20 km (5.4 to 10.8 nmi) (Au et al., 2000). Singing males are typically solitary and maintain spacing of 5 to 6 km (2.7 to 3.2 nmi) from one another (Tyack, 1981; Frankel et al., 1995). Songs have been recorded on the wintering ground, along migration routes, and less often on northern feeding grounds (Richardson et al., 1995).

Gabriele and Frankel (2002) reported that underwater acoustic monitoring in Glacier Bay National Park, Alaska, has shown that humpback whales sing more frequently in the late summer and early fall than previously thought. A song is a series of sounds in a predictable order. Humpback songs are typically about 15 min long and are believed to be a mating-related display performed only by males. This study showed that humpback whales frequently sing while they are in Glacier Bay in August through November. Songs were not heard earlier than August, despite the presence of whales, nor later than November, possibly because the whales had started to migrate. It is possible that song is not as prevalent in the spring as it is in the late summer and fall; however, whales still vocalize at this time. The longest song session was recorded in November and lasted almost continuously for 4.5 hours, but most other song sessions were shorter. The songs in Hawaii and Alaska were similar within a single year. The occurrence of songs possibly correlates to seasonal hormonal activity in male humpbacks prior to the migration to the winter grounds.

4.1.7 NORTH PACIFIC RIGHT WHALE (*EUBALAENA JAPONICA*)

The North Pacific right whale is listed as endangered under the ESA and depleted under the MMPA. There are no reliable population estimates for the North Pacific right whale, but it is estimated that there are no more than a few hundred North Pacific right whales in the North Pacific Ocean (Angliss and Allen, 2009). Two stocks have been identified for this right whale, an eastern (southeastern Bering Sea and northern Gulf of Alaska) and western stock (Sea of Okhotsk) (Allen and Angliss, 2011). Based on sightings made during Japanese-Russian cetacean surveys in the Okhotsk Sea in August and September of 1989, 1990 and 1992, Miyashita and Kato (1998) derived a population estimate of 922 whales using line-transect analysis. More recent (2000 and 2003) surveys of the Sea of Okhotsk have been conducted but no new population estimates have been made available.

The North Pacific right whale is not a very well known species because the remaining population consists of so few whales. This species is often found in continental shelf waters but also occurs in oceanic waters. From historic records, North Pacific right whales were recorded in offshore waters with a northward migration in the spring and southward migration in autumn (Jefferson et al., 2008). This whale population is primarily sighted in the Sea of Okhotsk and the eastern Bering Sea (Kenney, 2009). The western stock of North Pacific right whales feeds principally in the Sea of Okhotsk (Allen and Angliss, 2011). Since 1996, a small number of North Pacific right whales have been observed consistently in the southeastern Bering Sea (Goddard and Rugh, 1998).

Current migratory patterns of North Pacific right whales are unknown, although they are thought to migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly well offshore (Scarff, 1986, Clapham et al., 2004). Breeding grounds for this species are unknown. No winter coastal calving grounds in the eastern North Pacific have been identified (Scarff, 1986), leading to speculation that North Pacific right whales may breed offshore. Feeding grounds for the North Pacific right whale are poorly known, but are most likely in the Sea of Okhotsk, southeastern Bering Sea, and northwestern Gulf of Alaska; these areas are most pelagic than the feeding grounds documented for the North Atlantic right whale (Kenney, 2009). There is no swim speed or dive information available for the North Pacific right whale.

There is no direct measurement of the hearing sensitivity of right whales (Ketten, 2000; Thewissen, 2002). However, thickness measurements of the basilar membrane of North Atlantic right whale suggests a hearing range from 10 Hz to 22 kHz, based on established marine mammal models (Parks et al., 2007); this same range can be used as a proxy for North Pacific right whales. McDonald and Moore (2002) studied the vocalizations of North Pacific right whales in the eastern Bering Sea using autonomous seafloor-moored recorders. This study described five vocalization categories: up calls, down-up calls, down calls, constant calls, and unclassified vocalizations. The up call was the predominant type of vocalization and typically swept from 90 Hz to 150 Hz. The down-up call swept down in frequency for 10 to 20 Hz before it became a typical up call. The down calls were typically interspersed with up calls. Constant calls were also interspersed with up calls. Constant calls were also subdivided into two categories: single frequency tonal or a frequency waver of up and down, which varied by approximately 10 Hz. The down and constant calls were lower in frequency than the up calls, averaging 118 Hz for the down call and 94 Hz for the constant call (McDonald and Moore, 2002).

4.1.8 SEI WHALE (*BALAENOPTERA BOREALIS*)

The sei whale is currently listed as endangered under the ESA and depleted under the MMPA. The global population for the sei whale is estimated to be 80,000 whales (Jefferson et al., 2008). In the eastern North Pacific and Hawaiian waters, 46 and 77 sei whales are estimated to occur (Carretta et al., 2009).

Sei whales are primarily found in temperate zones of the world's oceans. Like other members of the family Balaenopteridae, sei whales are assumed to migrate to subpolar higher latitudes where they feed during the late spring through early fall, followed by movements to lower latitudes where they breed and calve during the fall through winter (Jefferson et al., 2008). In the North Atlantic, sei whales are located off Nova Scotia and Labrador during the summer and as far south as Florida during the winter (Leatherwood and Reeves, 1983). In the North Pacific, they range from the Gulf of Alaska to California in the east and from Japan to the Bering Sea in the west. Specific breeding grounds are not known for this species.

Sei whales are fast swimmers, surpassed only by blue whales (Sears and Perrin, 2009). Swim speeds have been recorded at 4.6 kph (2.5 kt), with a maximum speed of 25 kph (13.5 kt) (Jefferson et al., 2008). Dive times range from 0.75 to 15 min, with a mean duration of 1.5 min (Schilling et al., 1992). Sei whales make shallow foraging dives of 20 to 30 m (65 to 100 ft), followed by a deep dive up to 15 min in duration (Gambell, 1985).

There is no direct measurement of the hearing sensitivity of sei whales (Ketten, 2000; Thewissen, 2002). Sei whale vocalizations are the least studied of all the rorquals. Rankin and Barlow (2007) recorded sei whale vocalizations in Hawaii and reported that all vocalizations were downsweeps, ranging from on average from 100.3 to 446 Hz for "high frequency" calls and from 39.4 to 21.0 Hz for "low frequency" calls. In another study, McDonald et al. (2005) recorded sei whales in Antarctica with an average frequency of 433 Hz.

4.2 ODONTOCETES POTENTIALLY OCCURRING IN THE WESTERN NORTH PACIFIC PROVINCES DURING SPRING OR SUMMER

Of the twenty-five species or species groups of odontocete marine mammals (i.e., whales, dolphins, and porpoises), or toothed whales that may potentially occur in one of the nine provinces in which the ONR ATE may occur, only one, the sperm whale, is classified as endangered under the ESA and depleted under the MMPA (Table 2). Odontocetes are differentiated from mysticetes by the presence of functional teeth and a single blowhole. Commercial whaling depleted the largest odontocete, the sperm whale significantly until the whaling moratorium was instituted but other smaller odontocetes are still hunted by coastal whale fisheries; aboriginal and traditional coastal drive and harpoon whaling fisheries exist in some areas of the Pacific and Atlantic Oceans, including Japan, Indonesia, Grenadines, and Faroe Islands, that target a number of odontocete species (van Ginkel, 2005; Ellis, 2009; Kasuya, 2009).

All odontocetes are capable of acoustic communication involving the generation of sonic and ultrasonic whistles, burst-pulse sounds, and clicking signals with peak energy between 10 and 200 kHz. The peak in odontocete hearing is above 2 kHz (Thewissen, 2002). Odontocetes have a broad acoustic range with recent hearing thresholds measuring between 400 Hz and 100 kHz (Finneran et al., 2002). Odontocetes produce a variety of click and tonal sounds for communication and echolocation purposes (Au, 1993). Odontocetes likely communicate primarily above 1,000 Hz and echolocate above 20 to 30 kHz (Würsig and Richardson, 2002). Little is known about the details of most sound production and auditory thresholds for many odontocete species (Frankel, 2009).

4.2.1 BAIRD'S BEAKED WHALE (*BERARDIUS BAIRDII*)

The Baird's beaked whale is not listed under the ESA nor as depleted under the MMPA. Even though the global population size for this beaked whale species is unknown, the abundance of Baird's beaked whale off the Pacific coast of Japan has been estimated as 5,029 whales, with 1,260 whales estimated in the eastern Sea of Japan, and 660 in the southern Sea of Okhotsk (Kasuya, 2009). Baird's beaked whales occur in the North Pacific Ocean, including the Bering and Okhotsk Seas (Kasuya, 1986 and 2009). Ohizumi et al. (2003) reported that Baird's beaked whales migrate to the coastal waters of the western North Pacific and the southern Sea of Okhotsk in the summer.

Few swim speed data are available for any beaked whale species. Baird's beaked whales were recorded diving between 15 and 20 min, with a maximum dive duration of 67 min (Barlow, 1999; Kasuya, 2009). In a recent study, a Baird's beaked whale in the western North Pacific had a maximum dive time of 64.4 min and a maximum depth of 1,777 m (5,830 ft). Minamikawa et al. (2007) reported that one deep dive (>1,000 m [3,280 ft]) by Baird's beaked whales was followed by several intermediate dives (100 to 1,000 m [328 to 3,280 ft]).

There is no direct measurement of auditory threshold for the hearing sensitivity of Baird's beaked whales (Ketten, 2000; Thewissen, 2002). The Baird's beaked whale produces a variety of sounds, mainly burst-pulse clicks and frequency modulated (FM) whistles. Baird's beaked whales have been recorded producing high frequency (HF) sounds between 12 and 134 kHz with dominant frequencies between 23 to 24.6 kHz and 35 to 45 kHz (Dawson et al., 1998). The functions of these signal types are unknown. Clicks and click trains were heard sporadically throughout the recorded data, which may suggest that these beaked whales possess echolocation abilities. There is no available data regarding seasonal or geographical variation in the sound production of these species. Estimated SLs are not documented.

4.2.2 BLAINVILLE'S BEAKED WHALE (*MESOPLODON DENSIROSTRIS*)

Blainville's beaked whales are not listed as threatened or endangered under the ESA nor are they categorized as depleted under the MMPA. The worldwide population size for this *Mesoplodon* spp. is unknown. The abundance of Blainville's beaked whales in the Hawaii stock has been estimated as 2,872 whales while the Western North Pacific stock has been estimated as 8,032 animals (Ferguson and Barlow, 2001 and 2003; Carretta et al., 2011). Blainville's beaked whales are the most cosmopolitan of the *Mesoplodon* beaked whales and have a continuous distribution throughout tropical, sub-tropical, and warm-temperate waters of the world's oceans, although no occurrence records have been documented for the Mediterranean Sea (MacLeod et al., 2006; Pitman, 2009). Strandings of Blainville's have been reported from eastern Japan (MacLeod et al., 2006). These beaked whales are normally found in deep (>2,000 m [6,562 ft]) pelagic waters or in continental slope waters (Davis et al., 1998). In a study of Blainville's beaked whales in the Bahamas, MacLeod and Zuur (2005) found that the distribution of this beaked whale was closely related to bottom topography.

Blainville's beaked whales tagged in Hawai'i made total movements of up to 2,923 km (1,578 nmi), yet the net distance from the tagging location never exceeded 139 km (75 nmi) (Schorr et al., 2009). Few swim speed data are available for any beaked whale species. Schorr et al. (2009) reported a horizontal swim speed of 0.8 to 1.5 kph (0.4 to 0.8 kt) for a Blainville's beaked whales in Hawaii with a maximum rate of 8.1 kph. Dives of Blainville's beaked whales averaged 7.5 min during social interactions at the surface (Baird et al., 2004). In another study, Blainville's beaked whales were found spend more time in the upper 100 m. of the water column than Cuvier's beaked whales and regularly dive to water depths >800 m (>2,625 ft), with a median dive depth averaging 922 m (3,025 ft) and maximum dive durations of 48 to 54 min with maximum dive depths of Blainville's beaked whales to 1,408 m (4,619 ft) (Baird et al., 2006).

Auditory information on Blainville's beaked whales is somewhat sparse. An audiogram measured from a stranded Blainville's beaked whale documented a hearing threshold from 5.6 to 160 kHz, while the best hearing range spanned 40 to 50 kHz, with threshold below 50 dB re 1μPa (Pacini et al., 2011). In a study of echolocation clicks in Blainville's beaked whales, Johnson et al. (2006) found that the whales make various types of clicks while foraging. The whales have a distinct search click that is in the form of an FM upsweep with a minus 10 dB bandwidth from 26 to 51 kHz (Johnson et al., 2006). They also produce a buzz click that is during the final stage of prey capture, and they have no FM structure with a minus 10 dB bandwidth from 25 to 80 kHz or higher (Johnson et al., 2006). Studies on Cuvier's and Blainville's beaked whales conducted by Johnson et al. (2004) concluded that no vocalizations were detected from any tagged beaked whales when they were within 200 m (656 ft) of the surface; the whales started clicking at an average depth of 400 m (1,312 ft), ranging from 200 to 570 m (656 to 1,870 ft), and stopped clicking when they started their ascent at an average depth of 720 m (2,362 ft), with a range of 500 to 790 m (1,640 to 2,591 ft).

4.2.3 COMMON BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*)

The bottlenose dolphin is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. The global population for the bottlenose dolphin is unknown. Miyashita (1993) estimated an abundance of 168,791 animals for the Philippine Sea region while 317,000 bottlenose dolphins are estimated to inhabit the waters of Japan (Jefferson et al., 2008). The bottlenose dolphin is distributed worldwide in temperate to tropical waters of the Pacific, Atlantic, and Indian Oceans. They are primarily found in coastal waters but also occur in diverse habitats ranging from rivers and protected bays to oceanic islands and the open ocean, over the continental shelf, and along the shelf break (Scott and Chivers, 1990; Sudara and Mahakunlayanakul, 1998; Wells and Scott, 2009). Seasonal movements vary between inshore and offshore locations and year-round home ranges (Croll et al., 1999; Wells and Scott, 2009). Calving season is generally year-round with peaks occurring from early spring to early fall (Scott and Chivers, 1990). There are no known breeding grounds.

Common bottlenose females can live up to 57 years old while the maximum age for males is 48 (Wells and Scott, 1990). Females reach sexual maturity at ages 5 to 13, while males mature at ages 9 to 14 (Wells and Scott, 2009). Females can remain reproductive for long period of time, with the oldest mother reported to be age 48 (Wells and Scott, 1990). Gestation last approximately 12 months.

Sustained swim speeds for bottlenose dolphins range between 4 and 20 kph (2.2 and 10.8 kt) and may reach speeds as high as 29.9 kph (16.1 kt) (Croll et al., 1999). Dive times range from 38 seconds to 1.2 min but have been known to last as long as 10 min (Mate et al., 1995; Croll et al., 1999). The dive depth of a bottlenose dolphin in Tampa Bay, Florida, was measured at 98 m (322 ft) (Mate et al., 1995). The deepest dive recorded for a bottlenose dolphin is 535 m (1,755 ft), reached by a trained dolphin (Ridgway, 1986).

