APPLICATION FOR RENEWAL OF ANNUAL LETTERS OF AUTHORIZATION FOR THE EMPLOYMENT OF SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE (SURTASS LFA) SONAR ONBOARD FOUR VESSELS

UNDER SECTION 101 (a)(5)(A) OF THE MARINE MAMMAL PROTECTION ACT

MAY 2013

SUBMITTED BY: DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS
INTELLIGENCE, SURVEILLANCE AND
RECONNAISSANCE CAPABILITIES DIVISION
(N2/N6F2)

SUBMITTED TO: NATIONAL MARINE FISHERIES SERVICE
OFFICE OF PROTECTED SPECIES
PERMITS AND CONSERVATION DIVISION

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ACRONYMS AND ABBREVIATIONS

°	degree(s)
%	percent
≥	greater than or equal to
<	less than
±	plus or minus
µ	micro (10^{-6})
AEP	auditory evoked potential
AIM	Acoustic Integration Model©
APPS	Act to Prevent Pollution from Ships
ASW	antisubmarine warfare
BO	biological opinion
BOEM	Bureau of Ocean Energy Management
BRS	behavioral response study
C	Celcius
CNO	Chief of Naval Operations
CNP	Central North Pacific
CV	coefficient of variance
CW	continuous wave
CWA	Clean Water Act
dB	decibel(s)
dB re 1 µPa @ 1 m	decibels relative to one microPascal measured at one meter from center of acoustic source
dB re 1 μPa^2-sec	decibels relative to one micropascal squared per second
DoI	Department of the Interior
DoN	Department of the Navy
DPS	dstinct population segment
ECS	East China Sea
EEZ	exclusive economic zone
EIS	environmental impact statement
ESA	Endangered Species Act
ETP	eastern tropical Pacific
F	Fahrenheit
FM	frequency modulated

ACRONYMS AND ABBREVIATIONS

ft	feet
HF	high frequency
HF/M3	high frequency marine mammal monitoring
HLA	horizontal line array
hr	hour(s)
Hz	Hertz
IA	Inshore Archipelago
IUCN	International Union of Conservation of Nature
ITS	Incidental Take Statement
IWC	International Whaling Commission
km	kilometer(s)
km^2	kilometers squared
kHz	kiloHertz
kph	kilometers per hour
kt	knot(s)
LF	low frequency
LFA	Low Frequency Active
LOA	Letter of Authorization
LFS	low frequency sound
LTM	Long Term Monitoring
m	meter(s)
M3	Marine Mammal Monitoring
min	minute(s)
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MPA	marine protected area
NDAA	National Defense Authorization Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
nmi	nautical mile(s)
NP	North Pacific
OBIA(s)	offshore biologically important area(s)
OEIS/EIS	Overseas Environmental Impact Statement and Environmental Impact Statement

ACRONYMS AND ABBREVIATIONS

OIC	officer in charge
Pa	Pascal
PTS	permanent threshold shift
RL	received level
rms	root mean squared
SAG	Scientific Advisory Group
SE	standard error
sec	second(s)
SEIS	supplemental environmental impact statement
SEL	sound exposure level
SL	source level
SOJ	Sea of Japan
Sonar	SOund Navigation And Ranging
SPE	single ping equivalent
SPL	sound pressure level
SRP	Scientific Research Program
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Tactical-Auxiliary General Ocean Surveillance
TTS	temporary threshold shift
U.S.	United States of America
U.S.C.	United States Code
USNS	United States Naval Ship
VLA	vertical line array
WNP	Western North Pacific

1 DESCRIPTION OF THE PROPOSED ACTIVITY

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

1.1 INTRODUCTION

Pursuant to Section 101 (a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended (MMPA;16 USC 1371), the Department of the Navy (hereafter, the Navy) is applying to the National Marine Fisheries Service (NMFS) for renewals of annual Letters of Authorization (LOAs) for the employment of Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar during training, testing, and routine military operations in the western and central North Pacific Ocean. Marine mammals will be harassed due to the underwater noise generated incidentally by the employment of SURTASS LFA sonar systems during at-sea operations. As a result, the Navy is requesting annual LOAs under the MMPA for taking of marine mammals by Level A (no lethal taking) and Level B harassment incidental to the employment of SURTASS LFA sonar systems onboard the United States Naval Ship (USNS) IMPECCABLE, USNS EFFECTIVE, USNS ABLE, and USNS VICTORIOUS for the annual period from 15 August 2013 through 14 August 2014 for no more than 20 total missions. The four SURTASS LFA sonar vessels will operate in the same eleven mission areas in the western and central North Pacific Ocean authorized under the 2012 to 2013 LOAs (NOAA, 2012a).

The basis of this request for annual LOAs are: (1) the analysis of spatial and temporal distributions of protected marine mammals in potential operating areas for SURTASS LFA sonar, (2) a review of activities that have the potential to affect marine mammals, and (3) a technical risk assessment to determine the likelihood of effects from use of active sonar during Navy training, testing, and routine military operations in the western and central North Pacific Ocean, with specific geographic areas exempted from operations. For this request for LOAs, analysis of SURTASS LFA proposed sonar operations examined the potential exposure to marine mammals resulting from 20 proposed at-sea missions, of seven days duration each, conducted by four vessels using SURTASS LFA sonar with a maximum number of actual transmission hours per vessel that would not exceed 432 hours (hr) annually.

1.2 SURTASS LFA SONAR OPERATIONS

The Chief of Naval Operations' mission for SURTASS LFA sonar operations is to train the Navy crews manning the vessels and to test and operate the LFA systems in as many and varied at-sea environments as possible. The Navy has determined that operations of the SURTASS LFA sonar, which are the subject of NMFS's Final Rule (NOAA, 2012), include testing and training, and military operations. Furthermore, these operations constitute a military readiness activity as that term is defined in Public Law 107-314 (16 U.S.C. § 703 note) as those activities constitute "training and operations of the Armed Forces that relate to combat" and "adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use."

A complete description of the Navy's current and proposed employment of SURTASS LFA sonar may be found in the Navy's June 2012 Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement (SEIS/SOEIS) for SURTASS LFA Sonar (DoN, 2012). SURTASS LFA sonar systems are and will be operated in accordance with the geographic restrictions[1] and monitoring mitigation protocols delineated in the 2012 Navy SEIS/SOEIS, the Navy's Record of Decision (DoD,

1 Broadly, the geographic restrictions for operation of SURTASS LFA sonar include no operation of the sonar in polar waters, within 22 kilometers [km] (12 nautical miles [nmi]) of land, and in offshore biologically important areas (OBIAs) for marine mammals, of which 22 OBIAs have been designated for SURTASS LFA sonar.

2012), the NMFS' MMPA Final Rule (NOAA, 2012), annual LOAs, as issued (NOAA, 2012a), and the 5-Year biological opinion (BO) and annual BO/Incidental Take Statements (ITSs) (NMFS, 2012 and 2012a).

1.2.1 SURTASS LFA SONAR SYSTEM

The SURTASS LFA sonar system is comprised of a passive acoustic component, SURTASS, and an active sonar component, LFA. SURTASS is the passive or sound-receiving component that receives sound signals on a series of hydrophones mounted together to form a horizontal line array (HLA). The HLA is towed behind a SURTASS LFA sonar vessel at a speed of about 5.6 kph (3 kt). Since the SURTASS component only receives sound signals and transmits no sonar or sound energy into the marine environment and is towed at such a slow speed, the SURTASS component will result in no impact to potentially occurring marine mammals.

The LFA sonar source is a vertical line array (VLA) of up to 18 source projectors suspended beneath the vessel. The LFA source operates within the frequency range of 100 to 500 Hertz (Hz) with each individual source projector transmitting signals with a source level (SL) of approximately 215 decibels relative to 1 microPascal at a reference of 1 meter (dB re 1 µPa at 1 m) (root mean squared [rms]) or less. The typical LFA sonar signal is not transmitted as a constant tone but is instead transmitted as various waveforms that fluctuate in frequency and duration. A complete sequence of sound transmissions is referred to as a wavetrain or ping. These wavetrains have a duration between 6 and 100 seconds (sec), with an average duration of 60 sec and no more than 10 sec at any single frequency. The time between sonar wavetrain/ping transmissions is typically 6 to 15 minutes. The average duty cycle (ratio of sound "on" time to total time) is less than 20%, with a typical duty cycle, based on LFA operational parameters since 2003, ranging nominally between 7.5 to 10%.