Bottlenose dolphins hear underwater sounds in the range of 150 Hz to 135 kHz (Johnson, 1967; Ljungblad et al., 1982). Their best underwater hearing occurs at 15 kHz, where the threshold level range is 42 to 52 dB RL (Sauerland and Dehnhardt, 1998). Bottlenose dolphins also have good sound location abilities and are most sensitive when sounds arrive directly towards the head (Richardson et al., 1995). Bottlenose dolphins produce sounds as low as 0.05 kHz and as high as 150 kHz with dominant frequencies at 0.3 to 14.5 kHz, 25 to 30 kHz, and 95 to 130 kHz (Johnson, 1967; Popper, 1980; McCowan and Reiss, 1995; Schultz et al., 1995; Croll et al., 1999; Oswald et al., 2003). The maximum SL produced is 228 dB (Croll et al., 1999). Bottlenose dolphins produce a variety of whistles, echolocation clicks and burst-pulse sounds. Echolocation clicks, with peak frequencies from 40 to 130 kHz, are hypothesized to be used in navigation, foraging, and predator detection (Au, 1993; Houser et al., 1999; Jones and Sayigh, 2002). According to Au (1993), sonar clicks are broadband, ranging in frequency from a few kilohertz to more than 150 kHz, with a 3 dB bandwidth of 30 to 60 kHz (Croll et al., 1999). The echolocation signals usually have a 50 to 100 microseconds duration with peak frequencies ranging from 30 to 100 kHz and fractional bandwidths between 10 and 90 % of the peak frequency (Houser et al., 1999). Burst-pulses, or squawks, are commonly produced during social interactions. These sounds are broadband vocalizations that consist of rapid sequences of clicks with inter-click intervals less than 5 milliseconds. Burst-pulse sounds are typically used during escalations of aggression (Croll et al., 1999).

Each individual bottlenose dolphin has a fixed, unique FM pattern, or contour whistle called a signature whistle. These signal types have been well studied and are presumably used for recognition, but may have other social contexts (Jones and Sayigh, 2002; Frankel, 2009). Signature whistles have a narrow-band sound with the frequency commonly between 4 and 20 kHz, duration between 0.1 and 3.6 seconds, and an SL of 125 to 140 dB (Croll et al., 1999). Jones and Sayigh (2002) reported geographic variations in behavior and in the rates of vocal production. Whistles and echolocation varied between Southport, North Carolina, the Wilmington-North Carolina Intracoastal Waterway (ICW), the Wilmington, North Carolina, coastline, and Sarasota, Florida. Dolphins at the Southport site whistled more than the dolphins at the Wilmington site, which whistled more than the dolphins at the ICW site, which whistled more than the dolphins at the Sarasota site. Echolocation production was higher at the ICW site than all of the other sites. Dolphins in all three of the North Carolina sites spent more time in large groups than the dolphins at the Sarasota site. Echolocation occurred most often when dolphins were socializing (Jones and Sayigh, 2002).

4.2.4 CUVIER'S BEAKED WHALE (*ZIPHIUS CAVIROSTRIS*)

Cuvier's beaked whale is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. Global population estimates for this species are unknown. An abundance of 90,725 Cuvier's beaked whales is estimated for the North Pacific stock (Ferguson and Barlow, 2003). The Cuvier's beaked whale is the most cosmopolitan of all beaked whale species, with a wide distribution in oceanic tropical to polar waters of all oceans except high-latitude polar areas (Heyning and Mead, 2009). This species is also found in enclosed seas such as the Sea of Japan and the Sea of Okhotsk (Omura et al., 1955; Jefferson et al., 2008). The Cuvier's apparently prefers waters over the continental slope. No data on breeding and calving grounds are available.

Swim speeds of Cuvier's beaked whale have been recorded between 5 and 6 kph (2.7 and 3.3 kt) (Houston, 1991). Dive durations range between 20 and 87 min with an average dive time near 30 min (Heyning, 1989; Jefferson et al., 1993; Baird et al., 2004). This species is a deep diving species and can reach depths of 1,888 m (6,194 ft) (Heyning and Mead, 2009).

There is no direct measurement of auditory threshold for the hearing sensitivity of Cuvier's beaked whales (Ketten, 2000; Thewissen, 2002). Cuvier's beaked whales were recorded producing HF clicks between 13 and 17 kHz; since these sounds were recorded during diving activity, the clicks were assumed to be associated with echolocation (Frantzis et al., 2002). A more recent study on Cuvier's beaked whale vocalization abilities by Johnson et al. (2004) recorded frequencies of Cuvier's clicks ranging from about 12 to 40 kHz with associated SLs of 200 to 220 dB re 1 µPa @ 1 m (peak-to-peak) (Johnson et al., 2004). Johnson et al. (2004) also found that Cuvier's beaked whales do not vocalize when within 200 m (656 ft) of the surface and only started clicking at an average depth of 475 m (1,558 ft) and stopped clicking on the ascent at an average depth of 850 m (2,789 ft) with click intervals of approximately 0.4 seconds. Zimmer et al. (2005) also studied the echolocation clicks of Cuvier's beaked whales and recorded a SL of 214 dB re 1 µPa @ 1 m (peak-to-peak). There are no available data regarding seasonal or geographical variation in the sound production of Cuvier's beaked whales.

4.2.5 DALL'S PORPOISE (*PHOCOENOIDES DALLI*)

Dall's porpoise is not listed under the ESA. The total global population of the Dall's porpoise is unknown but this porpoise is considered to be one of the most common cetacean species in the central North Pacific (Jefferson et al., 2008; Jefferson, 2009b). There are an estimated 104,000 harbor porpoises along the Pacific coast of Japan and 554,000 in the Okhotsk Sea (Jefferson et al., 2008).

The Dall's porpoise is found exclusively in the North Pacific Ocean and adjacent seas (Bering Sea, Okhotsk Sea, and Sea of Japan) (Jefferson et al., 2008). This oceanic species is primarily found in deep offshore waters from 30°N to 62°N or in areas where deepwater occurs close to shore, but this species has been observed in the inshore waters of Washington, British Columbia, and Alaska (Jefferson et al., 2008). Distribution in most areas is very poorly defined (Jefferson, 2009b).

Dall's porpoises are thought to be one of the fastest swimming of the small cetaceans (Croll et al., 1999; Jefferson, 2009b). Average swim speeds are between 2.4 and 21.6 kph (1.3 and 11.7 kt) and are dependent on the type of swimming behavior (slow rolling, fast rolling, or rooster-tailing) (Croll et al., 1999), but Dall's porpoises may reach speeds of 55 kph (29.7 kt) for quick bursts (Leatherwood and Reeves, 1983). They are relatively deep divers, diving to 275 m (900 ft) for as long as 8 min (Ridgway, 1986; Hanson et al., 1998).

There is no direct measurement of the hearing sensitivity of Dall's porpoises (Ketten, 2000; Thewissen, 2002). It has been estimated that the reaction threshold of Dall's porpoise for pulses at 20 to 100 kHz is about 116 to 130 dB RL, but higher for pulses shorter than one millisecond or for pulses higher than 100 kHz (Hatakeyama et al., 1994).

Dall's porpoises produce sounds as low as 40 Hz and as high as 160 kHz (Ridgway, 1966; Evans, 1973; Awbrey et al., 1979; Evans and Awbrey, 1984; Hatakeyama and Soeda, 1990; Hatakeyama et al., 1994). They can emit LF clicks in the range of 40 Hz to 12 kHz (Evans, 1973; Awbrey et al., 1979). Narrow band clicks are also produced with energy concentrated around 120 to 130 kHz (Au, 1993). Their maximum peak-to-peak SL is 175 dB (Evans, 1973; Evans and Awbrey, 1984). Dall's porpoise do not whistle very often.

4.2.6 FALSE KILLER WHALE (*PSEUDORCA CRASSIDENS*)

The Main Hawaiian Islands insular distinct population segment (DPS) of the false killer whale was listed as endangered under the ESA in November 2012 (NOAA, 2012). The global population for this species is unknown. In the northwestern Pacific, an estimated 17,000 false killer whales have been documented (Miyashita, 1993). False killer whales are found in tropical to warm temperate zones in deep, offshore waters (Stacey et al., 1994; Odell and McClune, 1999; Baird, 2009). Although typically a pelagic species, they approach close to the shores of oceanic islands and regularly mass strand (Baird, 2009). False killer whales have a poorly known ecology. Breeding grounds and seasonality in breeding are unknown; however, one population does have a breeding peak in late winter (Jefferson et al., 2008). Adults of both sexes are thought to become sexually mature between ages of 8 and 14, with males likely maturing later than females. Maximum life span has been estimated at 57 for males and 62 for females (Baird, 2009; Yoshida et al., 2010). These whales do not have specific feeding grounds but feed opportunistically (Odell and McClune, 1999; Jefferson et al., 2008). False killer whales have an approximate swim speed of 3 kph (1.6 kt), although a maximum swim speed has been documented at 28.8 kph (11.9 kt) (Brown et al. 1966; Rohr et al., 2002).

False killer whales hear underwater sounds in the range of less than 1 to 115 kHz (Johnson, 1967; Au, 1993). Their best underwater hearing occurs at 17 kHz, where the threshold level ranges between 39 to 49 dB RL. In a study by Yuen et al. (2005), false killer whales' hearing was measured using both behavioral and auditory evoked potentials (AEP) audiograms; the behavioral data show that this species is most sensitive between 16 and 24 kHz, with peak sensitivity at 20 kHz, while the AEP data showed that this species best hearing sensitivity is from 16 to 22.5 kHz, with peak sensitivity at 22.5 kHz. Au et al. (1997) studied the effects of the Acoustic Thermometry of Ocean Climate (ATOC) program on false killer whales; the hearing thresholds for false killer whales were 140.7 dB RL ± 1.2 dB for the 75-Hz pure tone and 139.0 dB RL ± 1.1 dB for the ATOC signal.

False killer whales produce a wide variety of sounds from 4 to 130 kHz, with dominant frequencies between 25 to 30 kHz and 95 to 130 kHz (Busnel and Dziedzic, 1968; Kamminga and van Velden, 1987; Thomas and Turl, 1990; Murray et al., 1998). Most signal types vary among whistles, burst-pulse sounds and click trains (Murray et al. 1998). Whistles generally range between 4.7 and 6.1 kHz. False killer whales echolocate highly directional clicks ranging between 20 and 60 kHz and 100 and 130 kHz (Kamminga and van Velden, 1987; Thomas and Turl, 1990). There are no available data regarding seasonal or geographical variation in the sound production of false killer whales. Estimated SL of clicks are near 228 dB (Thomas and Turl, 1990).

4.2.7 FRASER'S DOLPHIN (*LAGENODELPHIS HOSEI*)

Fraser's dolphin is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. The global population for this species is unknown. Abundances or densities of Fraser's dolphins only exist for a limited number of regions: the North Pacific stock has been estimated as 220,789 dolphins (Ferguson and Barlow, 2001 and 2003), and in the eastern Sulu Sea, the abundance is estimated as 13,518 dolphins (Dolar, 2009).

Fraser's dolphins occur primarily in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans (Croll et al., 1999; Dolar, 2009). This species is an oceanic species that is most commonly found in deep waters (1,500 to 2,000 m [4,921 to 6,562 ft]) usually 15 to 20 km (8 to 11 nmi) from shore or where deepwater approaches the shore, such as occurs in the Philippines, Taiwan, some Caribbean islands, and the Indonesian-Malay archipelago (Jefferson et al., 2008). Breeding areas and seasonal movements of this species have not been confirmed. However, in Japan, calving appears to peak in the spring and fall. Sexual maturity occurs at age 5 to 8 for females and 7 to 10 years old for males (Amano et al., 1996).

Swim speeds of Fraser's dolphin have been recorded between 4 and 7 kph (2.2 and 3.8 kt) with swim speeds up to 28 kph (15 kt) when escaping predators (Croll et al., 1999). Several foraging depths have been recorded. Based on prey composition, it is believed that Fraser's dolphins feed at two depth horizons in the ETP. The shallowest depth in this region is no less than 250 m (820 ft) and the deepest is no less than 500 m (1640 ft). In the Sulu Sea, they appear to feed near the surface to at least 600 m (1,968 ft). In South Africa and in the Caribbean, they were observed feeding near the surface (Dolar et al., 2003). According to Watkins et al. (1994), Fraser's dolphins herd when they feed, swimming rapidly to an area, diving for 15 seconds or more, surfacing and splashing in a coordinated effort to surround the school of fish. Dive durations are not available.

There is no direct measurement of the hearing sensitivity of Fraser's dolphins (Ketten, 2000; Thewissen, 2002). Fraser's dolphins produce sounds ranging from 4.3 to over 40 kHz (Leatherwood et al., 1993; Watkins et al., 1994). Echolocation clicks are described as short broadband sounds without emphasis at frequencies below 40 kHz, while whistles were frequency-modulated tones concentrated between 4.3 and 24 kHz. Whistles have been suggested as communicative signals during social activity (Watkins et al., 1994). There are no available data regarding seasonal or geographical variation in the sound production of Fraser's dolphins. Source levels were not available.

4.2.8 GINKGO-TOOTHED BEAKED WHALE (*MESOPLODON GINKGODENS*)

Ginkgo-toothed beaked whales are not listed as threatened or endangered under the ESA nor are they categorized as depleted under the MMPA. No estimates of worldwide abundance are available, but the North Pacific stock of ginkgo-toothed beaked whales has been estimated as 22,799 whales (Ferguson and Barlow, 2001 and 2003). The ginkgo-toothed beaked whale occurs tropical to warm temperate waters of the Indian and Pacific Ocean, where the majority of occurrence records are from the seas surrounding Japan (Jefferson et al., 2008; Pitman, 2009). No confirmed sightings of this species have been reported and all occurrence records are of strandings (MacLeod et al., 2006). There is no information on the ecology of this beaked whale, and no dive, swim, or hearing information is available.

4.2.9 HUBBS' BEAKED WHALE (*MESOPLODON CARHUBBSI*)

Hubb's beaked whales are not listed under the ESA nor categorized as depleted under the MMPA. Little is known definitively about this species of beaked whales, particularly about its biology. No population estimates are available for the Hubbs' beaked whale. This species of beaked whale is known from fewer than 60 occurrence records from Japan and the Pacific coast of North America, including one well-documented at-sea sighting of two separate groups off Oregon, since it was identified 50 years ago (Yamada et al., 2012). Hubbs' beaked whales are endemic to the cold-temperate oceanic waters of the North Pacific from about 35° to 54°N, with records ranging from British Columbia and California in the east and Japan in the west (MacLeod et al., 2006; Yamada et al., 2012). Nothing is known about the population structure or movements of the Hubbs' beaked whale within their reputed North Pacific range (Yamada et al., 2012).

No information is available on hearing in the Hubbs' beaked whale. Recordings have been made of Hubb's beaked whale producing whistles, which ranged between 2.6 and 10.7 kHz, and pulsed sounds from 300 Hz to 80 kHz and higher with dominant frequencies from 300 Hz to 2 kHz (Buerki et al., 1989; Lynn and Reiss, 1992).

4.2.10 KILLER WHALE (*ORCINUS ORCA*)

Only the Southern Resident killer whale DPS is listed as endangered under the ESA, with both the Southern Resident and AT 1 stocks of killer whales classified as depleted under the MMPA. Critical habitat is designated for the Southern Resident killer whales in the inland marine waters of Washington (Puget Sound, Strait of Juan de Fuca, and Haro Strait) (NOAA, 2006).

Although no current global population estimates are available, Reeves and Leatherwood (1994) estimated the killer whale worldwide abundance near 100,000 individuals. Resident killer whales in the North Pacific consist of the southern, northern, southern Alaska (which includes southeast Alaska and Prince William Sound whales), western Alaska, and western North Pacific groups (NOAA, 2005). Resident killer whales occur in large pods with roughly 10 to 60 members. About 430 killer whales currently are estimated in the Hawaiian stock (Carretta et al., 2009) and 12,256 whales are estimated for the North Pacific stock (Ferguson and Barlow, 2001 and 2003). 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, especially in areas of high productivity and in high latitude coastal areas (Leatherwood and Dahlheim, 1978; Ford, 2009). However, they appear to be more common within 800 km (430 nmi) of major continents in cold-temperate to subpolar waters (Mitchell, 1975).

Killer whales are found in at least three different ecotypes; resident, transients, and offshore animals are found in the northern hemisphere (Olesiuk et al., 2005), with three ecotypes (A, B, and C) found in Antarctic waters (Ford, 2009). The different eco-type specialize on different types of prey, typically fish (e.g. residents) and/or marine mammals (e.g. transients). In some cases their specialization can be quite narrow. Reproduction within the southern resident ecotype appears to occur frequently within each pod but not with closely related individuals, and there was no evidence of the southern resident whales mating with other groups (Ford et al., 2011). In the northern resident group, females typically birth their first calf at about ages 12 to 14 and produce an average of five calves over their reproduction lifespan (Ford, 2009). Approximately half of the females become reproductively senescent by age 41, and the oldest known mother was 44. Calving is believed to peak in autumn but may occur during any season (Olesiuk et al., 2005).

Swimming speeds usually range between 6 to 10 kph (3.2 to 5.4 kt), but they can achieve speeds up to 37 kph (20 kt) in short bursts (Lang, 1966; LeDuc, 2009). In southern British Columbia and northwestern Washington State, killer whales spend 70% of their time in the upper 20 m (66 ft) of the water column, but can dive to 100 m (330 ft) or more with a maximum recorded depth of 201 m (660 ft) (Baird et al., 1998). The deepest dive recorded by a killer whale is 265 m (870 ft), reached by a trained individual (Ridgway, 1986). Dive durations range from 1 to 10 min (Norris and Prescott, 1961; Lenfant, 1969; Baird et al., 1998).

Killer whales hear underwater sounds in the range of <500 Hz to 120 kHz (Bain et al., 1993; Szymanski et al., 1999). Their best underwater hearing occurs between 15 and 42 kHz, where the threshold level is near 34 to 36 dB RL (Hall and Johnson, 1972; Szymanski et al., 1999). Killer whales produce sounds as low as 80 Hz and as high as 85 kHz with dominant frequencies at 1 to 20 kHz (Schevill and Watkins, 1966; Diercks et al., 1971, 1973; Evans, 1973; Steiner et al., 1979; Awbrey et al., 1982; Ford and Fisher, 1982; Ford, 1989; Miller and Bain, 2000). An average of 12 different call types (range 7 to 17)—mostly repetitive discrete calls—exist for each pod (Ford, 2009). Pulsed calls and whistles, called dialects, carry information hypothesized as geographic origin, individual identity, pod membership, and activity level. Vocalizations tend to be in the range between 500 Hz and 10 kHz and may be used for group cohesion and identity (Ford, 2009; Frankel, 2009). Whistles and echolocation clicks are also included in killer whale repertoires, but are not a dominant signal type of the vocal repertoire in comparison to pulsed calls (Miller and Bain, 2000). Erbe (2002) recorded received broadband sound pressure levels of orca burst-pulse calls ranging between 105 and 124 dB RL at an estimated distance of 100 m (328 ft).

4.2.11 *Kogia* spp.—Pygmy Sperm Whale *(Kogia breviceps)* and Dwarf Sperm Whale *(Kogia sima)*

Neither the pygmy sperm whale nor dwarf sperm whale is listed under the ESA nor are they categorized as depleted under the MMPA. Abundance estimates of the global population sizes for these species are unknown but the abundance in the North Pacific has been estimated as 350,553 whales (Ferguson and Barlow, 2001 and 2003). Pygmy and dwarf sperm whales are distributed worldwide in temperate to tropical deep waters and are especially common along continental shelf breaks (Evans, 1987; McAlpine, 2009). Dwarf sperm whales appear to occur in more pelagic, warmer waters than the pygmy sperm whale (Caldwell and Caldwell, 1989; McAlpine, 2009). Breeding areas for both species include waters off Florida (Evans, 1987). There is little evidence that pygmy and dwarf sperm whales have a seasonal migration pattern (McAlpine, 2009).

Swim speeds vary and were found to reach up to 11 kph (5.9 kt) (Scott et al., 2001). In the Gulf of California, *Kogia* spp. have been recorded with an average dive time of 8.6 min, whereas dwarf sperm whales in the Gulf of Mexico exhibited a maximum dive time of 43 min (Breese and Tershy, 1993; Willis and Baird, 1998).

There are sparse data on the hearing sensitivity for pygmy sperm whales. An ABR study on a rehabilitating pygmy sperm whale indicated that this species has an underwater hearing range that is most sensitive between 90 and 150 kHz (Carder et al., 1995; Ridgway and Carder, 2001). No hearing measured hearing data are available for the dwarf sperm whale. Recent recordings from captive pygmy sperm whales indicate that they produce sounds between 60 and 200 kHz with peak frequencies at 120 to 130 kHz (Santoro et al., 1989; Carder et al., 1995; Ridgway and Carder, 2001). Echolocation pulses were documented with peak frequencies at 125 to 130 kHz (Ridgway and Carder, 2001). Thomas et al. (1990) recorded an LF swept signal between 1.3 to 1.5 kHz from a captive pygmy sperm whale in Hawaii. Jérémie et al. (2006) reported frequencies ranging from 13 to 33 kHz for dwarf sperm whale clicks with durations of 0.3 to 0.5 sec. No geographical or seasonal differences in sounds have been documented and no estimated source levels were available.

4.2.12 LONGMAN'S BEAKED WHALE (*INDOPACETUS PACIFICUS*)

The global abundance of the Longman's beaked whale, also known as the Indo-Pacific beaked whale, is unknown and few population data exist for this species, except for in Hawaiian waters, where the population is estimated as 760 animals (Jefferson et al., 2008). The distribution of Longman's beaked whale is limited to the Indo-Pacific region (Leatherwood and Reeves, 1983; Jefferson et al., 2008). Recently, groups of whales sighted in the equatorial Indian and Pacific Oceans off Mexico and Africa have tentatively been identified as Longman's beaked whales (Ballance and Pitman, 1998; Pitman et al., 1998; Pitman, 2009a). No data are available to confirm seasonal migration patterns for Longman's beaked whales. No data on breeding and calving grounds are available.

No data are available on swim speeds or dive depths. Only a small number of dive times have been recorded from this species. Dive duration in the Longman's beaked whale is 11 to 33 min, possibly up to 45 min (Pitman, 2009a). There is no direct measurement of hearing sensitivity for Longman's beaked whales (Ketten, 2000; Thewissen, 2002). No data are available on sound production in this species.

4.2.13 MELON-HEADED WHALE (*PEPONOCEPHALA ELECTRA*)

Melon-headed whales are not listed as threatened or endangered under the ESA nor are categorized as depleted under the MMPA. The global population for this species is unknown. The Western North Pacific stock of melon-headed whales is estimated as 36,770 whales (Ferguson and Barlow, 2001 and 2003). The melon-headed whale occurs in pelagic tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans from between 40°N to 30°S (Jefferson and Barros, 1997; Jefferson et al., 2008). Melon-headed whales are also found in areas where deep waters appear close to shore (within a few kilometers) as well as in some waters of the Philippines (Leatherwood et al., 1992). Donaldson (1983) suggested that the presence of melon-headed whales in the waters of Guam, Palau, and Japan suggests a possible link between equatorial Pacific and northern Pacific populations of this species, via the Mariana Islands. The first occurrence record in Japan was an individual killed by fishermen in the shallows of Hiratsuka Beach, Sugami Bay in 1963 (Nakajima and Nishiwaki, 1965). Other records along the perimeter of the western Philippine Sea include the sighting of more than 500 individuals in Suruga Bay (Nishiwaki and Norris, 1966), while other records are from coastal whale fisheries that captured 104 melon-headed whales in Okinawa (Miyazaki et al., 1998) and a mixed school of 500 Fraser's dolphins and melon-headed whales in 1991 (Amano et al., 1996) and some mass strandings (Miyazaki, 1983; Miyazaki et al., 1998).

Breeding areas and seasonal movements of this species have not been confirmed. General swim speeds for this species are not available. These animals often log at the water's surface in large schools composed of noticeable subgroups and are often found in mixed-species aggregations. No data are available on dive depths and dive times of melon-headed whales.

There is no direct measurement of hearing sensitivity for melon-headed whales (Ketten, 2000; Thewissen, 2002). Vocalizations of melon-headed whales include dominant frequencies of whistles ranging from 1 to 23.5 kHz, with both upsweeps and downsweeps in frequency modulation (Frankel and Yin, 2010). Maximum SLs are estimated at 155 dB for whistles and 165 dB re 1 µPa @ 1 m for click bursts (Watkins et al., 1997). Whistles had dominant frequencies around 8 to 12 kHz; higher-level whistles were estimated at no more than 155 dB re 1 µPa @ 1 m while clicks had dominant frequencies of 20 to 40 kHz; higher-level click bursts were judged to be about 165 dB re 1 µPa-m (Watkins et al., 1997).

4.2.14 PACIFIC WHITE-SIDED DOLPHIN (*LAGENORHYNCHUS OBLIQUIDENS*)

Pacific white-sided dolphins are not listed as threatened or endangered under the ESA nor are they categorized as depleted under the MMPA. In the North Pacific Ocean, an abundance of 931,000 to 990,000 Pacific white-sided dolphins has been estimated (Jefferson et al., 2008; Black, 2009). In Japanese waters, 30,000 to 50,000 Pacific white-sided dolphins have been estimated to occur (Nishiwaki, 1972). Pacific white-sided dolphins are mostly pelagic and have a primarily cold temperate distribution across the North Pacific; in the western North Pacific, this species occurs from Taiwan north to the Commander and Kuril Islands (Jefferson et al., 2008; Black, 2009). Pacific white-sided dolphins are distributed in continental shelf and slope waters generally within 185 km (100 nmi) of shore and often move into coastal and even inshore waters. No breeding grounds are known for this species. From studies of the ecology of their prey, Pacific white-sided dolphins are presumed to dive from 120 to 200 m (393.7 to 656 ft), with most of their foraging dives lasting a mean of 27 sec (Black, 1994). Maximum dive time for a tagged white-sided dolphin was 4 minutes, although the mean time was <1 minute (Mate et al., 1994). Captive Pacific white-sided dolphins have been recorded swimming as fast as 27.7 kph (15.0 kt) for 2 sec intervals (Fish and Hui, 1991) with a mean travel speed of 7.6 kph (Black, 1994). Pacific white-sided dolphins feed on fish and squid, although the dominant prey type varies regionally (Black, 2009).

Pacific white-sided dolphins hear in the frequency range of 2 to 125 kHz when the sounds are equal to or softer than 90 dB RL (Tremel et al., 1998). This species is not sensitive to low frequency sounds (i.e., 100 Hz to 1 kHz) (Tremel et al., 1998). Pacific white-sided dolphins produce broad-band clicks that are in the frequency range of 60 to 80 kHz and that have a SL at 180 dB re 1 µPa @ 1 m (Richardson et al., 1995). There are no available data regarding seasonal or geographical variation in the sound production of *Lagenorhynchus* dolphins.

4.2.15 PANTROPICAL SPOTTED DOLPHIN (*STENELLA ATTENUATA*)

The pantropical spotted dolphin is one of the most abundant dolphin species in the world. This species is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. In the Hawaiian EEZ, there are an estimated 10,260 pantropical spotted dolphins (Carretta et al., 2009). In the early 1990s, about 438,000 were estimated to occur in Japanese waters (Jefferson et al., 2008). Pantropical spotted dolphins occur throughout tropical and sub-tropical waters from roughly 40°N to 40°S in the Atlantic, Pacific, and Indian Oceans (Perrin, 2009). These dolphins typically are oceanic but are found close to shore in areas where deep water approaches the coast, as occurs in Taiwan, Hawaii, and the western coast of Central America (Jefferson et al., 2008). In the western Pacific, pantropical spotted dolphins are found from the northern coast of Honshū in Japan south to Australia (Miyazaki et al., 1974). Pantropical spotted dolphins have been hunted in several areas along the Pacific coast of Japan, including Taiji (Kii Peninsula), Arari (west Izu Peninsula), and Kawana and Futo (east Izu Peninsula) (Miyazaki et al., 1974). Pantropical dolphins have also been captured at Arari for public display (Nishiwaki et al., 1965). Little is known of the life history of pantropical spotted dolphins.

Pantropical spotted dolphins have been recorded swimming at speeds of 4 to 19 kph (2.2 to 10.3 kt), with bursts up to 22 kph 12 kt (Perrin, 2009a). Pantropical spotted dolphins dive to at least 170 m (557.7 ft), with most of their dives to between 50 and 100 m (164 and 328 ft) for 2 to 4 min, and most foraging occurs at night (Stewart, 2009). Pantropical spotted dolphins off Hawaii have been recorded to dive at a maximum depth of 122 m (400 ft) during the day and 213 m (700 ft) during the night (Baird et al., 2001). The average dive duration for the pantropical spotted dolphins is 1.95 min for depths as deep as 100 m (Scott et al., 1993). Dives of up to 3.4 min have been recorded (Perrin, 2009a).

There are no published hearing data for pantropical spotted dolphins (Ketten, 1998). Pantropical spotted dolphins produce whistles with a frequency range of 3.1 to 21.4 kHz (Richardson et al., 1995). They also produce click sounds that are typically bimodal in frequency with peaks at 40 to 60 kHz and 120 to 140 kHz with SLs up to 220 dB re 1 μPa (Schotten et al., 2004). There are no direct hearing measurements for the pantropical spotted dolphin.

4.2.16 PYGMY KILLER WHALE (*FERESA ATTENUATA*)

Pygmy killer whales are one of the least known cetacean species. This species is not listed as threatened or endangered under the ESA, nor is it categorized as depleted under the MMPA. The global population for this species is unknown. Estimates of 39,000 have been documented in the ETP (Jefferson et al., 2008) and 438,064 whales have been estimated in the West North Pacific stock (Miyashita, 1993). Pygmy killer whales have been recorded in oceanic tropical and subtropical waters (Caldwell and Caldwell, 1971; Donahue and Perryman, 2009). Pygmy killer whales are sighted relatively frequently in the ETP, the Hawaiian archipelago and off Japan (Leatherwood et al., 1988; Donahue and Perryman, 2009). No data are available to confirm seasonal migration patterns or on the locations of breeding and calving grounds for pygmy killer whales. General swim speeds for this species are not available, and no dive data are available.

Little information is available on the hearing sensitivity of pygmy killer whales. Recently, AEP-derived audiograms were obtained on two live-stranded pygmy killer whales during rehabilitation. The U-shaped audiograms of these pygmy killer whales showed that best hearing sensitivity occurred at 40 kHz with lowest hearing thresholds having occurred between 20 and 60 kHz (Montie et al., 2011). These stranded animals did not hear well at higher frequencies (90 and 96 dB re 1 μPa at 100 kHz) (Montie et al., 2011). Little is known of the sound production of this species. One document describes pygmy killer whales producing LF “growl” sounds (Pryor et al., 1965).