1.2.2 OPERATION OF SURTASS LFA SONAR

Past operation of SURTASS LFA sonar in the western and central North Pacific Ocean over the nine-year period spanning 2002 through 2011 involved 128 completed missions conducted over 472 days during which LFA sonar was transmitted for 908 hrs (or about 38 days out of a possible 3,285 days) in total. During those missions, only 12 marine mammals or sea turtles were visually observed, four marine animals were detected passive-acoustically, and 130 marine mammals/animals were detected active-acoustically by the high frequency marine mammal monitoring (HF/M3) sonar system. These detections of marine animals led to 139 suspensions/delays of LFA sonar transmissions. In the operational history of SURTASS LFA sonar, no vessel strikes of marine animals, physical injury to any marine animals, or marine mammal strandings have ever been associated with use of LFA sonar. Such results demonstrate that the geographic restriction of SURTASS LFA sonar use (i.e., coastal exclusion zones, offshore biologically important areas [OBIAs], and polar waters) and the success of the Navy's tripartite mitigation and monitoring measures have effectively preventing injury to protected marine species and affecting the least practicable adverse impacts on marine mammal species or stocks.

During the most recent history of SURTASS LFA sonar operations in the western North Pacific Ocean, four SURTASS LFA sonar vessels/systems have operated over the LOA/ITS reporting periods commencing in August 16, 2011 through the present. For the annual reporting period from August 2011 to August 2012, 66.34 hr of LFA sonar were transmitted during 15 missions over 28.5 mission days (Table 1). During this annual reporting period, LFA sonar was suspended three times in accordance with the mitigation monitoring protocol, and two acoustic detections (one passive and one HF/M3) and no visual detections of marine mammals or sea turtles were reported (Table 2). No dead or injured marine species were observed during the annual reporting period. Of the estimated 112 mission days (16 seven-day missions) estimated for SURTASS LFA sonar operations in the western North Pacific mission areas prior to the commencement of annual operations, only 28.5 mission days, or 25% of the permitted number, were executed during the annual period. Per the terms and conditions of the annual LOAs and associated ITS for the operation of SURTASS LFA sonar, the Navy submitted an annual and quarterly reports that detailed SURTASS LFA sonar operations, including the locations of operation and any

observations of marine mammals, over the associated reporting period. In accordance with the MMPA Final Rule for SURTASS LFA sonar employment, the annual report for the August 16, 2011 through August 15, 2012 LOAs was submitted on 2 October 2012 (DoN, 2012a).

The most current information summarizing the first six months of SURTASS LFA sonar operations aboard the four permitted vessels during the current LOAs and ITS (16 August 2012 to 16 February 2013) shows that a total of six missions have been completed over 16.0 days in the western North Pacific Ocean, resulting in 29.09 hr of LFA sonar transmissions, nine LFA sonar shut-downs, seven detections of marine mammals by the active HF/M3 sonar, and no visual or passive acoustic detections (Table 2). No dead or injured marine mammals been observed during the first six months of the annual reporting period.

Table 1. Summary of annual SURTASS LFA sonar operations under the LOAs and ITS reporting period from 16 August 2011 to 15 August 2012.

SURTASS LFA VESSEL	ANNUAL SURTASS LFA SONAR OPERATIONS						
	MISSIONS	MISSION DURATION (DAYS)	LFA TRANSMISSIONS (HOURS)	LFA SONAR SUSPENSIONS	VISUAL DETECTIONS	PASSIVE ACOUSTIC DETECTIONS	HF/M3-ACTIVE ACOUSTIC DETECTIONS
USNS ABLE (T-AGOS 20)	6	16.3	35.56	3[2]	0	1	1
USNS EFFECTIVE (T-AGOS 21)	5	7.8	24.26	0	0	0	0
USNS IMPECCABLE (T-AGOS 23)	3	0.6	1.97	0	0	0	0
USNS VICTORIOUS (T-AGOS 19)	1	3.8	4.55	0	0	0	0
Annual Totals	**15**	**28.5**	**66.34**	**3**	**0**	**1**	**1**

2 One suspension of LFA sonar due to loss of passive acoustic system.

Table 2. Summary of SURTASS LFA sonar operations under the current LOAs and ITS (16 August 2012 through 15 August 2013) for the first two quarters (August through February) of the annual reporting period.

SURTASS LFA VESSEL	ANNUAL SURTASS LFA SONAR OPERATIONS TO DATE						
	MISSIONS	MISSION DURATION (DAYS)	LFA TRANSMISSIONS (HOURS)	LFA SONAR SUSPENSIONS	VISUAL DETECTIONS	PASSIVE ACOUSTIC DETECTIONS	HF/M3-ACTIVE ACOUSTIC DETECTIONS
USNS ABLE (T-AGOS 20)	1	1.3	2.63	0	0	0	0
USNS EFFECTIVE (T-AGOS 21)	3	11.9	20.93	9	0	0	7
USNS IMPECCABLE (T-AGOS 23)	1	1.8	4.4	0	0	0	0
USNS VICTORIOUS (T-AGOS 19)	1	1.0	1.13	0	0	0	0
Totals	**6**	**16.0**	**29.09**	**9**	**0**	**0**	**7**

2 DURATION AND LOCATION OF SURTASS LFA SONAR USE

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

2.1 DURATION

Due to uncertainties in the world's political climate, a detailed account of future operating locations for SURTASS LFA sonar cannot be predicted. However, for planning and analysis purposes, a nominal annual deployment schedule were developed, based on actual LFA operations conducted since January 2003 and projected Navy requirements. The SURTASS LFA sonar vessels typically operate independently but may operate in conjunction with other naval air, surface, or submarine assets. The vessels generally travel in straight lines or racetrack patterns depending on the operational scenario.

Annually, a nominal schedule for each SURTASS LFA sonar vessel entails approximately 240 days performing active operations (Table 3). Between missions, an estimated total of 71 days per year will be spent in port for upkeep and repair and to exchange crew members. Although the actual number and length of the individual missions within the 240 days are difficult to predict, the maximum number of actual transmission hours per vessel per year will not exceed 432 hr. A total of 16 missions in the western North Pacific and four missions in the central North Pacific Ocean are being requested for all SURTASS LFA sonar vessels.

Table 3. Nominal annual deployment schedule for SURTASS LFA sonar vessels.

UNDERWAY—MISSION	DAYS	NOT UNDERWAY	DAYS
Transit	54	In-port upkeep	40
Active operations (432 hours transmissions per vessel based on 7.5% duty cycle)	240	Regular overhaul	31
Total underway	294	Total not underway	71
Total			365

The maximum number of LFA sonar transmission hours and mission days conducted is usually much fewer than the number used in planning and modeling, however. For instance, during the last full LOAs reporting period from August 2011 through August 2012 (Table 1), 15 missions were conducted by the four SURTASS LFA sonar vessels in the western North Pacific Ocean during which SURTASS LFA sonar was only transmitted for 66.3 hr during 28.5 mission days. In the first six months of the current LOAs reporting period (16 August 2012 through 15 August 2013), six missions have been conducted over 16 missions days with a total of only 29.1 hr of LFA sonar transmissions (Table 2).

2.2 POTENTIAL SURTASS LFA SONAR MISSION AREAS

The mission areas requested for SURTASS LFA sonar deployment and transmission during the August 2013 to August 2014 reporting period are the same 11 mission areas (Table 4) in the western and central North Pacific in which SURTASS LFA sonar is authorized to operate during the current LOAs (Figures 1

and 2). These areas include nine mission areas in the western North Pacific Ocean and two mission areas in the central North Pacific Ocean. SURTASS LFA mission areas 10 and 11 are located within the Hawaii Range Complex. No more than three missions are proposed for any one mission area (Table 4).

Table 4. Mission areas and number of SURTASS LFA missions proposed to occur 15 August 2013 through 14 August 2014 in the western and central North Pacific Ocean.

Mission Area Number	SURTASS LFA Mission Area	Number Proposed Missions
1	East of Japan	1
2	North Philippine Sea	3
3	West Philippine Sea	3
4	Offshore Guam	3
5	Sea of Japan	2
6	East China Sea	1
7	South China Sea	1
8	Offshore Japan (25° to 40° N)	1
9	Offshore Japan (10° to 25° N)	1
10	Hawaii North	2
11	Hawaii South	2

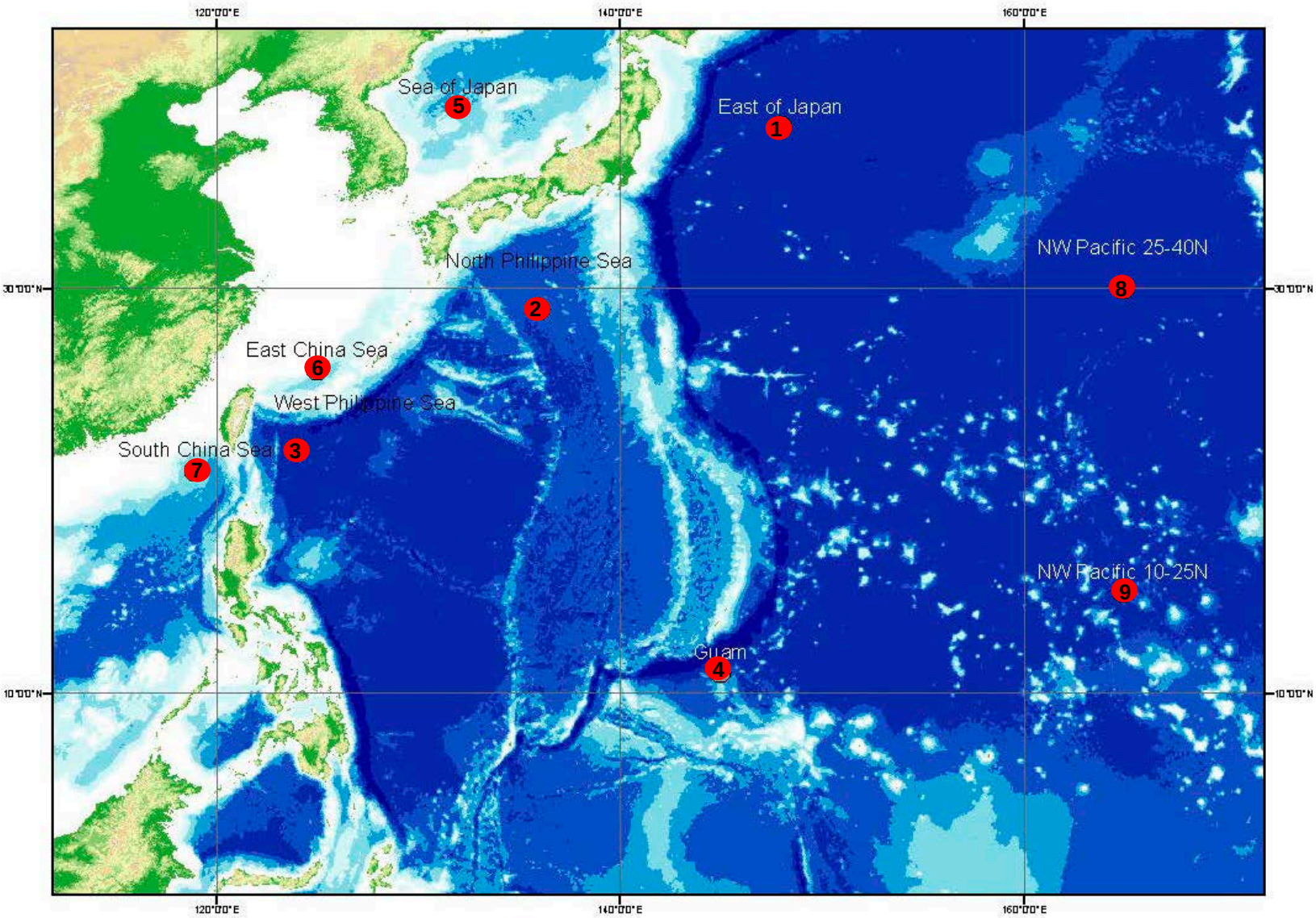

Figure 1. Mission areas in western North Pacific Ocean for SURTASS LFA sonar employment.

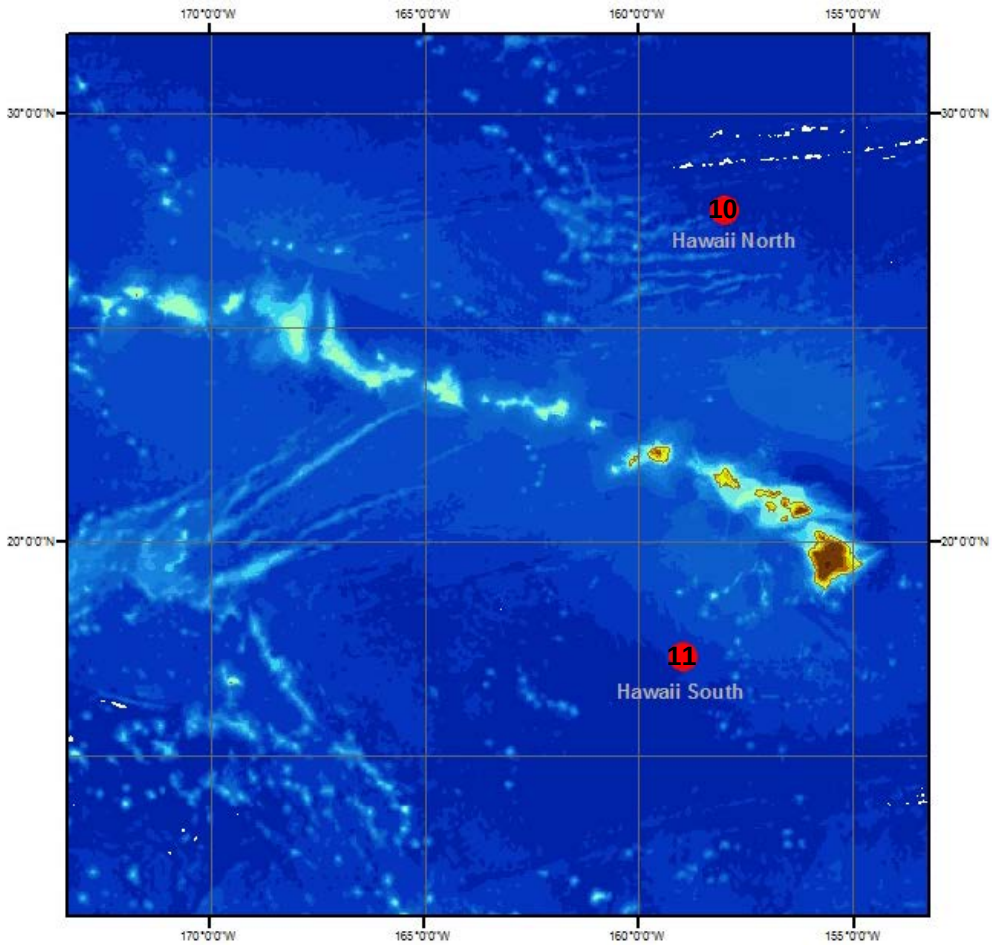

Figure 2. Mission areas in central North Pacific Ocean for SURTASS LFA sonar employment.

3 MARINE MAMMALS

Requirement 3: *The species and numbers of marine mammals likely to be found within an activity area.*

As many as 34 species of marine mammals may occur at least seasonally in the western and central North Pacific Ocean mission areas for SURTASS LFA sonar (Table 5). These species include eight mysticete (baleen whales) species, 25 odontocete species (toothed whales/dolphins/porpoises), and one pinniped species (seals, sea lions, and walruses). Some of these species are only found seasonally while others occur year-round in the potential SURTASS LFA sonar mission areas. Some species, such as the beaked whales and *Kogia* species are difficult to differentiate at sea and often little occurrence information is known about these species in some areas. For these reasons, two undifferentiated species groups, *Mesoplodon* spp. (Blainville's, Ginkgo-toothed, Hubb's, and Stejneger's beaked whales) and *Kogia* spp. (dwarf and pygmy sperm whales), are included to account for these species in some mission areas. Of the potentially occurring marine mammals, nine species are listed under the Endangered Species Act (ESA) as endangered. Of the ESA-listed marine mammal species, only the Hawaiian monk seal has critical habitat designated in the vicinity of a SURTASS LFA North Pacific mission areas. Critical habitat for the Hawaiian monk seal is designated use areas of the Northwestern Hawaiian Islands (NWHI) to a depth of 37 meters (m) (120 feet [ft]). One of the geographic restrictions for the use of SURTASS LFA sonar is that the sonar-generated sound field must be below received levels of 180 decibels relative to one microPascal (root mean squared) (dB re 1 µPa [rms]) (sound pressure level [SPL]) within 22 kilometers (km) (12 nautical miles [nmi]) of any coastline. The critical habitat boundaries for the Hawaiian monk seal lie within this coastal exclusion zone for operation of SURTASS LFA sonar. Thus, no effects to the Hawaiian monk seal's critical habitat including no destruction or adverse modification are considered possible from use of SURTASS LFA sonar in the Hawaii-North or Hawaii-South mission areas.