4.2.17 RISSO’S DOLPHIN (*GRAMPUS GRISEUS*)

Risso’s dolphins are not listed as threatened or endangered under the ESA nor are categorized as depleted under the MMPA. Although no global population abundance exists for the Risso’s dolphin, in the waters of the ETP, Japan, the Philippines, and off Sri Lanka abundances have been estimated at 175,000; 83,000; 950; and 5,550 to 13,000 dolphins, respectively (Jefferson et al., 2008). Risso’s dolphin inhabits deep oceanic and continental slope waters from the tropics through the temperate regions (Leatherwood et al., 1980; Jefferson et al., 1993). They occur predominantly at steep shelf-edge habitats, between 400 and 1,000 m (1,300 and 3,281 ft) deep with water temperatures commonly between 15 and 20°C and rarely below 10°C (Baird, 2009a). Seasonal migrations for Japanese populations have been apparent, although seasonal variation in their movement patterns elsewhere have not been studied (Kasuya, 1971; Mitchell 1975). Life history data for Risso’s dolphins are poorly known, largely being derived from strandings or the result of drive fisheries. No data on breeding grounds are available, but Risso’s dolphins have been known to calve year round although peak breeding times differ by habitat. Breeding peaks in Japan during summer to fall (Jefferson et al., 2008). Swim speeds from Risso’s dolphins were recorded at 2 to 12 kph (1.1 to 6.5 kt) off Santa Catalina Island (Shane, 1995). Dive times up to 30 min have been reported for this species (Jefferson et al., 2008).

Audiograms for Risso’s dolphins indicate their hearing RLs equal to or less than approximately 125 dB in frequencies ranging from 1.6 to 110 kHz (Nachtigall et al., 1995). Philips et al. (2003) reported that Risso’s dolphins are capable of hearing frequencies up to 80 kHz. Optimal underwater hearing occurs between 4 and 80 kHz, with hearing threshold levels from 63.6 to 74.3 dB RL. Other audiograms obtained on Risso’s dolphin (Au et al., 1997) confirm previous measurements and demonstrate hearing thresholds of 140 dB RL for a 1-second 75 Hz signal (Au et al., 1997; Croll et al., 1999). Au et al. (1997) estimated the effects of the ATOC source on false killer whales and on Risso’s dolphins. The ATOC source transmitted 75-Hz, 195 dB SL acoustic signal to study ocean temperatures. The hearing sensitivity was measured for Risso's dolphins and their thresholds were found to be 142.2 dB RL ± 1.7 dB for the 75 Hz pure tone signal and 140.8 dB RL ± 1.1 dB for the ATOC signal (Au et al., 1997).

Risso's dolphins produce sounds as low as 0.1 kHz and as high as 65 kHz with dominant frequencies between 2 to 5 kHz and at 65 kHz (Watkins, 1967; Au, 1993; Croll et al., 1999; Philips et al., 2003). The maximum peak-to-peak SL, with dominant frequencies at 2 to 5 kHz, is about 120 dB (Au, 1993). In one experiment conducted by Philips et al. (2003), clicks were found to have a peak frequency of 65 kHz, with 3 dB bandwidths at 72 kHz and durations ranging from 40 to 100 microsec. In a second experiment, Philips et al. (2003) recorded clicks with peak frequencies up to 50 kHz, with 3 dB bandwidth at 35 kHz with durations ranging from 35 to 75 microsec. SLs were up to 208 dB. The behavioral and acoustical results from these experiments provided evidence that Risso's dolphins use echolocation. Estimated SLs of echolocation clicks can reach up to 216 dB (Philips et al., 2003). Bark vocalizations consisted of highly variable burst pulses and have a frequency range of 2 to 20 kHz. Buzzes consisted of a short burst pulse of sound around 2 seconds in duration with a frequency range of 2.1 to 22 kHz. Low frequency, narrowband grunt vocalizations ranged between 400 and 800 Hz. Chirp vocalizations were slightly higher in frequency than the grunt vocalizations, ranging in frequency from 2 to 4 kHz. There are no available data regarding seasonal or geographical variation in the sound production of Risso's dolphin.

4.2.18 ROUGH-TOOTHED DOLPHIN (*STENO BREDANENSIS*)

The rough-toothed dolphin is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. Globally, few population estimates are available for the rough-toothed dolphin; in the West North Pacific stock, which was estimated as 45,729 animals (Ferguson and Barlow, 2001 and 2003). Occurrence data are insufficient elsewhere to estimate abundances. Rough-toothed dolphins occur in oceanic tropical and warm-temperate waters around the world and appear to be relatively abundant in certain areas; these dolphins are also found in continental shelf waters in some locations, such as Brazil (Jefferson, 2009). In the Pacific, these dolphins inhabit waters from central Japan to northern Australia and from Baja California, Mexico, south to Peru. In the eastern Pacific, they are associated with warm, tropical waters that lack major upwelling (Jefferson, 2009a). Their range includes the southern Gulf of California and the South China Sea. Rough toothed dolphins are also found in the Indian Ocean, from the southern tip of Africa to Australia (Jefferson et al., 2008). Seasonal movements and breeding areas for this species have not been confirmed.

Rough-toothed dolphins are not known to be fast swimmers. They are known to skim the surface at a moderate speed (Jefferson, 2009a). Swim speeds of this species vary from 5.6 to 16 kph (3.0 to 8.6 kt) (Watkins et al., 1987a; Ritter, 2002). Rough-toothed dolphins can dive 30 to 70 m (98 to 230 ft) with dive duration ranging from 0.5 to 3.5 min (Watkins et al., 1987a; Ritter, 2002). Dives up to 15 min have been recorded for groups of dolphins (Miyazaki and Perrin, 1994).

Very little information is available on the hearing sensitivity of rough-toothed dolphins. Cook et al. (2005) performed AEPs on five live-stranded rough-toothed dolphins and found that these dolphins could detect sounds between 5 and 80 kHz; the authors believe that rough-toothed dolphins are likely capable of detecting frequencies much higher than 80 kHz. Rough-toothed dolphins produce sounds ranging from 0.1 kHz up to 200 kHz (Popper, 1980; Miyazaki and Perrin, 1994; Richardson et al., 1995). Clicks have peak energy at 25 kHz, while whistles have a maximum energy between 2 to 14 kHz (Norris and Evans, 1967; Norris, 1969; Popper, 1980). There are no available data regarding seasonal or geographical variation in the sound production of this species.

4.2.19 SHORT-BEAKED COMMON DOLPHINS (*DELPHINUS DELPHIS*)

The differentiation of two common dolphin species, short-beaked and long-beaked common dolphins, has only occurred recently and the two species continue to be difficult to distinguish at sea. In addition, a geographic form of the long-beaked common dolphin is recognized—the Indo-Pacific common dolphin (*Delphinus capensis tropicalis*). Common dolphins are not listed as threatened or endangered under the ESA nor are categorized as depleted under the MMPA. The global population for all common dolphin species is unknown. Short-beaked common dolphins are the most abundant species at an estimate of 3,000,000 in the Eastern Tropical Pacific (ETP) (Jefferson et al., 2008). There are little data available on abundance estimates of long-beaked common dolphins. An estimated 3,286,163 common dolphins have been estimated for the Western North Pacific stock (Ferguson and Barlow, 2001 and 2003).

Short-beaked and long-beaked common dolphins are distributed worldwide in temperate, tropical, and subtropical oceans, primarily along continental shelf and steep bank regions where upwelling occurs (Jefferson et al. 2008; Perrin, 2009). They seem to be most common in the coastal waters of the Pacific Ocean, usually beyond the 200-m (656-ft) isobath (Croll et al., 1999). Long-beaked common dolphins, however, seem to prefer shallower, warmer waters that are closer to the coast (Perrin, 2009). They are often found within 180 km (97.2 nmi) of the coast (Jefferson et al., 2008). Long-beaked common dolphins occur around West Africa, from Venezuela to Argentina in the western Atlantic Ocean, from southern California to central Mexico and Peru in the eastern Pacific Ocean, around Korea, southern Japan, and Taiwan in the western Pacific, and around Madagascar and South Africa. No breeding grounds are known for common dolphins (Croll et al., 1999). Calving peaks during May and June both in the northeastern Atlantic and North Pacific. The age of sexual maturity also varies regionally from 3 to 12 years for males and 2 to 8 years for females. The maximum age reported is 30 years old (Perrin, 2009).

Swim speeds for *Delphinus* spp. have been measured at 5.8 kph (3.1 kt) with maximum speeds of 16.2 kph (8.7 kt); but in other studies, common dolphins have been recorded at swimming up to 37.1 kph (20 kt) (Hui, 1987; Croll et al., 1999). Dive depths range between 9 and 200 m (30 and 656 ft), with a majority of dives 9 to 50 m (30 to 164 ft) (Evans, 1994). The deepest dive recorded for these species was 260 m (850 ft) (Evans, 1971). The maximum dive duration has been documented at 5 min (Heyning and Perrin, 1994). The deepest foraging dive recorded was 200 m (656 ft) (Evans, 1994).

Common dolphins produce sounds as low as 0.2 kHz and as high as 150 kHz, with dominant frequencies at 0.5 to 18 kHz and 30 to 60 kHz (Caldwell and Caldwell, 1968; Popper, 1980; Au, 1993; Moore and Ridgway, 1995). Signal types consist of clicks, squeals, whistles, and creaks (Evans, 1994). Whistles of short-beaked common dolphins range between 7.4 and 13.6 kHz, while the whistles of long-beaked common dolphins ranges from 7.7 to 15.5 kHz (Oswald et al., 2003). Most of the energy of echolocation clicks is concentrated between 15 and 100 kHz (Croll et al., 1999). The maximum peak-to-peak SL of common dolphins is 180 dB. In the North Atlantic, the mean SL was approximately 143 dB with a maximum of 154 dB (Croll et al., 1999). There are no available data regarding seasonal or geographical variation in the sound production of common dolphins.

4.2.20 SHORT-FINNED PILOT WHALE (*GLOBICEPHALA MACRORHYNCHUS*)

The short-finned pilot whale is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. A global population estimate for short-finned pilot whales is unknown. Estimates of 500,000 have been documented in the ETP, 7,700 have been estimated in Philippine waters, 60,000 in Japanese waters (Jefferson et al., 2008), and as 53,608 whales in the West North Pacific stock (Miyashita, 1993). Short-finned pilot whales have a tropical and subtropical distribution (Olson, 2009). There appears to be little seasonal movement of this species. Some short-finned pilot whales stay year round near the California Channel Islands whereas others are found offshore most of the year moving inshore with the movement of squid (Croll et al., 1999). In the northern hemisphere, mating typically occurs in spring or early summer with calving occurring in the summer or fall. No breeding grounds have been confirmed.

Pilot whales generally have swim speeds ranging between 2 to 12 kph (1.1 to 6.5 kt) (Shane, 1995). Short-finned pilot whales have swim speeds ranging between 7 and 9 kph (3.8 and 4.6 kt) (Norris and Prescott, 1961). Both long- and short-finned pilot whales are considered deep divers, feeding primarily on fish and squid (Croll et al., 1999). A short-finned pilot whale was recorded as diving to 610 m (2,000 ft) (Ridgway, 1986).

No information has been available on short-finned pilot whale hearing until recently. AEPs were used to measure the hearing sensitivity of two short-finned pilot whales (Schlundt et al., 2011). This study tested hearing of one captive and one stranded short-finned pilot whale and found the region of best hearing sensitivity for the captive whale to be between 40 and 56 kHz (thresholds of 78 and 79 dB re 1 µPa, respectively) with the upper limit of functional hearing between 80 and 100 kHz (Schlundt et al., 2011). The only measurable detection threshold for the stranded pilot whale was 108 dB re 1 µPa at 10 kHz, which suggested severe hearing loss above 10 kHz (Schlundt et al., 2011). The hearing range of the captive short-finned pilot whale was similar to other odontocete species, particularly of larger toothed whales.

Pilot whales echolocate with a precision similar to bottlenose dolphins and also vocalize with other school members (Olson, 2009). Short-finned pilot whales produce sounds as low as 280 Hz and as high as 100 kHz, with dominant frequencies between 2 to 14 kHz and 30 to 60 kHz (Caldwell and Caldwell, 1969; Fish and Turl, 1976; Scheer et al., 1998). The mean frequency of calls produced by short-finned pilot whales is 7,870 Hz, much higher than the mean frequency of calls produced by long-finned pilot whales (Rendell et al., 1999). Echolocation abilities have been demonstrated during click production (Evans, 1973). SLs of clicks have been measured as high as 180 dB (Fish and Turl, 1976; Richardson et al., 1995). There are little available data regarding seasonal or geographical variation in the sound production of the short-finned pilot whale, although there is evidence of group specific call repertoires (Olson, 2009).

4.2.21 SPERM WHALE (*PHYSETER MACROCEPHALUS*)

The sperm whale is currently listed as endangered under the ESA and depleted under the MMPA. The global population of sperm whales is unknown, but is estimated to be about 360,000 (Jefferson et al., 2008). Estimates of abundance for the eastern tropical Pacific (ETP) are 4,000 whales (Jefferson et al., 2008) and 102,112 whales for the North Pacific stock (Allen and Angliss, 2010). Sperm whales are primarily found in deeper (>1000 m [3,280 ft]) ocean waters and distributed in polar, temperate, and tropical zones of the world (Reeves and Whitehead, 1997). With the largest range of all cetaceans, except killer whales (Rice, 1998) sperm whales commonly occur near the equator and in the North Pacific (Whitehead, 2009). The migration patterns of sperm whales are not well understood, as some whales show seasonal north-south migrational patterns while others show no clear seasonal migration, especially in the equatorial areas (Whitehead, 2009). Males of the eastern North Pacific stock are thought to move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands (Kasuya and Miyashita, 1988). Mark-recapture data show extensive movements throughout the North Pacific and along the U.S. west coast into the Gulf of Alaska and Bering Sea/Aleutian Islands region (Allen and Angliss, 2011). The sperm whale has a prolonged breeding season extending from late winter through early summer. In the Southern Hemisphere, the calving season is between November and March (Simmonds and Hutchinson, 1996), although specific breeding and foraging grounds are not well known for this species.

Swim speeds of sperm whales generally range from 2.6 to 4 kph (2.2 kt) (Watkins et al., 2002; Whitehead, 2009). Dive durations range between 18.2 to 65.3 min (Watkins et al., 2002). Sperm whales may be the longest and deepest diving mammals with recorded dives to 1,500 m (4,921 ft) (Davis et al, 2007), but stomach content evidence suggests that sperm whales may dive as deep as 3,200 m (10,498 ft) (Clarke, 1976). Foraging dives typically last about 30 to 40 min and descend to depths from 300 to 1,245 m (984 to 4,085 ft) (Papastavrou, 1989; Wahlberg, 2002).

Recent audiograms measured from a sperm whale calf suggest an auditory range of 2.5 to 60 kHz, with best hearing sensitivity between 5 and 20 kHz (Ridgway and Carder, 2001). Measurements of evoked response data from one stranded sperm whale have shown a lower limit of hearing near 100 Hz (Gordon et al., 1996). Sperm whales produce broadband clicks with energy from less than 100 Hz to 30 kHz (Watkins and Schevill, 1977; Goold and Jones, 1995; Weilgart and Whitehead, 1997; Thode et al., 2002). Regular click trains and creaks have been recorded from foraging sperm whales and may be produced as a function of echolocation (Whitehead and Weilgart, 1991; Jaquet et al., 2001; Madsen et al., 2002). A series of short clicks, termed "codas," have been associated with social interactions and are thought to play a role in communication (Watkins and Schevill, 1977; Weilgart and Whitehead, 1993; Pavan et al., 2000). Distinctive coda repertoires have shown evidence of geographical variation among female sperm whales (Weilgart and Whitehead, 1997; Whitehead, 2009). SELs of clicks have been measured between 202 and 236 dB (Mohl et al., 2000; Mohl et al., 2003; Madsen and Møhl, 2000; Thode et al., 2002). Mohl et al. (2000) reported results from recordings of sperm whales at high latitudes with a large-aperture array that were interpreted to show high directionality in their clicks, with maximum recorded SLs greater than 220 dB. Mohl et al. (2003) further described the directionality of the clicks and show that the source levels of clicks differ significantly with aspect angle. This is dependent on the direction that the click is projected and the point where the click is received. The maximum SL for any click in these recordings was 236 dB with other independent events ranging from 226 to 234 dB (Mohl et al., 2003).

Zimmer et al. (2005) discuss the three-dimensional beam pattern of regular sperm whale clicks. Regular clicks have several components including a narrow, high-frequency sonar beam to search for prey, a less-directional backward pulse that provides orientation cues, and a low-frequency component of low directionality that conveys sound to a large part of the surrounding water column with a potential for reception by conspecifics at large ranges. The click travel time was used to estimate the acoustic range of the whale during its dives. In this study, the SL of the high-frequency sonar beam in the click was 229 dB (peak value). The backward pulse had an SL of 200 dB (peak value). The low-frequency component immediately followed the backward pulse and had a long duration, with peak frequencies that are depth dependent to over 500 m (1640 ft). Zimmer et al. (2005) propose that the initial backward pulse is produced by the phonic lips and activates air volumes connected to the phonic lips, which generate the low-frequency component. The two dominant frequencies in the low-frequency component indicate either one resonator with aspect-dependent radiation patterns or two resonators with similar volumes at the surface but different volumes at various depths. Most of the energy of the initial backward-directed pulse reflects forward off the frontal sac into the junk and leaves the junk as a narrow, forward-directed pulse. A fraction of that energy is reflected by the frontal sac back into the spermaceti organ to generate higher-order pulses. This forward-directed pulse is well suited for echolocation.

4.2.22 SPINNER DOLPHIN (*STENELLA LONGIROSTRIS*)

The spinner dolphin is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. Spinner dolphins are one of the most abundant dolphin species in the world. In the ETP there is an estimated 1,250,000 (Jefferson et al., 2008) while in the Pacific there are an estimated 2,805 spinner dolphins in the Hawaiian stock (Carretta et al., 2009), and 1,015,059 dolphins in the North Pacific stock (Ferguson and Barlow, 2001 and 2003). Spinner dolphins are pantropical, occurring in tropical and most subtropical oceanic waters from about 40°S to 40°N, except in the Mediterranean Sea (Jefferson et al. 2008). Spinner dolphins are found in coastal regions of Hawaii, the eastern Pacific, Indian Ocean, and off Southeast Asia, usually resting in the shallow waters of bays of oceanic islands and atolls. The dwarf species occurs only in the shallow waters of Southeast Asia and northern Australia is found in shallower waters in the Gulf of Thailand, Timor Sea, and Arafura Sea (Jefferson et al., 2008; Perrin, 2009b). Breeding is seasonal and the timing varies between populations.

Hawaiian spinner dolphins have swim speeds ranging from 2.6 to 6 kph (1.4 to 3.2 kt) (Norris et al., 1994). Based on where their prey is located in the water column, spinner dolphins likely dive as deep as 600 m (1,969 ft) (Perrin, 2009b). Dive durations are unknown for this species. Spinner dolphins are known for their aerial behavior, spinning up to seven times during one aerial leap from the water, reaching heights of 3 m (9 ft) above the water surface with an airborne time of 1.25 sec (Fish et al., 2006).

There are no current hearing data on spinner dolphins. The amount and variety of signal types generally increases with increasing social activity, particularly in Hawaiian spinner dolphins (Frankel, 2009). Spinner dolphins produce burst pulse calls, echolocation clicks, whistles, and screams (Norris et al., 1994; Bazua-Duran and Au, 2002). The results of a study on spotted and spinner dolphins conducted by Lammers et al. (2003) revealed that the whistles and burst pulses of the two species span a broader frequency range than is traditionally reported for delphinids. The fundamental frequency contours of whistles occur in the human hearing range, but the harmonics typically reach 50 kHz and beyond. Additionally, the burst pulse signals are predominantly ultrasonic, often with little or no energy below 20 kHz (Lammers et al., 2003).

4.2.23 STEJNEGER'S BEAKED WHALE (*MESOPLODON STEJNEGERI*)

Stejneger's beaked whales are not listed as threatened or endangered under the ESA nor are categorized as depleted under the MMPA. No abundance estimates of the global or regional populations are available, but occurrence records suggest that this beaked whale may not be rare in the Sea of Japan or the northernmost region of the North Pacific Ocean (Jefferson et al., 2008). Stejneger's beaked whales are endemic to cold-temperate and sub-polar waters of the North Pacific Ocean, principally in the northernmost regions of the North Pacific from the Bering Sea and off Russia to California and the Sea of Japan (MacLeod et al., 2006). No information is available on swim speeds, dive depths, hearing, or vocalizations in the Stejneger's beaked whale.

4.2.24 STRIPED DOLPHIN (*STENELLA COERULEOALBA*)

Striped dolphins are not listed as threatened or endangered under the ESA nor are categorized as depleted under the MMPA. Striped dolphins are known to be the most abundant species in the Mediterranean Sea, with an estimated 225,000 individuals (Jefferson et al., 2008; Archer, 2009). In the ETP, there is an estimated 1 million striped dolphins (Jefferson et al., 2008) and in the West North Pacific stock, there are 570,038 dolphins estimated (Miyashita, 1993). Striped dolphins are common in tropical and warm-temperate waters in the Atlantic, Pacific, and Indian Oceans. In the North Pacific Ocean, the northern limits are the Sea of Japan and Hokkaido in the west and Washington State in the east (Reeves et al., 2002). Striped dolphins are found outside the continental shelf, over the continental shelf, and are associated with convergence zones and waters. Off the coast of Japan, striped dolphins congregate at the periphery of the Kuroshio Current where warm water meets up with cold water (Miyazaki et al., 1974). In Japan, two calving peaks have been noted for the striped dolphin, one in summer, and another in winter (Perrin et al., 1994).

Average swim speeds of 11 kph (5.9 kt) were measured from striped dolphins in the Mediterranean (Archer and Perrin, 1999). Based on stomach contents, it is predicted that striped dolphins may be diving down 200 to 700 m (656 to 2,297 ft) to feed (Archer, 2009). Dive times are unknown for this species.

The behavioral audiogram developed by Kastelein et al. (2003) shows hearing capabilities from 0.5 to 160 kHz. The best underwater hearing of the species appears to be at from 29 to 123 kHz (Kastelein et al., 2003). Striped dolphins produce whistle vocalizations ranging from 6 to >24 kHz with peak frequencies ranging from 8 to 12.5 kHz (Thomson and Richardson, 1995).

4.3 PINNIPEDS POTENTIALLY OCCURRING IN THE WESTERN NORTH PACIFIC PROVINCES DURING SPRING OR SUMMER

4.3.1 HAWAIIAN MONK SEAL (*MONACHUS SCHAUINSLANDI*)

Hawaiian monk seals are listed as endangered under the ESA and depleted under the MMPA (Table 1). Critical habitat for the Hawaiian monk seal has been established from the shore to 37 m (121 ft) of water depth in 10 areas of the Northwest Hawaiian Islands (NWHI) (NOAA, 1988). In 2011, revisions to the Hawaiian monk seal's critical habitat were proposed. The proposed critical habitat would extend the current critical habitat boundaries in the NWHI, including Sand and Midway Islands, from the 37-m to 500-m (121 to 1,640 ft) isobath and would include six new areas in the Main Hawaiian Islands from 5-m (16-ft) on land to the 500-m (1,640-ft) seaward isobath (NOAA, 2011a). The best available population estimate for this species is 1,161 individuals (Carretta et al., 2010).

Hawaiian monk seals range throughout the Hawaiian Archipelago and Johnson, Midway, and Kure Atolls (westernmost of the Northwest Hawaiian Islands) (NOAA, 2011a). Hawaiian monk seals at Kure Atoll have been observed foraging at Hancock Banks, located 300 km (162 nmi) northwest of Kure Atoll. Reeves et al. (1999) and Eldredge (1991; 2003) have noted occurrence records for seals (unidentified species) in the Marshall and Gilbert Islands. Long distance movements (up to 400 km [216 nmi]) of the Hawaiian monk seal have been documented, but most seals show high site fidelity to their natal island (Abernathy, 1999; Gilmartin and Forcada, 2009). However, it seems unlikely that many seals would travel a distance near that recorded as a maximum distance (300 to 400 km [162 to 216 nmi]). Since the early 1990s, a small but increasing population of monk seals and an increasing number of annual births has been documented in the Main Hawaiian Islands (NOAA, 2011a). Monk seals spend a greater proportion of their time at sea, in water depths ranging from 1 to 300 m (3 to 984 ft) in shelf, slope, and bank habitats but come ashore (haul out) on a variety of substrates, including sandy beaches, rocky shores, rock ledges, and emergent reefs. Pupping only occurs on sandy beaches adjacent to protected waters.

No swim speed data are available. This species commonly dive to depths of less than 100 m (328 ft) but have been recorded diving down to depths of 300 to 500 m (984 to 1,640 ft) (Parrish et al., 2002). The Hawaiian monk seal can also dive for up to 20 min and perhaps longer (Parrish et al., 2002). Routine dives range from 3 to 6 min in principally shallow water depths from 10 to 40 m (33 to 131 ft) (Stewart, 2009).

Only one audiogram has been recorded for the Hawaiian monk seal, which indicated relatively poor hearing sensitivity, a narrow range of best hearing sensitivity (12 to 28 kHz), and a relatively low upper frequency limit (Thomas et al., 1990; Kastak and Schusterman, 1999). Above 30 kHz, high-frequency hearing sensitivity dropped markedly (Thomas et al., 1990). However, the audiogram was obtained from a single, untrained seal whose hearing curve suggested that its responses may have been affected by disease or age (Reeves et al., 2001). No underwater sound production has been reported for this species. Recorded in-air vocalizations of Hawaiian monk seals consist of a variety of sounds, including a liquid bubble sound (100 to 400 Hz), a guttural expiration (about 800 Hz) produced during short-distance agonistic encounters, a roar (<800 Hz) for long-distance threats, a belch-cough made by males when patrolling (<1 kHz), and sneeze/snorts/coughs of variable frequencies that are <4 kHz (Miller and Job, 1992).

5 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

<u>REQUIREMENT 5</u>*: *Type of incidental take authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury, and/or death) and the method of incidental taking.

ONR requests an IHA pursuant to MMPA Section 101(a)(5)(D) for the potential incidental taking of marine mammals by Level B harassment (behavioral effects) during its planned ONR ATE in international waters of one of nine provinces in the western North Pacific Ocean in spring or summer of 2013. The operations outlined in Chapter 1 have the potential for incidental harassment of marine mammals. Underwater signals (addressed herein) will be generated by no more than four acoustic sources, with no concurrent transmissions by the ONR ATE sources. Takes by MMPA Level B incidental harassment will potentially occur when a marine mammal, or mammals, near one of the sources are exposed to the sounds generated by the proposed sources. The potential for effects will depend on the species of marine mammal, the behavior of the animal(s) at the time of reception of the stimulus, and the RL of the sound (see Chapters 6 and 7). Behavioral reactions are possible by marine mammal(s) that may be in proximity of one of the sources during their sound transmissions. Analysis results of potential for harm to marine mammals support a conclusion that MMPA Level A harassment of marine mammals (see Chapters 6 and 7) is not reasonably foreseeable in any of the nine provinces in which the ONR ATE may be conducted. Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

6 INCIDENTAL TAKES

***REQUIREMENT 6*: Age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in paragraph (a)(5) of this section, and the number of times such takings by each type of taking are likely to occur.**

The estimated numbers of marine mammals that could potentially be affected by the proposed activity in the international waters of one of the nine provinces of the western North Pacific during spring or summer of 2013 are presented.

6.1 POTENTIAL EFFECTS OF THE ONR ATE ACOUSTIC SOURCES

To estimate the potential risk of physical auditory or behavioral effects due to the transmissions from the no more than four acoustic sources deployed in one of the nine provinces of the western North Pacific Ocean during the ONR ATE, underwater acoustical modeling and associated analyses were undertaken. Historically, acoustic exposure thresholds for marine mammal behavior have been just that, fixed thresholds or step functions. While heuristically convenient, step functions do not accurately represent most animal behavior. Accurately representing animal behavior was one of the driving factors in the creation of the behavior risk function (BRF) (also known as risk continuum function) (Figure 2), where the probability of significant behavioral response is considered a function of received sound pressure level (SPL). While behavioral response is almost certainly determined by more factors than exposure level, it is also likely that in the limited situation of exposure to acoustic energy when all other contextual factors are known and held constant, received sound level can be used as a proxy for behavioral response.

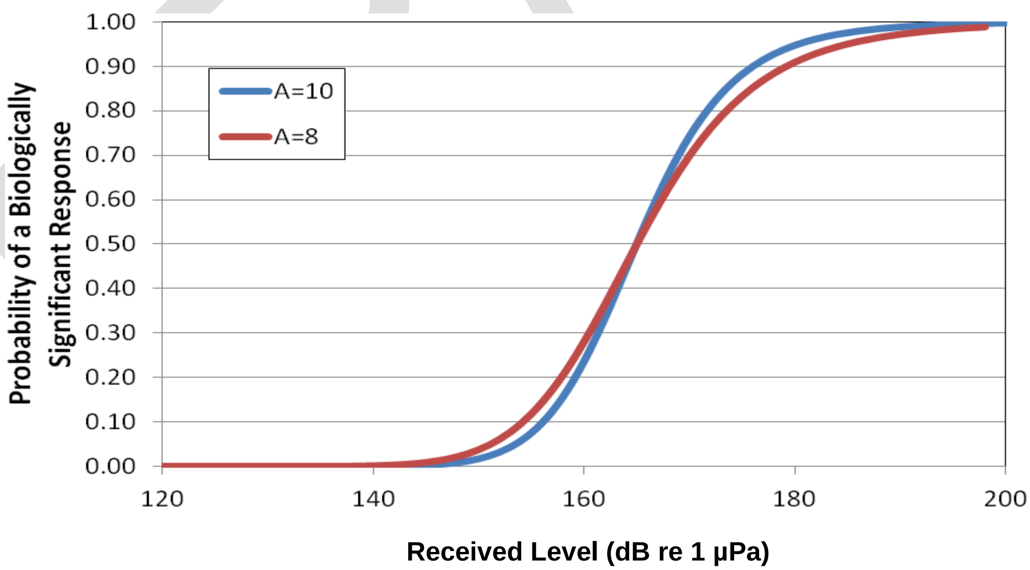

Figure 2. Behavioral response functions for mysticetes (red) and odontocetes and pinnipeds (blue).

To estimate the acoustic exposure a marine mammal is likely to receive while the active sources employed in ONR ATE during spring or summer are transmitting, the movement of potentially occurring marine mammals and the acoustic field to which they may be exposed were modeled. The sound fields around the active sources were estimated based on the details of the active source transmissions and the BELLHOP underwater acoustic propagation model. These data were convolved with simulated marine mammals ("animats") in the Acoustic Integration Model© (AIM). Marine mammal species potentially occurring in the nine provinces of the western North Pacific Ocean (Table 3) in which ONR ATE may be conducted were assigned diving and movement behaviors, including dive depth, surfacing time, dive duration, swimming speed, and heading change. Once the animals' behavior was defined, animats were created and randomly distributed over the simulation area determined for each active source. AIM was used to simulate the acoustic exposure for marine mammal species over the proposed transmissions of each of the active acoustic sources.