3.1 MARINE MAMMAL ABUNDANCE AND DENSITY ESTIMATES

Although the distribution of many marine mammal species is irregular and highly dependent upon geography, oceanography, and seasonality, density and abundance estimates for each marine mammal species occurring in SURTASS LFA mission areas are critical components of the analytical estimation methodology to assess risk to marine mammal populations from activities occurring in the marine environment. Marine mammal density and stock/abundance estimates were derived for the proposed 2013 to 2014 mission areas for employment of SURTASS LFA sonar (Table 6). These data were derived using the most current and best available published source information and data (Appendix A), including the NMFS 2012 Stock Assessment Reports for Alaska and the United States (U.S.) Pacific (Allen and Angliss, 2013; Carretta et al., 2013).

When density estimates were not available for a species in a mission area, then density estimates from a region with similar oceanographic characteristics were extrapolated to that mission area. For example, the eastern tropical Pacific (ETP) has been extensively surveyed and provides a comprehensive understanding of marine mammals in temperate oceanic waters (Ferguson and Barlow, 2001 and 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 pilot whales and beaked whales, as well as the pygmy and dwarf sperm whales. Density estimates in some mission areas are available for these species groups rather than the individual species. Where possible, seasonal densities have been provided.

Table 5. Marine mammal species potentially occurring in SURTASS LFA sonar mission areas of the western and central North Pacific Ocean and their status under the ESA and MMPA.

SPECIES	ESA STATUS	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
Humpback whale (*Megaptera novaeangliae*)	Endangered	Depleted
North Pacific right whale (*Eubalaena japonica*)	Endangered	Depleted
Sei whale (*Balaenoptera borealis*)	Endangered	Depleted
Western North Pacific Gray whale (*Eschrichtius robustus*)	Western North Pacific DPS Only—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*)		
Dwarf sperm whale (*Kogia sima*)		
False killer whale (*Pseudorca crassidens*)	Main Hawaiian Islands Insular DPS—Endangered	Depleted
Fraser's dolphin (*Lagenodelphis hosei*)		
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens)*		
Hubbs beaked whale (*Mesoplodon carhubbsi)*		
Killer whale (*Orca orcinus*)[3]		
Kogia spp.		
Longman's beaked whale (*Indopacetus pacificus*)		
Melon-headed whale (*Peponocephala electra*)		
Mesoplodon spp.		
Pacific white-sided dolphin (*Lagenorhynchus obliquidens)*		
Pantropical spotted dolphin (*Stenella attenuata*)		
Pygmy killer whale (*Feresa attenuata*)		
Pygmy sperm whale (*Kogia breviceps*)		
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

3 Only the Southern Resident killer whale DPS, found principally in U.S. and Canadian inland waters, is listed as endangered.

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Mission Area #1: East of Japan								
Bryde's whale	WNP	20,501	1	0.0006	0.0006	0.0006	0.0006	2
Common minke whale	WNP "O" Stock	25,049	3	0.0022	0.0022	0.0022	0.0022	3
Fin whale	WNP	9,250	4, 5			0.0002	0.0002	5
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Sei whale	NP	8,600	5	0.0006	0.0006	0.0006	0.0006	5, 7
Baird's beaked whale	WNP	8,000	8	0.0029	0.0029	0.0029	0.0029	8
Common bottlenose dolphin	WNP	168,791	9	0.0171	0.0171	0.0171	0.0171	9
Cuvier's beaked whale	WNP	90,725	10, 11	0.0031	0.0031	0.0031	0.0031	10, 11
False killer whale	WNP Pelagic	16,668	9	0.0036	0.0036	0.0036	0.0036	9
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Hubbs' beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0031	0.0031	0.0031	0.0031	10, 11
Pacific white-sided dolphin	WNP	931,000	13	0.0082	0.0082	0.0082	0.0082	10, 11
Pantropical	WNP	438,064	9			0.0259	0.0259	9

4 NP=North Pacific; WNP=Western North Pacific; CNP=Central North Pacific; ECS=East China Sea; SOJ=Sea of Japan; IA=Inshore Archipelago

5 No density in a season means that the marine mammal does not occur in that mission area during that season.

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
spotted dolphin								
Pygmy killer whale	WNP	30,214	10, 11	0.0021	0.0021	0.0021	0.0021	10, 11
Risso's dolphin	WNP	83,289	9	0.0097	0.0097	0.0097	0.0097	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0059	0.0059	0.0059	0.0059	10, 11
Short-beaked common dolphin	WNP	3,286,163	10, 11	0.0761	0.0761	0.0761	0.0761	10, 11
Short-finned pilot whale	WNP	53,608	9	0.0128	0.0128	0.0128	0.0128	9
Sperm whale	NP	102,112	15	0.0012	0.0012	0.0012	0.0012	16
Spinner dolphin	WNP	1,015,059	10, 11			0.0008	0.0008	14
Striped dolphin	WNP	570,038	9	0.0111	0.0111	0.0111	0.0111	9
Mission Area #2: North Philippine Sea								
Blue whale	CNP	9,250	5, 17, 18	0.0001	0.0001		0.0001	5, 10, 11, 19
Bryde's whale	WNP	20,501	1	0.0006	0.0006	0.0006	0.0006	2
Common minke whale	WNP "O" Stock	25,049	3	0.0044	0.0044	0.0044	0.0044	3
Fin whale	WNP	9,250	4, 5	0.0002	0.0002			5
Humpback whale	WNP	1,107	20	0.0009	0.0009		0.0009	19, 21
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Blainville's beaked whale	WNP	8,032	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Common bottlenose dolphin	WNP	168,791	9	0.0146	0.0146	0.0146	0.0146	9
Cuvier's beaked whale	WNP	90,725	10, 11	0.0054	0.0054	0.0054	0.0054	10, 11

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
False killer whale	WNP Pelagic	16,668	9	0.0029	0.0029	0.0029	0.0029	9
Fraser's dolphin	WNP	220,789	10, 11	0.0042	0.0042	0.0042	0.0042	14
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0031	0.0031	0.0031	0.0031	10, 11
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0043	0.0043	0.0043	0.0043	16
Pacific white-sided dolphin	WNP	931,000	13	0.0119	0.0119			10, 11
Pantropical spotted dolphin	WNP	438,064	9	0.0137	0.0137	0.0137	0.0137	9
Pygmy killer whale	WNP	30,214	10, 11	0.0021	0.0021	0.0021	0.0021	10, 11
Risso's dolphin	WNP	83,289	9	0.0106	0.0106	0.0106	0.0106	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0059	0.0059	0.0059	0.0059	10, 11
Short-beaked common dolphin	WNP	3,286,163	10, 11	0.0562	0.0562	0.0562	0.0562	10, 11
Short-finned pilot whale	WNP	53,608	9	0.0153	0.0153	0.0153	0.0153	9
Sperm whale	NP	102,112	15	0.0012	0.0012	0.0012	0.0012	16
Spinner dolphin	WNP	1,015,059	10, 11	0.0008	0.0008	0.0008	0.0008	14
Striped dolphin	WNP	570,038	9	0.0329	0.0329	0.0329	0.0329	9
Mission Area #3: West Philippine Sea								
Blue whale	CNP	9,250	5, 17, 18	0.0001	0.0001		0.0001	5, 10, 11, 19

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Bryde's whale	WNP	20,501	1	0.0006	0.0006	0.0006	0.0006	2
Common minke whale	WNP "O" Stock	25,049	3	0.0033	0.0033	0.0033	0.0033	3
Fin whale	WNP	9,250	4, 5	0.0002	0.0002			5
Humpback whale	WNP	1,107	20	0.0009	0.0009		0.0009	19, 21
Blainville's beaked whale	WNP	8,032	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Common bottlenose dolphin	WNP	168,791	9	0.0146	0.0146	0.0146	0.0146	9
Cuvier's beaked whale	WNP	90,725	10, 11	0.0003	0.0003	0.0003	0.0003	10, 11
False killer whale	WNP Pelagic	16,668	9	0.0029	0.0029	0.0029	0.0029	9
Fraser's dolphin	WNP	220,789	10, 11	0.0042	0.0042	0.0042	0.0042	14
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0017	0.0017	0.0017	0.0017	10, 11
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0043	0.0043	0.0043	0.0043	16
Pantropical spotted dolphin	WNP	438,064	9	0.0137	0.0137	0.0137	0.0137	9
Pygmy killer whale	WNP	30,214	10, 11	0.0021	0.0021	0.0021	0.0021	10, 11
Risso's dolphin	WNP	83,289	9	0.0106	0.0106	0.0106	0.0106	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0059	0.0059	0.0059	0.0059	10, 11