To estimate the risk of MMPA Level B incidental harassment, which includes behavior and temporary threshold shift (TTS)[4] effects, potentially resulting from exposure to the active acoustic sources employed in ONR ATE, both the maximum received level (RL) and the cumulative energy level (sound exposure level [SEL]) for each animat from each source were determined. The maximum RL for each animat was input into the risk continuum function to estimate Level B harassment. Note that there are two BRFs, one for mysticetes (baleen whales; red in Figure 2), and one for odontocetes and pinnipeds (toothed whales and seals; blue in Figure 2).

To determine the potential for temporary threshold shift (TTS) (part of MMPA Level B harassment) and permanent threshold shift (PTS) (MMPA Level A harassment) in the marine mammal species potentially occurring in the nine western North Pacific provinces, the modeled SEL values were compared to the appropriate SEL threshold (Table 13). Since TTS is recoverable and is considered to result from the temporary, non-injurious fatigue of hearing-related tissues, it represents the upper bound of the potential for MMPA Level B effects. PTS, however, is non-recoverable and, by definition, results from the irreversible impacts on auditory sensory cells, supporting tissues, or neural structures within the auditory system. PTS is thus considered within the potential for MMPA Level A effects.

Table 13. Acoustic criteria and thresholds used for predicting physiological effects on marine mammals from exposure to active acoustic sources in ONR ATE.

MARINE MAMMAL SPECIES	PHYSIOLOGICAL EFFECTS	
	ONSET TTS (MMPA LEVEL B)	ONSET PTS (MMPA LEVEL A)
All Cetaceans	195 dB re 1 µPa^2-sec	215 dB re 1 µPa^2-sec
Pinnipeds—Hawaiian monk seal	204 dB re 1 µPa^2-sec	224 dB re 1 µPa^2-sec

4 Temporary threshold shift or TTS is a temporary loss of hearing caused by exposure to high sound levels; high sound levels cause the threshold at which an animal hears sound to shift upwards, resulting in decreased hearing sensitivity.

In determining the potential effects to the marine mammal species possibly occurring in the nine provinces during spring or summer in which ONR ATE may occur, the following assumptions were made regarding modeling of the underwater acoustic sources:

- Each of the ONR ATE sources was modeled individually and its potential effects computed independent of other experiment activities;
- Acoustic propagation model BELLHOP was used to model the acoustic environment,
- Spring and summer sound velocity profiles (SVPs) from GDEM 2.5 database, the U.S. Navy standard database for SVPs, were used;
- Bathymetry was derived from the ETOPO2 database;
- A surface wind speed of 7.7 m/sec (15 kt) was used in the Bechmann-Spezzichino model to estimate surface loss;
- Seafloor properties, including bottom loss, were derived from the U.S. Navy standard CBLUG and MGS databases;
- Animal movement parameters for the species occurring in the proposed test area were extracted from the database created by Marine Acoustics, Inc.;
- Densities for marine mammals in the nine provinces of the western North Pacific Ocean were derived using the best available data (see Tables 4 through 12);
- Animats that encountered the geographic boundaries of the model area “reflected” back into the model area, maintaining a constant overall animat model density;
- No mitigation was applied to the analysis results.

The precision with which environmental effects can be calculated is largely determined by the accuracy with which the marine mammal densities are estimated for the selected geographic area and season**.** While the marine mammal densities used in this analysis (Tables 4 through 12) represent the best available data in spring and summer for the waters of the nine provinces in which the ONR ATE may be conducted, few dedicated marine mammal surveys for the purpose of deriving densities have been undertaken in these waters and only rarely are data available for estimating seasonal populations. The derivation process by which the marine mammal densities were estimated for the nine western North Pacific provinces has been accepted by NMFS in previous Navy environmental planning documents and utilized for regulatory decisions related to impacts on protected and ESA-listed species.

The analysis conducted on the ONR ATE activities to assess the potential for effects on marine mammals has shown that the possibility of marine mammals being exposed to MMPA Level A harassment is not reasonably foreseeable. Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

There is a possibility that MMPA Level B (behavioral reaction and TTS) incidental harassment may occur (Tables 14 to 22). For all ESA-listed species, the probability of MMPA Level B effects occurring is low, with the highest potential for fin whales; with an estimated 1.7096 fin whales potentially experiencing behavioral reactions or TTS from exposure from up to four acoustic sources during ONR ATE (see Table 23, which provides the maximum MMPA Level A and B harassment estimates across all nine provinces). For marine mammal species protected under the MMPA, the maximum estimated MMPA Level B incidental harassment for any of the nine provinces of the western North Pacific is estimated at 86.3962 for the short-beaked common dolphin, with the estimates of potential impacts to all other MMPA-protected species being lower.

Table 14. Total MMPA Level A and Level B incidental harassment associated with experiment activities for the marine mammals occurring in possible ONR ATE province, Sea of Japan, during spring and/or summer.

SEA OF JAPAN				
SPECIES	SPRING TOTAL MMPA LEVEL A HARASSMENT	SPRING TOTAL MMPA LEVEL B HARASSMENT	SUMMER TOTAL MMPA LEVEL A HARASSMENT	SUMMER TOTAL MMPA LEVEL B HARASSMENT
Mysticetes				
Bryde's Whale	0.0000	0.0796	0.0000	0.0826
Common Minke Whale	0.0000	0.4296	0.0000	0.4137
Common Minke Whale—J Stock	0.0000	0.1718	0.0000	0.1655
Fin Whale	0.0000	1.7096	0.0000	1.7219
Gray Whale	0.0000	0.0036	0.0000	0.0038
North Pacific Right Whale	0.0000	0.0033		
Odontocetes				
Baird's Beaked Whale	0.0000	0.1818	0.0000	0.1875
Common Bottlenose Dolphin	0.0000	0.4243	0.0000	0.5489
Cuvier's Beaked Whale	0.0000	1.7704	0.0000	1.9994
Dall's Porpoise	0.0000	37.5293	0.0000	53.0706
False Killer Whale	0.0000	1.4767	0.0000	2.2959
Killer Whale	0.0000	0.0823	0.0000	0.0894
Kogia spp.	0.0000	0.9661	0.0000	1.1090
Pacific White-sided Dolphin	0.0000	0.9550		
Risso's Dolphin	0.0000	4.1472	0.0000	4.3269
Rough-toothed Dolphin	0.0000	2.6233	0.0000	2.6392
Short-beaked Common Dolphin	0.0000	1.2034	0.0000	1.5843
Short-finned Pilot Whale	0.0000	1.2034	0.0000	1.5843
Sperm Whale	0.0000	0.8967	0.0000	0.9548
Spinner Dolphin			0.0000	0.5189
Stejneger's Beaked Whale	0.0000	0.2855	0.0000	0.9030
Striped Dolphin	0.0000	2.7058	0.0000	3.6508

Table 15. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, East China Sea, during spring and/or summer.

East China Sea				
Species	**Spring Total MMPA Level A Harassment**	**Spring Total MMPA Level B Harassment**	**Summer Total MMPA Level A Harassment**	**Summer Total MMPA Level B Harassment**
Mysticetes				
Bryde's Whale	0.0000	1.9562	0.0000	1.9562
Common Minke Whale	0.0000	7.7064	0.0000	7.7064
Common Minke Whale-J Stock	0.0000	3.1526	0.0000	3.1526
Fin Whale	0.0000	0.4425	0.0000	0.4425
Gray Whale	0.0000	0.0361		
North Pacific Right Whale	0.0000	0.0214		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.5985	0.0000	0.5985
Common Bottlenose Dolphin	0.0000	2.0106	0.0000	2.0106
Cuvier's Beaked Whale	0.0000	0.3591	0.0000	0.3591
False Killer Whale	0.0000	4.0170	0.0000	4.0170
Fraser's Dolphin	0.0000	5.7854	0.0000	5.7854
Ginkgo-toothed Beaked Whale	0.0000	0.5985	0.0000	0.5985
Killer Whale	0.0000	0.1600	0.0000	0.1600
Kogia spp.	0.0000	1.9871		1.9871
Longman's Beaked Whale	0.0000	0.2993	0.0000	0.2993
Melon-headed Whale	0.0000	15.489	0.0000	15.489
Pacific White-sided Dolphin	0.0000	7.5305		
Pantropical Spotted Dolphin	0.0000	35.8584	0.0000	35.8584
Pygmy Killer Whale	0.0000	0.5067	0.0000	0.5067
Risso's Dolphin	0.0000	11.3736	0.0000	11.3736
Rough-toothed Dolphin	0.0000	3.1752	0.0000	3.1752
Short-beaked Common Dolphin	0.0000	56.1128	0.0000	56.1128
Short-finned Pilot Whale	0.0000	3.4242	0.0000	3.4242
Sperm Whale	0.0000	1.6701	0.0000	1.6701
Spinner Dolphin	0.0000	2.1661	0.0000	2.1661
Striped Dolphin	0.0000	15.2411	0.0000	15.2411

Table 16. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, South China Sea, during spring and/or summer.

SOUTH CHINA SEA				
SPECIES	SPRING TOTAL MMPA LEVEL A HARASSMENT	SPRING TOTAL MMPA LEVEL B HARASSMENT	SUMMER TOTAL MMPA LEVEL A HARASSMENT	SUMMER TOTAL MMPA LEVEL B HARASSMENT
Mysticetes				
Bryde's Whale	0.0000	1.9562	0.0000	1.9562
Common Minke Whale	0.0000	5.7798	0.0000	5.7798
Fin Whale	0.0000	0.4425	0.0000	0.4425
Gray Whale	0.0000	0.0361		
North Pacific Right Whale	0.0000	0.0214		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.5985	0.0000	0.5985
Common Bottlenose Dolphin	0.0000	2.0106	0.0000	2.0106
Cuvier's Beaked Whale	0.0000	0.3591	0.0000	0.3591
False Killer Whale	0.0000	4.0170	0.0000	4.0170
Fraser's Dolphin	0.0000	5.7854	0.0000	5.7854
Ginkgo-toothed Beaked Whale	0.0000	0.5985	0.0000	0.5985
Killer Whale	0.0000	0.1600	0.0000	0.1600
Kogia spp.	0.0000	1.9871	0.0000	1.9871
Longman's Beaked Whale	0.0000	0.2993	0.0000	0.2993
Melon-headed Whale	0.0000	15.4891	0.0000	15.4891
Pantropical Spotted Dolphin	0.0000	35.8584	0.0000	35.8584
Pygmy Killer Whale	0.0000	0.5067	0.0000	0.5067
Risso's Dolphin	0.0000	11.3736		11.3736
Rough-toothed Dolphin	0.0000	3.1752	0.0000	3.1752
Short-finned Pilot Whale	0.0000	3.4242	0.0000	3.4242
Sperm Whale	0.0000	1.6293	0.0000	1.6293
Spinner Dolphin	0.0000	2.1661	0.0000	2.1661
Striped Dolphin	0.0000	15.2411	0.0000	15.2411

Table 17. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, North Philippine Sea, during spring and/or summer.

NORTH PHILIPPINE SEA				
SPECIES	SPRING TOTAL MMPA LEVEL A HARASSMENT	SPRING TOTAL MMPA LEVEL B HARASSMENT	SUMMER TOTAL MMPA LEVEL A HARASSMENT	SUMMER TOTAL MMPA LEVEL B HARASSMENT
Mysticetes				
Blue Whale	0.0000	0.0156		
Bryde's Whale	0.0000	0.6565	0.0000	0.6565
Common Minke Whale	0.0000	6.2459	0.0000	6.2459
Fin Whale	0.0000	0.3633		
Humpback Whale	0.0000	0.9372		
North Pacific Right Whale	0.0000	0.0051		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.1928	0.0000	0.1928
Common Bottlenose Dolphin	0.0000	13.6247	0.0000	13.6247
Cuvier's Beaked Whale	0.0000	2.0825	0.0000	2.0825
False Killer Whale	0.0000	2.8630	0.0000	2.8630
Fraser's Dolphin	0.0000	3.0425	0.0000	3.0425
Ginkgo-toothed Beaked Whale	0.0000	0.1928	0.0000	0.1928
Killer Whale	0.0000	0.0927	0.0000	0.0927
Kogia spp.	0.0000	2.2840	0.0000	2.2840
Longman's Beaked Whale	0.0000	0.0964	0.0000	0.0964
Melon-headed Whale	0.0000	4.2254	0.0000	4.2254
Pacific White-sided Dolphin	0.0000	7.2591		
Pantropical Spotted Dolphin	0.0000	9.95404	0.0000	9.9540
Pygmy Killer Whale	0.0000	2.0732	0.0000	2.0732
Risso's Dolphin	0.0000	7.8023	0.0000	7.8023
Rough-toothed Dolphin	0.0000	5.8877	0.0000	5.8877
Short-beaked Common Dolphin	0.0000	56.2627	0.0000	56.2627
Short-finned Pilot Whale	0.0000	17.0362	0.0000	17.0362
Sperm Whale	0.0000	0.4171	0.0000	0.4171
Spinner Dolphin	0.0000	0.6031	0.0000	0.6031
Striped Dolphin	0.0000	23.9042	0.0000	23.9042

Table 18. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, West Philippine Sea, during spring and/or summer.

WEST PHILIPPINE SEA				
SPECIES	SPRING TOTAL MMPA LEVEL A HARASSMENT	SPRING TOTAL MMPA LEVEL B HARASSMENT	SUMMER TOTAL MMPA LEVEL A HARASSMENT	SUMMER TOTAL MMPA LEVEL B HARASSMENT
Mysticetes				
Blue Whale	0.0000	0.0132		
Bryde's Whale	0.0000	0.7033	0.0000	0.7033
Common Minke Whale	0.0000	2.6284	0.0000	2.6284
Fin Whale	0.0000	0.2265		
Humpback Whale	0.0000	1.3049		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.1938	0.0000	0.1938
Common Bottlenose Dolphin	0.0000	13.2224	0.0000	13.2224
Cuvier's Beaked Whale	0.0000	0.1163	0.0000	0.1163
False Killer Whale	0.0000	3.5349	0.0000	3.5349
Fraser's Dolphin	0.0000	2.2116	0.0000	2.2116
Ginkgo-toothed Beaked Whale	0.0000	0.1938	0.0000	0.1938
Killer Whale	0.0000	0.075	0.0000	0.0750
Kogia spp.	0.0000	0.8050	0.0000	0.8050
Longman's Beaked Whale	0.0000	0.0969	0.0000	0.0969
Melon-headed Whale	0.0000	5.2171	0.0000	5.2171
Pantropical Spotted Dolphin	0.0000	12.1187	0.0000	12.1187
Pygmy Killer Whale	0.0000	2.5598	0.0000	2.5598
Risso's Dolphin	0.0000	4.7850	0.0000	4.7850
Rough-toothed Dolphin	0.0000	3.3914	0.0000	3.3914
Short-finned Pilot Whale	0.0000	7.6145	0.0000	7.6145
Sperm Whale	0.0000	0.4874	0.0000	0.4874
Spinner Dolphin	0.0000	0.7342	0.0000	0.7342
Striped Dolphin	0.0000	14.5071	0.0000	14.5071

Table 19. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, East of Japan, during spring and/or summer.