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Short-finned pilot whale	WNP	53,608	9	0.0076	0.0076	0.0076	0.0076	9
Sperm whale	NP	102,112	15	0.0012	0.0012	0.0012	0.0012	16
Spinner dolphin	WNP	1,015,059	10, 11	0.0008	0.0008	0.0008	0.0008	14
Striped dolphin	WNP	570,038	9	0.0164	0.0164	0.0164	0.0164	9
Mission Area #4: Offshore Guam								
Blue whale	CNP	9,250	5, 17, 18	0.0001	0.0001		0.0001	5, 10, 11, 16, 19
Bryde's whale	WNP	20,501	1	0.0004	0.0004	0.0004	0.0004	16
Common minke whale	WNP "O" Stock	25,049	3	0.0003	0.0003		0.0003	10, 11
Fin whale	WNP	9,250	4, 5	0.0001	0.0001		0.0001	10, 11
Humpback whale	CNP	10,103	20	0.0009	0.0009		0.0009	19, 21
Sei whale	NP	8,600	5	0.0003	0.0003		0.0003	16
Blainville's beaked whale	WNP	8,032	10, 11	0.0012	0.0012	0.0012	0.0012	14
Common bottlenose dolphin	WNP	168,791	9	0.0013	0.0013	0.0013	0.0013	14
Cuvier's beaked whale	WNP	90,725	10, 11	0.0062	0.0062	0.0062	0.0062	14
Dwarf sperm whale	WNP	350,553	10, 11	0.0071	0.0071	0.0071	0.0071	14
False killer whale	WNP Pelagic	16,668	9	0.0011	0.0011	0.0011	0.0011	16
Fraser's dolphin	WNP	220,789	10, 11	0.0042	0.0042	0.0042	0.0042	14
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0009	0.0009	0.0009	0.0009	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	14
Longman's beaked whale	WNP	1,007	14	0.0004	0.0004	0.0004	0.0004	14

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Melon-headed whale	WNP	36,770	10, 11	0.0043	0.0043	0.0043	0.0043	16
Pantropical spotted dolphin	WNP	438,064	9	0.0226	0.0226	0.0226	0.0226	16
Pygmy killer whale	WNP	30,214	10, 11	0.0001	0.0001	0.0001	0.0001	16
Pygmy sperm whale	WNP	350,553	10, 11	0.0029	0.0029	0.0029	0.0029	14
Risso's dolphin	WNP	83,289	9	0.0010	0.0010	0.0010	0.0010	14
Rough-toothed dolphin	WNP	145,729	10, 11	0.0036	0.0036	0.0036	0.0036	14
Short-finned pilot whale	WNP	53,608	9	0.0036	0.0036	0.0036	0.0036	14
Sperm whale	NP	102,112	15	0.0012	0.0012	0.0012	0.0012	16
Spinner dolphin	WNP	1,015,059	10, 11	0.0008	0.0008	0.0008	0.0008	14
Striped dolphin	WNP	570,038	9	0.0062	0.0062	0.0062	0.0062	16
Mission Area #5: Sea of Japan								
Bryde's whale	WNP	20,501	1	0.0001	0.0001	0.0001	0.0001	10, 11
Common minke whale	WNP "O" Stock	25,049	3	0.0004	0.0004	0.0004	0.0004	10, 11
Common minke whale	WNP "J" Stock	893	22	0.0002	0.0002	0.0002	0.0002	10, 11
Fin whale	WNP	9,250	4, 5	0.0009	0.0009	0.0009	0.0009	10, 11
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Western North Pacific gray whale	WNP	121	1	0.0001	0.0001	0.0001	0.0001	

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Baird's beaked whale	WNP	8,000	8	0.0003	0.0003	0.0003	0.0003	8
Common bottlenose dolphin	IA	105,138	23	0.0008	0.0008	0.0008	0.0008	12
Cuvier's beaked whale	WNP	90,725	10, 11	0.0031	0.0031	0.0031	0.0031	10, 11
Dall's porpoise	SOJ	76,720	10, 11	0.0520	0.0520	0.0520	0.0520	10, 11
False killer whale	IA	9,777	23	0.0027	0.0027	0.0027	0.0027	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0017	0.0017	0.0017	0.0017	10, 11
Pacific white-sided dolphin	IA	931,000	13	0.0030	0.0030			10, 11
Risso's dolphin	IA	83,289	9	0.0073	0.0073	0.0073	0.0073	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0036	0.0036	0.0036	0.0036	14
Short-beaked common dolphin	WNP	3,286,163	10, 11	0.0860	0.0860	0.0860	0.0860	10, 11
Short-finned pilot whale	WNP	53,608	9	0.0014	0.0014	0.0014	0.0014	9
Sperm whale	NP	102,112	15	0.0012	0.0012	0.0012	0.0012	16
Spinner dolphin	WNP	1,015,059	10, 11			0.0008	0.0008	14
Stejneger's beaked whale	WNP	8,000	8	0.0005	0.0005	0.0005	0.0005	10, 11
Striped dolphin	IA	570,038	9	0.0058	0.0058	0.0058	0.0058	12
Mission Area #6: East China Sea								
Bryde's whale	WNP	20,501	1	0.0006	0.0006	0.0006	0.0006	2

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Common minke whale	WNP "O" Stock	25,049	3	0.0044	0.0044	0.0044	0.0044	3
Common minke whale	WNP "J" Stock	893	22	0.0018	0.0018	0.0018	0.0018	3
Fin whale	ECS	500	4, 5	0.0002	0.0002	0.0002	0.0002	5
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Western North Pacific gray whale	WNP	121	1	0.0001	0.0001		0.0001	
Blainville's beaked whale	WNP	8,032	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Common bottlenose dolphin	IA	105,138	23	0.0008	0.0008	0.0008	0.0008	12
Cuvier's beaked whale	WNP	90,725	10, 11	0.0003	0.0003	0.0003	0.0003	10, 11
False killer whale	IA	9,777	23	0.0011	0.0011	0.0011	0.0011	16
Fraser's dolphin	WNP	220,789	10, 11	0.0042	0.0042	0.0042	0.0042	14
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0017	0.0017	0.0017	0.0017	10, 11
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0043	0.0043	0.0043	0.0043	16
Pacific white-sided dolphin	IA	931,000	13	0.0028	0.0028			10, 11
Pantropical	IA	219,032	9	0.0137	0.0137	0.0137	0.0137	9

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
spotted dolphin								
Pygmy killer whale	WNP	30,214	10, 11	0.0001	0.0001	0.0001	0.0001	16
Risso's dolphin	IA	83,289	9	0.0106	0.0106	0.0106	0.0106	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0036	0.0036	0.0036	0.0036	14
Short-beaked common dolphin	WNP	3,286,163	10, 11	0.0461	0.0461	0.0461	0.0461	10, 11
Short-finned pilot whale	WNP	53,608	9	0.0016	0.0016	0.0016	0.0016	16
Sperm whale	NP	102,112	5	0.0012	0.0012	0.0012	0.0012	6
Spinner dolphin	WNP	1,015,059	10, 11	0.0008	0.0008	0.0008	0.0008	14
Striped dolphin	IA	570,038	9	0.0058	0.0058	0.0058	0.0058	12
Mission Area #7: South China Sea								
Bryde's whale	WNP	20,501	1	0.0006	0.0006	0.0006	0.0006	2
Common minke whale	WNP "O" Stock	25,049	3	0.0033	0.0033	0.0033	0.0033	3
Fin whale	WNP	9,250	4, 5	0.0002	0.0002	0.0002	0.0002	5
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Western North Pacific gray whale	WNP	121	1	0.0001	0.0001		0.0001	
Blainville's beaked whale	WNP	8,032	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Common bottlenose dolphin	IA	105,138	23	0.0008	0.0008	0.0008	0.0008	12