EAST OF JAPAN				
SPECIES	**SPRING TOTAL MMPA LEVEL A HARASSMENT**	**SPRING TOTAL MMPA LEVEL B HARASSMENT**	**SUMMER TOTAL MMPA LEVEL A HARASSMENT**	**SUMMER TOTAL MMPA LEVEL B HARASSMENT**
Mysticetes				
Bryde's Whale	0.0000	1.0446	0.0000	1.0446
Common Minke Whale	0.0000	2.5020	0.0000	2.5020
Fin Whale			0.0000	0.3041
North Pacific Right Whale	0.0000	0.0137		
Sei Whale	0.0000	1.0446	0.0000	1.0446
Odontocetes				
Baird's Beaked Whale	0.0000	0.6882	0.0000	0.6882
Common Bottlenose Dolphin	0.0000	23.7805	0.0000	23.7805
Cuvier's Beaked Whale	0.0000	0.8637	0.0000	0.8637
False Killer Whale	0.0000	7.3891	0.0000	7.3891
Ginkgo-toothed Beaked Whale	0.0000	0.1393	0.0000	0.1393
Hubbs' Beaked Whale	0.0000	0.1393	0.0000	0.1393
Killer Whale	0.0000	0.0922	0.0000	0.0922
Kogia spp.	0.0000	2.0898	0.062	2.0898
Pacific White-sided Dolphin	0.0000	6.7547	0.0000	6.7547
Pantropical Spotted Dolphin			0.0000	28.6528
Pygmy Killer Whale	0.0000	4.3103	0.0000	4.3103
Risso's Dolphin	0.0000	4.4968	0.0000	4.4968
Rough-toothed Dolphin	0.0000	2.9292	0.0000	2.9292
Short-beaked Common Dolphin	0.0000	58.4208	0.0000	58.4208
Short-finned Pilot Whale	0.0000	18.7461	0.0000	18.7461
Sperm Whale	0.0000	0.3836	0.0000	0.3836
Spinner Dolphin			0.0000	0.9182
Striped Dolphin	0.0000	12.2798	0.0000	12.2798

Table 20. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, Offshore Guam, during spring and/or summer.

Offshore Guam				
Species	**Spring Total MMPA Level A Harassment**	**Spring Total MMPA Level B Harassment**	**Summer Total MMPA Level A Harassment**	**Summer Total MMPA Level B Harassment**
Mysticetes				
Blue Whale	0.0000	0.0126		
Bryde's Whale	0.0000	0.3713	0.0000	0.3713
Common Minke Whale	0.0000	0.1865		
Fin Whale	0.0000	0.0116		
Humpback Whale	0.0000	1.6395		
Sei Whale	0.0000	0.2626		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.4305	0.0000	0.4305
Common Bottlenose Dolphin	0.0000	1.6848	0.0000	1.6848
Cuvier's Beaked Whale	0.0000	2.2811	0.0000	2.2811
Dwarf Sperm Whale	0.0000	4.2209	0.0000	4.2209
False Killer Whale	0.0000	1.6277	0.0000	1.6277
Fraser's Dolphin	0.0000	2.8413	0.0000	2.8413
Ginkgo-toothed Beaked Whale	0.0000	0.3422	0.0000	0.3422
Killer Whale	0.0000	0.1344	0.0000	0.1344
Longman's Beaked Whale	0.0000	0.1509	0.0000	0.1509
Melon-headed Whale	0.0000	6.2763	0.0000	6.2763
Pantropical Spotted Dolphin	0.0000	24.7255	0.0000	24.7255
Pygmy Killer Whale	0.0000	0.2053	0.0000	0.2053
Pygmy Sperm Whale	0.0000	1.7203	0.0000	1.7203
Risso's Dolphin	0.0000	0.5393	0.0000	0.5393
Rough-toothed Dolphin	0.0000	1.1334	0.0000	1.1334
Short-finned Pilot Whale	0.0000	3.8255	0.0000	3.8255
Sperm Whale	0.0000	0.4918	0.0000	0.4918
Spinner Dolphin	0.0000	0.9081	0.0000	0.9081
Striped Dolphin	0.0000	6.7393	0.0000	6.7393

Table 21. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, Northwest Pacific Ocean—25° to 40°N, during spring and/or summer.

NORTHWEST PACIFIC OCEAN—25 TO 40°N				
SPECIES	SPRING TOTAL MMPA LEVEL A HARASSMENT	SPRING TOTAL MMPA LEVEL B HARASSMENT	SUMMER TOTAL MMPA LEVEL A HARASSMENT	SUMMER TOTAL MMPA LEVEL B HARASSMENT
Mysticetes				
Bryde's Whale	0.0000	0.3247	0.0000	0.3247
Common Minke Whale	0.0000	0.3258	0.0000	0.3258
Fin Whale			0.0000	0.1816
Sei Whale	0.0000	0.2297	0.0000	0.2297
Odontocetes				
Baird's Beaked Whale	0.0000	0.0321	0.0000	0.0321
Blainville's Beaked Whale	0.0000	0.2700	0.0000	0.2700
Common Bottlenose Dolphin	0.0000	0.7186	0.0000	0.7186
Cuvier's Beaked Whale	0.0000	1.4424	0.0000	1.4424
Dwarf Sperm Whale	0.0000	3.1681	0.0000	3.1681
False Killer Whale	0.0000	3.5541	0.0000	3.5541
Hubbs' Beaked Whale	0.0000	0.1928	0.0000	0.1928
Killer Whale	0.0000	0.0927	0.0000	0.0927
Longman's Beaked Whale	0.0000	0.0964	0.0000	0.0964
Melon-headed Whale	0.0000	2.6360	0.0000	2.6360
Mesoplodon spp.	0.0000	0.1928	0.0000	0.1928
Pacific White-sided Dolphin	0.0000	1.8655	0.0000	1.8655
Pantropical Spotted Dolphin	0.0000	8.2248	0.0000	8.2248
Pygmy Killer Whale	0.0000	0.0592	0.0000	0.0592
Pygmy Sperm Whale	0.0000	1.2967	0.0000	1.2967
Risso's Dolphin	0.0000	0.338	0.0000	0.338
Rough-toothed Dolphin	0.0000	1.3790	0.0000	1.3790
Short-beaked Common Dolphin	0.0000	86.3962	0.0000	86.3962
Short-finned Pilot Whale	0.0000	2.3494	0.0000	2.3494
Sperm Whale	0.0000	0.7528	0.0000	0.7528
Spinner Dolphin	0.0000	1.3587	0.0000	1.3587
Striped Dolphin	0.0000	4.2432	0.0000	4.2432
Pinnipeds				
Hawaiian Monk Seal	0.0000	0.0067	0.0000	0.0067

Table 22. Total MMPA Level A and Level B incidental harassment associated with all acoustic source transmissions for the marine mammals occurring in possible ONR ATE province, Northwest Pacific Ocean—10° to 25°N, during spring and/or summer.

Northwest Pacific Ocean—10 to 25°N				
Species	Spring Total MMPA Level A Harassment	Spring Total MMPA Level B Harassment	Summer Total MMPA Level A Harassment	Summer Total MMPA Level B Harassment
Mysticetes				
Blue Whale	0.0000	0.0126		
Bryde's Whale	0.0000	0.2716	0.0000	0.2716
Fin Whale	0.0000	0.0116		
Sei Whale	0.0000	0.1177		
Odontocetes				
Blainville's Beaked Whale	0.0000	0.2575	0.0000	0.2575
Common Bottlenose Dolphin	0.0000	0.9903	0.0000	0.9903
Cuvier's Beaked Whale	0.0000	1.3760	0.0000	1.3760
Dwarf Sperm Whale	0.0000	2.5420	0.0000	2.5420
False Killer Whale	0.0000	0.8359	0.0000	0.8359
Fraser's Dolphin	0.0000	1.7103	0.0000	1.7103
Killer Whale	0.0000	0.0864	0.0000	0.0864
Longman's Beaked Whale	0.0000	0.0920	0.0000	0.0920
Melon-headed Whale	0.0000	3.9154	0.0000	3.9154
Pantropical Spotted Dolphin	0.0000	12.3846	0.0000	12.3846
Pygmy Killer Whale	0.0000	0.0880	0.0000	0.0880
Pygmy Sperm Whale	0.0000	1.0404	0.0000	1.0404
Risso's Dolphin	0.0000	0.2557	0.0000	0.2557
Rough-toothed Dolphin	0.0000	0.6259	0.0000	0.6259
Short-finned Pilot Whale	0.0000	2.2298	0.0000	2.2298
Sperm Whale	0.0000	0.8876	0.0000	0.8876
Spinner Dolphin	0.0000	2.0459	0.0000	2.0459
Striped Dolphin	0.0000	6.3892	0.0000	6.3892

Table 23. Maximum MMPA Level A and Level B incidental harassment estimated from exposure to acoustic sources employed during ONR ATE by marine mammal species potentially occurring in the nine provinces of the western North Pacific Ocean during spring and summer.

MARINE MAMMAL SPECIES	MAXIMUM MMPA LEVEL A HARASSMENT	MAXIMUM MMPA LEVEL B HARASSMENT
Mysticetes		
Blue Whale	0.0000	0.0156
Bryde's Whale	0.0000	1.9562
Common Minke Whale	0.0000	7.7064
Fin Whale	0.0000	1.7096
Gray Whale	0.0000	0.0038
Humpback Whale	0.0000	1.6395
North Pacific Right Whale	0.0000	0.0214
Sei Whale	0.0000	1.0446
Odontocetes		
Baird's Beaked Whale	0.0000	0.6882
Blainville's Beaked Whale	0.0000	0.5985
Common Bottlenose Dolphin	0.0000	23.7805
Cuvier's Beaked Whale	0.0000	2.2811
Dall's Porpoise	0.0000	53.0706
Dwarf Sperm Whale	0.0000	4.2209
False Killer Whale	0.0000	7.38912
Fraser's Dolphin	0.0000	5.7854
Ginkgo-toothed Beaked Whale	0.0000	0.5985
Hubbs' Beaked Whale	0.0000	0.1928
Killer Whale	0.0000	0.1600
Kogia spp.	0.0000	2.2840
Longman's Beaked Whale	0.0000	0.2993
Melon-headed Whale	0.0000	15.4891
Mesoplodon spp.	0.0000	0.1928
Pacific White-sided Dolphin	0.0000	7.5305
Pantropical Spotted Dolphin	0.0000	35.8584
Pygmy Killer Whale	0.0000	4.3103
Pygmy Sperm Whale	0.0000	1.7203
Risso's Dolphin	0.0000	11.3736
Rough-toothed Dolphin	0.0000	5.8877
Short-beaked Common Dolphin	0.0000	86.3962
Short-finned Pilot Whale	0.0000	18.7461
Sperm Whale	0.0000	1.6701
Spinner Dolphin	0.0000	2.1661
Stejneger's Beaked Whale	0.0000	0.2855
Striped Dolphin	0.0000	23.9042
Pinnipeds		
Hawaiian Monk Seal	0.0000	0.0067

Due to the meager species-specific information available for the large oceanic area of the nine western North Pacific provinces in which the ONR ATE may occur, it is not possible to estimate the age, sex, and reproductive condition of marine mammals potentially taken by Level B incidental harassment. In conclusion, acoustic transmissions associated with the ONR ATE may affect marine mammal species protected under the ESA and may result in MMPA Level B harassment.

7 IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

<u>REQUIREMENT 7</u>*: *Anticipated impact of the activity upon the species or stocks.

To estimate the potential risk of physical auditory effects or behavioral disruption due to source transmissions, a comprehensive program of underwater acoustical modeling was undertaken (see OEA Appendix A). The potential for physiological effects (MMPA Level A harassment) resulting from the use of one of the four active acoustic sources during the ONR ATE is not reasonably foreseeable in all nine provinces (Tables 14 to 22). Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

There is a possibility that MMPA Level B (behavioral reaction and TTS) incidental harassment may occur (Tables 14 to 22). For all ESA-listed species, the probability of MMPA Level B effects occurring is low, with the highest potential for fin whales; with an estimated 1.7096 fin whales potentially experiencing behavioral reactions or TTS from exposure from up to four acoustic sources during ONR ATE (Table 23). For marine mammal species protected under the MMPA, the maximum estimated MMPA Level B incidental harassment for any of the nine provinces of the western North Pacific is estimated at 86.3962 for the short-beaked common dolphin, with the estimates of potential impacts to all other MMPA-protected species being lower. In conclusion, acoustic transmissions associated with the ONR ATE may affect marine mammal species protected under the ESA and may result in MMPA Level B harassment.

The analysis conducted on the ONR ATE activities to assess the potential for effects on marine mammals has shown that marine mammals potentially occurring in the nine provinces of the western North Pacific may potentially be exposed to sound pressure levels that could result in MMPA Level B incidental harassment but are not reasonably expected to result in MMPA Level A harassment. Of the 34 species or species groups of marine mammals that may potentially be found in the experiment area, eight species, the blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, North Pacific right whale, sei whale, sperm whale, and Hawaiian monk seal, are listed under the ESA, with no critical habitat designated in the region. Considering the planned monitoring and mitigation measures, any potential adverse impacts to marine mammal species and stocks are expected to be transitory in nature and geographically limited. Any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.

Therefore, the results of the analyses conducted for ONR ATE support a finding of no significant harm to the environment of international waters. In summary:

- Potential effects on marine mammals are reasonably expected to be limited to MMPA Level B incidental harassment. Thus, any impacts to marine mammals are expected to be limited to some masking effects and behavioral responses in the areas ensonified by the acoustic sources.
- Potential MMPA Level B effects would not impact rates of recruitment or survival.
- MMPA Level B incidental harassment of marine mammals will not occur in ocean areas that are biologically important to marine mammals (e.g., foraging, reproductive areas, rookeries, or ESA critical habitat) or where small, localized populations occur.
- Based on the Navy's impact analysis results, no mortality nor injury (i.e., MMPA Level A harassment) of marine mammals is reasonably anticipated as a result of ONR ATE acoustic transmissions.

- The ONR ATE will entail the addition of sound energy to the oceanic ambient noise environment, which in conjunction with the sound produced by other anthropogenic sources may marginally increase the overall oceanic ambient noise level. Increases in ambient noise levels have the potential to affect marine animals by causing masking. However, broadband, continuous low-frequency ambient noise (e.g., commercial ship traffic) is more likely to mask marine mammals than the sound that will be transmitted during the ONR ATE. Any masking would potentially occur over only a very small spatial and temporal scale.

8 IMPACT ON SUBSISTENCE USE

***REQUIREMENT 8*: Anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.**

The ONR ATE will take place in international waters of one of nine provinces in the western North Pacific Ocean. No subsistence hunting of marine mammal species by Alaskan Native groups or any other U.S. indigenous groups takes place in or near the ONR ATE provinces of the western North Pacific Ocean. Thus, the proposed action will have no impact on the availability of marine mammal species or stocks for subsistence uses.

9 IMPACT TO MARINE MAMMAL HABITAT

***REQUIREMENT 9*: Anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.**

No ESA-designated critical habitats of any marine mammal species are located in or near the waters of the nine western North Pacific Ocean provinces in which the proposed ONR ATE may be conducted nor are any international marine mammal protected areas located within the vicinity of experiment area.

9.1 PHYSICAL HABITAT

During the ONR ATE, only acoustic transducers and receivers as well as standard oceanographic equipment will be deployed. Experimental systems are planned to be retrieved after data collection has been completed. The acoustic and oceanographic instrumentation that will be deployed operates in accordance with all applicable international rules and regulations related to environmental compliance, especially for discharge of potentially hazardous materials. Therefore, no discharges of pollutants will result from the deployment and operation of the acoustic and oceanographic instruments and systems.