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Cuvier's beaked whale	WNP	90,725	10, 11	0.0003	0.0003	0.0003	0.0003	10, 11
False killer whale	IA	9,777	23	0.0011	0.0011	0.0011	0.0011	16
Fraser's dolphin	WNP	220,789	10, 11	0.0042	0.0042	0.0042	0.0042	14
Ginkgo-toothed beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Kogia spp.	WNP	350,553	10, 11	0.0017	0.0017	0.0017	0.0017	10, 11
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0043	0.0043	0.0043	0.0043	16
Pantropical spotted dolphin	IA	219,032	9	0.0137	0.0137	0.0137	0.0137	9
Pygmy killer whale	WNP	30,214	10, 11	0.0001	0.0001	0.0001	0.0001	16
Risso's dolphin	IA	83,289	9	0.0106	0.0106	0.0106	0.0106	9
Rough-toothed dolphin	WNP	145,729	10, 11	0.0036	0.0036	0.0036	0.0036	14
Short-finned pilot whale	WNP	53,608	9	0.0016	0.0016	0.0016	0.0016	16
Sperm whale	NP	102,112	5	0.0012	0.0012		0.0012	6
Spinner dolphin	WNP	1,015,059	10, 11	0.0008	0.0008	0.0008	0.0008	14
Striped dolphin	IA	570,038	9	0.0058	0.0058	0.0058	0.0058	12
Mission Area #8: Offshore Japan/Pacific (25º to 40ºN)								
Bryde's whale	WNP	20,501	1	0.0004	0.0004	0.0004	0.0004	16

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Common minke whale	WNP "O" Stock	25,049	3	0.0003	0.0003	0.0003	0.0003	3
Fin whale	WNP	9,250	4, 5			0.0001	0.0001	5
Sei whale	NP	8,600	5	0.0003	0.0003	0.0003	0.0004	16
Baird's beaked whale	WNP	8,000	8	0.0001	0.0001	0.0001	0.0001	8
Blainville's beaked whale	WNP	8,032	10, 11	0.0007	0.0007	0.0007	0.0007	12
Common bottlenose dolphin	WNP	168,791	9	0.0008	0.0008	0.0008	0.0008	12
Cuvier's beaked whale	WNP	90,725	10, 11	0.0037	0.0037	0.0037	0.0037	12
Dwarf sperm whale	WNP	350,553	10, 11	0.0043	0.0043	0.0043	0.0043	12
False killer whale	WNP	16,668	9	0.0036	0.0036	0.0036	0.0036	9
Hubbs' beaked whale	NP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0027	0.0027	0.0027	0.0027	12
Mesoplodon spp.	WNP	22,799	10, 11	0.0005	0.0005	0.0005	0.0005	10, 11
Pacific white-sided dolphin	WNP	931,000	13	0.0048	0.0048	0.0048	0.0048	10, 11
Pantropical spotted dolphin	WNP	438,064	9	0.0113	0.0113	0.0113	0.0113	12
Pygmy killer whale	WNP	30,214	10, 11	0.0001	0.0001	0.0001	0.0001	12

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Pygmy sperm whale	WNP	350,553	10, 11	0.0018	0.0018	0.0018	0.0018	12
Risso's dolphin	WNP	83,289	9	0.0005	0.0005	0.0005	0.0005	12
Rough-toothed dolphin	WNP	145,729	10, 11	0.0019	0.0019	0.0019	0.0019	12
Short-beaked common dolphin	WNP	3,286,163	10, 11	0.0863	0.0863	0.0863	0.0863	10, 11
Short-finned pilot whale	WNP	53,608	9	0.0021	0.0021	0.0021	0.0021	12
Sperm whale	NP	102,112	15	0.0022	0.0022	0.0022	0.0022	12
Spinner dolphin	WNP	1,015,059	10, 11	0.0019	0.0019	0.0019	0.0019	12
Striped dolphin	WNP	570,038	9	0.0058	0.0058	0.0058	0.0058	12
Hawaiian monk seal	Hawaiian	1,212	17	0.0001	0.0001	0.0001	0.0001	
Mission Area #9: Offshore Japan/Pacific (10° to 25°N)								
Blue whale	CNP	9,250	5, 17, 18	0.0001	0.0001		0.0001	5, 10, 11, 19
Bryde's whale	WNP	20,501	1	0.0003	0.0003	0.0003	0.0003	12
Fin whale	WNP	9,250	4, 5	0.0001	0.0001			
Sei whale	NP	8,600	5	0.0001	0.0001			12
Blainville's beaked whale	WNP	8,032	10, 11	0.0007	0.0007	0.0007	0.0007	12
Common bottlenose dolphin	WNP	168,791	9	0.0008	0.0008	0.0008	0.0008	12
Cuvier's beaked whale	WNP	90,725	10, 11	0.0037	0.0037	0.0037	0.0037	12
Dwarf sperm whale	WNP	350,553	10, 11	0.0043	0.0043	0.0043	0.0043	12
False killer whale	WNP	16,668	9	0.0006	0.0006	0.0006	0.0006	12

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Fraser's dolphin	WNP	220,789	10, 11	0.0025	0.0025	0.0025	0.0025	12
Killer whale	WNP	12,256	10, 11	0.0001	0.0001	0.0001	0.0001	12
Longman's beaked whale	WNP	1,007	14	0.0003	0.0003	0.0003	0.0003	12
Melon-headed whale	WNP	36,770	10, 11	0.0027	0.0027	0.0027	0.0027	12
Pantropical spotted dolphin	WNP	438,064	9	0.0113	0.0113	0.0113	0.0113	12
Pygmy killer whale	WNP	30,214	10, 11	0.0001	0.0001	0.0001	0.0001	12
Pygmy sperm whale	WNP	350,553	10, 11	0.0018	0.0018	0.0018	0.0018	12
Risso's dolphin	WNP	83,289	9	0.0005	0.0005	0.0005	0.0005	12
Rough-toothed dolphin	WNP	145,729	10, 11	0.0019	0.0019	0.0019	0.0019	12
Short-finned pilot whale	WNP	53,608	9	0.0021	0.0021	0.0021	0.0021	12
Sperm whale	NP	102,112	15	0.0022	0.0022	0.0022	0.0022	12
Spinner dolphin	WNP	1,015,059	10, 11	0.0019	0.0019	0.0019	0.0019	12
Striped dolphin	WNP	570,038	9	0.0058	0.0058	0.0058	0.0058	12
Mission Area #10: Hawaii North								
Blue whale	CNP	9,250	5, 17, 18	0.0002	0.0002		0.0002	10, 11
Bryde's whale	Hawaiian	469	14	0.0002	0.0002	0.0002	0.0002	14
Common minke whale	Hawaiian	25,049	3	0.0002	0.0002		0.0002	10, 11
Fin whale	Hawaiian	174	24	0.0001	0.0001		0.0001	24
Humpback whale	CNP	10,103	20	0.0009	0.0009		0.0009	19

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Sei whale	Hawaiian	77	17	0.0001	0.0001		0.0001	
Blainville's beaked whale	Hawaiian	2,872	14	0.0012	0.0012	0.0012	0.0012	14
Common bottlenose dolphin	Hawaii Pelagic	3,178	17, 25	0.0013	0.0013	0.0013	0.0013	14
Common bottlenose dolphin	Kauai/Niihau	147	17, 25	0.0013	0.0013	0.0013	0.0013	14
Cuvier's beaked whale	Hawaiian	15,242	14, 17	0.0062	0.0062	0.0062	0.0062	14
False killer whale	Hawaii Pelagic	1,503	17, 26	0.0006	0.0006	0.0006	0.0006	26
False killer whale	Main Hawaiian Island Insular	151	17	0.0012	0.0012	0.0012	0.0012	27
False killer whale	Northwestern Hawaiian Islands	552	17, 26	0.0013	0.0013	0.0013	0.0013	26
Fraser's dolphin	Hawaiian	10,226	14	0.0042	0.0042	0.0042	0.0042	14
Killer whale	Hawaiian	349	14	0.0001	0.0001	0.0001	0.0001	14
Kogia spp.	Hawaiian	24,657	14	0.0101	0.0101	0.0101	0.0101	14
Longman's beaked whale	Hawaiian	1,007	14	0.0004	0.0004	0.0004	0.0004	14
Melon-headed whale	Hawaiian	2,950	14	0.0012	0.0012	0.0012	0.0012	14
Pantropical spotted dolphin	Hawaiian	8,978	14	0.0037	0.0037	0.0037	0.0037	14
Pygmy killer whale	Hawaiian	956	14	0.0004	0.0004	0.0004	0.0004	14
Risso's dolphin	Hawaiian	2,372	14	0.0010	0.0010	0.0010	0.0010	14