9.2 SOUND IN THE ENVIRONMENT

During the ONR ATE, deployment and operation of the sound sources would result in no physical alterations to the marine environment other than the marginal addition of sound energy to the oceanic ambient noise environment, which may have some effect on marine animals. Anthropogenic sources of ambient noise that are most likely to have contributed to increases in ambient noise levels order of importance are: commercial shipping, offshore oil and gas exploration and drilling, and naval and other uses of sonar (Hildebrand, 2005).

9.2.1 OCEANIC NOISE LEVELS

Ambient noise is the typical or persistent environmental background noise that is present throughout the ocean; it is generated by both natural and anthropogenic sources. The U.S. Marine Mammal Commission, in a recently published document on underwater sound in the marine environment, classifies ambient noise into three broad categories: natural biotic, which can include marine animals, fish, and invertebrates; natural abiotic, such as seismic disturbances; and anthropogenic, which includes noise from shipping vessels and seismic surveying (Bradley and Stern, 2008).

Andrew et al. (2002) compared ocean ambient sound from the 1960s with the 1990s for a receiver off the California coast. The data showed an increase in ambient noise of approximately 10 dB SPL in the frequency range of 20 to 80 Hz and 200 and 300 Hz, and about 3 dB SPL at 100 Hz over a 33-year period. A possible explanation for the rise in ambient noise is the increase in shipping noise. More recently, McDonald et al. (2006a) compared northeast Pacific Ocean ambient noise levels over the past four decades, from continuous measurements west of San Nicolas Island, California. Ambient noise levels at 30 to 50 Hz were 10 to 12 dB SPL higher in 2003 to 2004 than in 1964 to 1966, suggesting an increase in the rate of average noise of 2.5 to 3 dB SPL per decade. Above 50 Hz, the noise level differences between recording periods gradually diminished to a rise of 1 to 3 dB SPL at 100 to 300 Hz. McDonald et al. (2006a) cite commercial shipping as the most plausible explanation for the measured increases.

The number of commercial vessels plying the world's oceans approximately doubled between 1965 and 2003, and the gross tonnage quadrupled, with a corresponding increase in horsepower (McDonald et al., 2006a). Clark et al. (2009) demonstrated that acoustic communications space for the highly endangered North Atlantic right whale is seriously compromised by anthropogenic noise from commercial shipping traffic.

In a recent study, Di Iorio and Clark (2010) found that blue whales increase their rate of social calling in the presence of seismic exploration sparkers (plasma sound sources), which presumably represented a compensatory behavior to elevated ambient noise levels from seismic surveys. Southall et al. (2009) noted that even though naval and geophysical sound sources are currently receiving the greatest attention, other lower-power but more ubiquitous sound sources that add to the ambient noise environment occur in far greater numbers and cover much greater geographical ranges and deployment times.

Recent scientific papers and research have reported concerns about the increase in ocean surface acidity and the effects that this will have on ocean noise. Increased levels of carbon dioxide in the atmosphere are raising the dissolved carbon dioxide contents in the oceans, which produces carbonic acid (Hester et al., 2008; Brewer and Hester, 2009; Doney et al., 2009; Ilyina et al., 2010). Because the transmission loss of low frequency sound will decrease with increasing acidity, ocean background noise levels could increase. Several long term predictive models have been developed (Joseph and Chiu, 2010; Reeder and Chiu, 2010; Udovydchenkov et al., 2010). Over the next 100 years, predicted increases in LF ocean noise from acidification will be less than the present variability (approximately 1 dB) in background noise levels for LF.

9.2.1.1 Potential Effects of Ambient Noise

Oceanic ambient noise levels are increasing due to the global escalation in numbers of anthropogenic sources. There is increasing scientific evidence indicating effects on marine mammals from this escalation. In a study by Parks et al. (2007), evidence was provided of a behavioral change in sound production of the North and South Atlantic right whales, which was correlated with increased underwater ambient noise levels; the authors suggested that right whales might shift their call frequency to compensate for the increasing band-limitations caused by ambient background noise. Holt et al. (2009) studied the effects of anthropogenic sound exposure on the endangered Southern Resident killer whales in Puget Sound, reporting that these whales increased their call amplitude by 1 dB SPL for every 1 dB SPL increase in background noise (1 to 40 kHz).

Although the underwater acoustic sources deployed during the ONR ATE may marginally add to the oceanic ambient noise levels, any increase in noise will be temporary (no more than two weeks) and very limited in geographic scope. No impacts associated with the transient increase in ambient noise levels associated with the ONR ATE are anticipated.

10 IMPACTS TO MARINE MAMMALS FROM HABITAT LOSS OR MODIFICATION

<u>REQUIREMENT 10</u>*: *Anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The potential effects of the proposed activity on marine mammals are limited to short-term behavioral modifications (Level B incidental harassment). The potential for an effect on marine mammal habitats and food resources is expected to be negligible. A small minority of the marine mammals that are present near the proposed activity could possibly be temporarily displaced as much as a few kilometers by the elevated underwater sound levels due to transmissions from the ONR ATE sources. However, concentrations of marine mammals and/or marine mammal prey species are not expected to be encountered in or near the vicinity of the waters in the western North Pacific province in which the ONR ATE may occur, and there are no critical feeding, breeding, or migrating areas for any of the species that may be found there at the time of the proposed activity.

The proposed activity is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations because the ONR ATE will be limited both temporally and spatially and would not occur at an environmentally sensitive time period or location.

11 MEANS OF EFFECTING LEAST PRACTICABLE ADVERSE IMPACTS

<u>REQUIREMENT 11</u>*: *Availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Marine mammals may occur in the ONR ATE area during the proposed activities. To minimize the potential that incidental harassment may occur to marine mammal species and stocks, ONR ATE will be conducted in accordance with regulations by NMFS under the MMPA and the ESA, including obtaining permission for Level B incidental harassment of marine mammals and consulting on potential effects to listed species, respectively. Protective mitigation measures are an integral part of the proposed ONR ATE activity, which will take place in international waters of one of nine provinces of the western North Pacific. The ONR ATE will not be conducted within a designated marine sanctuary or critical marine habitat.

11.1 STANDARD OPERATING PROCEDURES

Vessel standard operating procedures, such as maintaining a minimum safe operating distance (i.e., 457 m [1,499 ft]) from detected marine mammals, will be followed to avoid any physical interaction with marine mammals.

11.2 VISUAL MONITORING

Visual monitoring will be conducted for marine mammals from the vessel when acoustic sources are transmitting during daylight hours. Shutdown procedures will occur if marine mammal(s) are visually detected within 1 km[5] (0.54 nmi) of any of the sources. This zone of influence is hereafter known as the mitigation zone.

Visual observers will be individuals trained for visually detecting and identifying marine mammal species. Visual observations will begin 30 minutes before the active acoustic source transmissions are scheduled to commence and will continue until 30 minutes after the active acoustic source transmissions are terminated, or 30 minutes after sunset, whichever occurs first.

Visual observers will maintain a marine mammal observation log that includes duration of time spent searching for marine mammals (on-effort time). The numbers and species of marine mammals sighted, as well as any unusual behavior, will be entered in the log.

11.3 PASSIVE ACOUSTIC MONITORING

Passive acoustic monitoring will be conducted when active acoustic sources are deployed during nighttime (i.e., no more than 35 hr) and other periods of decreased visual observation capabilities. Passive acoustic monitoring will include listening for vocalizations and visually inspecting spectrograms of RF-transmitted signals from a deployed AN/SSQ-53 DIFAR sonobuoy by personnel trained in detecting and identifying marine mammal sounds. Shutdown procedures will occur for any passive acoustic

5 This distance is calculated in the acoustic modeling of the acoustic sources, where the range to the 180 dB isopleth RL was determined to be much less than 1 km (0.54 nmi).

detection estimated to be from a marine mammal. Monitoring will begin 30 minutes before transmissions are scheduled to commence and continue until 30 minutes after transmissions are terminated or 30 minutes after sunrise, whichever occurs first.

Personnel that conduct passive acoustic monitoring will maintain a log that includes duration of time spent listening for marine mammals (on-effort time). The numbers and species identification (if possible) of marine mammals detected will be entered in the log, as well as date, time, and location of the detection and the date, time, and location of all sonobuoy deployments.

12 MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USES

<u>REQUIREMENT 12</u>*: *Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammals for Arctic subsistence uses, the applicant must submit either a "plan of cooperation" or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

The proposed action will take place in international waters of one of nine provinces in the western North Pacific Ocean, and no activities will take place in or near the subsistence hunting grounds of Alaskan native or U.S. indigenous groups. Furthermore, no impacts to marine mammal species or stocks utilized for subsistence uses would occur during the ONR ATE. Therefore, the implementation of the proposed action would have no impact on the availability of a species or stock for subsistence uses.

13 MONITORING AND REPORTING

***REQUIREMENT 13*: The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens of coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.**

ONR will conduct visual and passive acoustic monitoring for marine mammals during ONR ATE to implement the proposed mitigation and protective measures and to satisfy the monitoring requirements of the requested IHA. The objective of this monitoring is to detect marine mammals before they enter the mitigation zone (1-km distance from source). Visual and passive acoustic observers will provide information needed to order a shutdown of the underwater acoustic source if a marine mammal is detected in proximity to an active source.

Visual observations will begin 30 minutes before the active acoustic source transmissions are scheduled to commence and will continue until 30 minutes after the active acoustic source transmissions are terminated, or 30 minutes after sunset, whichever occurs first. Visual observers will maintain a marine mammal observation log that includes duration of time spent searching for marine mammals (on-effort time). The numbers and species of marine mammals sighted, as well as any unusual behavior, will be entered in the log.

Passive acoustic monitoring will be conducted when employing active acoustic sources during nighttime and during other periods of decreased visual observation capabilities. Passive acoustic monitoring will include listening for vocalizations and visually inspecting spectrograms of RF-transmitted signals from a deployed AN/SSQ-53 DIFAR sonobuoy by personnel trained in detecting and identifying marine mammal sounds. Monitoring will begin 30 minutes before transmissions are scheduled to commence and continue until 30 minutes after transmissions are terminated or 30 minutes after sunrise, whichever occurs first.

Personnel that conduct passive acoustic monitoring will maintain a log that includes duration of time spent listening for marine mammals (on-effort time). The numbers and species identification (if possible) of marine mammals detected will be entered in the log, as well as date, time, and location of the detection and the date, time, and location of all sonobuoy deployments.

Locations of any active sources in relation to any detected marine mammals will be used to estimate the numbers and species of marine mammals that may have been exposed to various received levels and to document any apparent disturbance reactions or lack thereof, as is feasible. Data will be used to help estimate the numbers of animals potentially taken by MMPA Level B harassment. All observations, as well as information regarding source shutdown, will be recorded in a standardized format.

A report will be submitted to NMFS within 90 days after the end of the ONR ATE. The report will provide, as feasible, documentation of methods, results, and interpretation pertaining to monitoring. The report will also, as feasible, summarize the dates and locations of the underwater acoustic source operations and marine mammal detections and the associated ONR ATE activities. Additionally, the report will, as feasible, include estimates of the amount and nature of potential harassment of marine mammals by MMPA Level B incidental harassment.

14 RESEARCH

***REQUIREMENT 14*: Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.**

The Department of the Navy (DoN) sponsors significant research and monitoring projects for living marine resources to study the potential effects of its activities on marine mammals. The research funding levels of the DoN increased to $32M in FY 2010 for marine mammal research and monitoring activities at universities, research institutions, federal laboratories, and private companies. Navy scientists also develop approaches to ensure that marine mammal resources are minimally impacted by existing and future Navy operations. It is imperative that the Navy's research and development (R&D) efforts related to marine mammals are conducted in an open, transparent manner with validated study needs and requirements. The goal of the Navy's R&D program is to enable collection and publication of scientifically valid research, as well as development of techniques and tools for Navy, academic, and commercial use. Historically, R&D programs are funded and developed by the Navy's Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45) and ONR. Primary focus of these programs since the 1990s is on understanding the effects of underwater sound on marine mammals, including physiological, behavioral, and ecological effects.

Navy-funded research has produced, and is producing, many peer-reviewed articles in professional journals. Publication in open professional literature through peer review is the benchmark for the quality of the research. This ongoing marine mammal research includes hearing and hearing sensitivity, auditory effects, dive and behavioral response models, underwater noise impacts, beaked whale global distribution, modeling of beaked whale hearing and behavioral response, tagging of free-ranging animals at sea, and radar-based detection of marine mammals from ships.

The Marine Life Sciences Division of ONR currently oversees six programs that examine the marine environment and are devoted to studying the effects of underwater sound and/or implementation of technological tools that will assist the Navy in studying and tracking marine mammals. The six programs are:

- Environmental consequences of underwater sound.
- Non-auditory biological effects of sound on marine mammals.
- Effects of sound on the marine environment.
- Sensors and models for marine environmental monitoring.
- Effects of underwater sound on hearing of marine animals.
- Passive acoustic detection, classification, and tracking of marine mammals.

Research cruises by NMFS and academic institutions have received funds from the Navy. For example, in April 2009, the Commander U.S. Pacific Fleet contributed approximately $250,000 in support of a NMFS marine mammal density survey of the Gulf of Alaska's offshore waters. The objective of this survey was to increase the information on marine mammal occurrence, density, and distribution within the Gulf of Alaska. The Navy also sponsored a marine mammal-dedicated visual and acoustic survey of the Mariana Islands and surrounding waters of the western North Pacific Ocean in 2007 that provided distribution and occurrence data on marine mammals for a region of the ocean lacking in marine mammal data (Fulling et al., 2011).

Since 2007, the Navy and the National Oceanic and Atmospheric Administration have annually funded independent scientists to conduct national and international research on the responses of deep-diving odontocetes to sonar signals. These are cetacean behavioral response studies (BRSs). The BRS research program continues into 2013, with a study planned off southern California.

To manage some of the Navy's marine mammal research programmatic elements, OPNAV N45 developed in 2011 a new Living Marine Resources (LMR) R&D program. The goal of the LMR R&D program is to identify and fill knowledge gaps, and to demonstrate, validate, and integrate new processes and technologies to minimize potential effects to marine mammals and other marine resources. Key elements of the LMR R&D program include:

- Developing an open and transparent process with a dedicated website for both project management and public review;
- Providing program management and execution, including inputs from various Navy commands involved in marine mammal monitoring and research;
- Ensuring funding of R&D projects that include internationally respected and authoritative researchers and institutions;
- Establishing and validating critical needs and requirements with input from a Navy Regional Advisory Committee (RAC);
- Interacting with key stakeholders outside the Navy via the RAC;
- Identifying key enabling capabilities and investment areas with advice and assistance from a Navy Technical Review Committee;
- Maintaining close interaction and coordination with the ONR basic research and early-stage applied research programs;
- Developing effective information and data for Navy environmental planners and operators; and
- Providing effective management of project/program funding.

In addition to sponsoring research on marine mammals in the western North Pacific Ocean, ONR also has sponsored underwater acoustic research in this region and surrounding waters over the last decade, including the following:

- A year-long acoustic tomography experiment that employed an acoustic system to monitor and assess the annual variations in the acoustic and oceanographic environment.
- Development experiments and demonstrations to test various scientific and technological underwater acoustic sensors and systems in realistic at-sea environments.
- An international experiment to assess the uncertainty in the acoustic environment heavily influenced by the Kuroshio Current and other oceanic circulation systems.

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