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Rough-toothed dolphin	Hawaiian	8,709	14	0.0036	0.0036	0.0036	0.0036	14
Short-finned pilot whale	Hawaiian	8,870	14	0.0036	0.0036	0.0036	0.0036	14
Sperm whale	Hawaiian	6,919	14	0.0028	0.0028	0.0028	0.0028	14
Spinner dolphin	Hawaii Pelagic	3,351	14	0.0014	0.0014	0.0014	0.0014	14
Spinner dolphin	Kauai/Niihau	601	17	0.0014	0.0014	0.0014	0.0014	14
Striped dolphin	WNP	13,143	14	0.0054	0.0054	0.0054	0.0054	14
Hawaiian monk seal	Hawaiian	1,212	17	0.0001	0.0001	0.0001	0.0001	
Mission Area #11: Hawaii South								
Blue whale	CNP	9,250	5, 17, 18	0.0002	0.0002		0.0002	10, 11
Bryde's whale	Hawaiian	469	14	0.0002	0.0002	0.0002	0.0002	14
Common minke whale	Hawaiian	25,049	3	0.0002	0.0002		0.0002	10, 11
Fin whale	Hawaiian	174	24	0.0001	0.0001		0.0001	24
Humpback whale	CNP	10,103	20	0.0009	0.0009		0.0009	19
Sei whale	Hawaiian	77	17	0.0001	0.0001		0.0001	
Blainville's beaked whale	Hawaiian	2,872	14	0.0012	0.0012	0.0012	0.0012	14
Common bottlenose dolphin	Hawaii Pelagic	3,178	17, 25	0.0013	0.0013	0.0013	0.0013	14
Common bottlenose dolphin	Oahu	594	17, 25	0.0013	0.0013	0.0013	0.0013	14

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
Common bottlenose dolphin	4-Islands Region	153	17, 25	0.0013	0.0013	0.0013	0.0013	14
Common bottlenose dolphin	Hawaii Island	102	17, 25	0.0013	0.0013	0.0013	0.0013	14
Cuvier's beaked whale	Hawaiian	15,242	14, 17	0.0062	0.0062	0.0062	0.0062	14
False killer whale	Hawaii Pelagic	1,503	17, 26	0.0006	0.0006	0.0006	0.0006	26
False killer whale	Main Hawaiian Island Insular	151	17	0.0012	0.0012	0.0012	0.0012	27
Fraser's dolphin	Hawaiian	10,226	14	0.0042	0.0042	0.0042	0.0042	14
Killer whale	Hawaiian	349	14	0.0001	0.0001	0.0001	0.0001	14
Kogia spp.	Hawaiian	24,657	14	0.0101	0.0101	0.0101	0.0101	14
Longman's beaked whale	Hawaiian	1,007	14	0.0004	0.0004	0.0004	0.0004	14
Melon-headed whale	Hawaiian	2,950	14	0.0012	0.0012	0.0012	0.0012	14
Pantropical spotted dolphin	Hawaiian	8,978	14	0.0037	0.0037	0.0037	0.0037	14
Pygmy killer whale	Hawaiian	956	14	0.0004	0.0004	0.0004	0.0004	14
Risso's dolphin	Hawaiian	2,372	14	0.0010	0.0010	0.0010	0.0010	14
Rough-toothed dolphin	Hawaiian	8,709	14	0.0036	0.0036	0.0036	0.0036	14
Short-finned pilot whale	Hawaiian	8,870	14	0.0036	0.0036	0.0036	0.0036	14
Sperm whale	Hawaiian	6,919	14	0.0028	0.0028	0.0028	0.0028	14
Spinner dolphin	Hawaii	3,351	14	0.0014	0.0014	0.0014	0.0014	14

Table 6. Marine mammal species, abundances, and densities of the stocks affected per SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[4]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[5]				Density reference(s)
				Winter	Spring	Summer	Fall	
	Pelagic							
Spinner dolphin	Oahu/4-Islands	355	17	0.0014	0.0014	0.0014	0.0014	14
Spinner dolphin	Hawaii Island	790	17	0.0014	0.0014	0.0014	0.0014	14
Striped dolphin	WNP	13,143	14	0.0054	0.0054	0.0054	0.0054	14
Hawaiian monk seal	Hawaiian	1,212	17	0.0001	0.0001	0.0001	0.0001	

Table 6 Literature Cited

1. IWC, 2009
2. Ohsumi, 1977
3. Buckland et al., 1992
4. Mizroch et al., 2009
5. Tillman, 1977
6. Best et al., 2001
7. Masaki, 1977
8. Kasuya, 1986
9. Miyashita, 1993
10. Ferguson and Barlow, 2001
11. Ferguson and Barlow, 2003
12. LGL, 2011
13. Buckland et al., 1993
14. Barlow, 2006
15. Kato and Miyashita, 1998
16. Fulling et al., 2011
17. Carretta et al., 2013
18. Stafford et al., 2001
19. LGL, 2008
20. Calambokidis et al., 2008
21. Acebes et al., 2007
22. Pastene and Goto, 1998
23. Miyashita, 1986
24. Barlow, 2003
25. Baird et al., 2009
26. Bradford et al., 2012
27. Oleson et al., 2010

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.*

There are no changes to Chapter 4 as described under NMFS 2012 Final Rule for SURTASS LFA sonar operations (NOAA, 2012), the Navy's 2011 Request for Rulemaking and Letter's of Authorization (DoN, 2011), and NMFS 2012 Letters of Authorization for SURTASS LFA sonar operations (NOAA, 2012a).

5 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

Requirement 5: 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.

Pursuant to MMPA Section 101(a)(5)(D) and the MMPA Final Rule (NOAA, 2012) for SURTASS LFA sonar operations, the Navy is requesting renewal of LOAs for the USNS IMPECCABLE (T-AGOS 23), USNS EFFECTIVE (T-AGOS 21), USNS ABLE (T-AGOS 20), and USNS VICTORIOUS (T-AGOS 19) for the taking of marine mammals (Levels A and B) incidental to operations of SURTASS LFA sonar for the 12-month period commencing 15 August 2013. The employment of SURTASS LFA sonar on four vessels has the potential for incidental harassment of marine mammals.

The basis of this LOAs request are (1) the analysis of spatial and temporal distributions of protected marine mammals in potential mission areas for SURTASS LFA sonar, (2) a review of activities that have the potential to affect marine mammals, and (3) a technical risk assessment to determine the likelihood of harassment from employment of SURTASS LFA sonar during Navy training, testing, and routine military operations in eleven mission areas of the western and central North Pacific Ocean. This renewal request document has been prepared in accordance with applicable regulations and the MMPA, as amended by the National Defense Authorization Act (NDAA)[6] for Fiscal Year 2004.

6 The NDAA modified the MMPA by removing the ‘‘small numbers’’ and ‘‘specified geographical region’’ limitations and amended the definition of ‘‘harassment’’ as it applies to a ‘‘military readiness activity.”

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.*

For SURTASS LFA sonar operation, potential impacts to marine mammals should be assessed in the context of the basic operational characteristics of the system:

- A maximum of four operating sonar systems aboard four SURTASS LFA vessels will be deployed in the Pacific Ocean.
- USNS IMPECCABLE (T-AGOS 23), USNS EFFECTIVE (T-AGOS 21), USNS ABLE (T-AGOS 20), and USNS VICTORIOUS (T-AGOS 19) are U.S. Coast Guard-certified for operations. In addition, these vessels will operate in accordance with all applicable Federal and U.S. Navy regulations and procedures related to environmental compliance. SURTASS LFA sonar vessel movements are not unusual or extraordinary and are part of routine operations of seagoing vessels. Therefore, there should be no unregulated environmental impacts from the operation of the SURTASS LFA sonar vessels.
- At-sea SURTASS LFA sonar missions would be temporary in nature. Of an estimated maximum 294 underway days per year per vessel, the SURTASS LFA sonar would be operated in the active mode a maximum of 240 days. During these 240 days, active transmissions would occur for a maximum of 432 cumulative hours per year per vessel. While the 432 hr are the maximum numbers of hours used in analysis of impact potential and requested for authorization, the actual number of total hours SURTASS LFA sonar has been transmitted historically for all T-AGOS vessels is far lower than this number. For instance, over the nine-year operation period from 2002 through 2011, LFA sonar was transmitted for 908 hr for all operational vessels or an average of 101 hr total per year.
- Average duty cycle (ratio of sound “on” time to total time) of the SURTASS LFA sonar active transmission mode is less than 20%. The typical duty cycle, based on historical LFA operational parameters since 2003, is nominally 7.5 to 10%. That is, only 7.5 to 20% of the time, the LFA acoustic sources could be transmitting while 80 to 92.5% of the time, the LFA sources would be off/not transmitting, thus, adding no sound into the marine environment. On an annual basis, each SURTASS LFA vessel is limited to transmitting no more than 4.9% of the time (or 432 hr out of 8,760 hrs).

6.1 POTENTIAL IMPACTS ON MARINE MAMMALS

The types of potential impacts on marine mammals from SURTASS LFA sonar operations can be broken down into several categories:

- **Non-auditory injury**: This includes the potential for resonance of the lungs/organs, tissue damage, and mortality. For the purposes of the SURTASS LFA sonar analyses presented here, all marine mammals exposed to underwater sound ≥180 dB SPL RL are evaluated as if they are injured (Level A “harassment” under the MMPA). Even though actual injury would not occur unless animals were exposed to sound at a level greater than this value (Southall et al., 2007), the analysis in the document will continue to define LFA’s injury level as ≥180 dB SPL RL. This should be viewed as a conservative value, used to maintain consistency in the analytical methodologies utilized in SURTASS LFA environmental impact statements (DoN, 2001, 2007, 2012), in incidental take applications under the MMPA, and in consultations under the ESA.

A. **Permanent threshold shift (PTS)**: A severe situation occurs when sound intensity is very high or of such long duration that the result is a permanent hearing loss on the part of the listener, which is referred to as permanent threshold shift (PTS). This constitutes Level A "harassment" under the MMPA. The intensity and duration of an underwater sound that will cause PTS varies across marine mammal species and even among individual animals. PTS is a consequence of the death of the sensory hair cells of the auditory epithelia of the ear with a resultant loss of hearing ability in the general vicinity of the frequencies of stimulation (Salvi et al., 1986; Myrberg, 1990; Richardson et al., 1995). PTS results in a permanent elevation in hearing threshold—an unrecoverable reduction in hearing sensitivity (Southall et al., 2007).

B. **Temporary threshold shift (TTS)**: Underwater sounds of sufficient loudness can cause a transient condition known as temporary threshold shift (TTS), in which an animal's hearing is impaired for a period of time. After termination of the sound, normal hearing ability returns over a period that may range anywhere from minutes to days, depending on many factors, including the intensity and duration of exposure to the intense sound. Hair cells may be temporarily affected by exposure to the sound, but they are not permanently damaged or killed. Thus, TTS is not considered an injury (Richardson et al., 1995; Southall et al., 2007), although during a period of TTS, animals may be at some disadvantage in terms of detecting predators or prey.

- **Behavioral change**: Various vertebrate species are affected by the presence of intense sounds in their environment (Salvi et al., 1986; Richardson et al., 1995). Behavioral responses to these sounds vary from subtle changes in surfacing and breathing patterns to cessation of vocalization or even active avoidance or escape from regions of high sound levels (Wartzok, et al., 2004). For military readiness activities, such as the use of SURTASS LFA sonar, Level B "harassment" under the MMPA is defined as any act that disturbs or is likely to disturb a marine mammal by causing disruption of natural behavioral patterns to a point where the patterns are abandoned or significantly altered. Behaviors include migration, surfacing, nursing, breeding, feeding, and sheltering. In a discussion on biologically significant behaviors and possible effects, the National Research Council noted that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce; these are the effects on individuals that can have population-level consequences and affect the viability of the species (NRC, 2005).

C. **Masking**: The presence of intense sounds in the environment can potentially interfere with an animal's ability to hear relevant sounds. This effect, known as "auditory masking", could interfere with the animal's ability to detect biologically-relevant sounds, such as those produced by predators or prey. During auditory masking, an animal may, thus, not be able to locate food or escape predacious attack.

6.1.1 NON-AUDITORY INJURY

Nowacek et al. (2007) and Southall et al. (2007) reviewed potential areas for non-auditory injury to marine mammals from active sonar transmissions. These include direct acoustic impact on tissue, indirect acoustic impact on tissue surrounding a structure, and acoustically mediated bubble growth within tissues from supersaturated dissolved nitrogen gas.

6.1.1.1 Direct Acoustic Impacts

Physical effects, such as direct acoustic trauma or acoustically enhanced bubble growth, require relatively intense received energy that would only occur at short distances from high-powered sonar sources (Nowacek et al., 2007; Zimmer and Tyack, 2007). The best available scientific information shows that, while resonance can occur in marine animals, this resonance does not necessarily cause injury, and any such injury is not expected to occur below a RL of 180 dB. Damage to the lungs and large sinus cavities of cetaceans from air space resonance is not regarded as a likely significant non-auditory injury because resonance frequencies of marine mammal lungs are below that of the LFA signal (Finneran, 2003).

Further, biological tissues are heavily damped and tissue displacement at resonance is predicted to be exceedingly small. In addition, lung tissue damage is generally uncommon in acoustic-related strandings (Southall et al., 2007).

6.1.1.2 Gas Bubble Formation

Presently, there are discussions among researchers regarding the potential for marine mammals to suffer from a form of decompression sickness caused by in vivo nitrogen gas-bubble growth. Jepson et al. (2003, 2005) and Fernandez et al. (2005) reported results of necropsies of stranded beaked whales, some of which coincided with naval sonar exercises, which they interpreted as consistent with a decompression-like syndrome (Nowacek et al., 2007).

Scientists have documented bone lesions (osteonecrosis), which may be a chronic result of nitrogen bubbles, in the rib and chevron bone articulations, nasal bones, and deltoid crests of sperm whale specimens from the Atlantic and Pacific Oceans dating from the late 1800s to 2003, (Moore and Early, 2004). This suggests that nonlethal pathologies related to gas bubbles may occur during the normal life span of, at least, the deep-diving sperm whale. Houser (2007) assessed the potential for nitrogen bubble formation in a trained dolphin. Based on repetitive dives to depths of 10, 30, 50, 70, and 100 m (32.8, 98.4, 164, 230, and 328 ft), ultrasound inspections were completed on the portal and innominate veins (i.e., the left and right brachiocephalic veins). Blood samples were also taken over a 20-minute (min) period at the end of each of the 50, 70, and 100 m (164, 230, and 328 ft) dives for the assessment of nitrogen partial pressure. There were no vascular bubbles found in any post-dive ultrasound. Nitrogen partial pressures from blood samples were not significantly elevated from those of the dolphin at rest (20 min post dive). Results suggest that repetitive, prolonged dives up to 100 m (328 ft) accumulate insufficient nitrogen to generate asymptomatic intravascular bubbles in bottlenose dolphins.

Zimmer and Tyack (2007) modeled nitrogen tension and bubble growth in beaked whales during normal diving behavior and for several hypothetical dive profiles to assess the risk of nitrogen bubble formation. These authors concluded that macroscopic bubbles are unlikely to pose a risk of decompression-like syndrome from a simple interruption of a normal deep foraging dive, even when accompanied by an unrealistic ascent rate. Zimmer and Tyack (2007) concluded, contrary to the findings of Jepson et al. (2003), that the interruption and rapid ascent from a regular deep foraging dive is unlikely to pose a risk of decompression-like syndromes; they suggested that gas bubble lesions in stranded beaked whales reported by Jepson et al. (2003, 2005) and Fernandez et al. (2005) might be caused by repetitive dives of short to medium surfacing duration without exceeding the depth of alveolar collapse. Also, Zimmer and Tyack (2007) found that the longer the dive time compared to surfacing time, the greater the risk; the authors suggested the hypothesis that beaked whales have an avoidance response to killer whales and great white sharks, which are their primary near-surface predators, resulting in their swimming at depths of approximately 25 m (82 ft) without exceeding alveolar collapse. This hypothesis requires more behavioral and physiological research.

Baird et al. (2008) investigated the variation in diving behavior from time-depth recorders on six Blainville's and two Cuvier's beaked whales. Both species demonstrated ascent rates from dives deeper than 800 m (2,625 ft) that were significantly slower than decent rates, both during the day and at night, suggesting some physiological purpose for the slower ascents. The whales also spent more time in dives to mid-water depths (100 to 600 m [328 to 1,969 ft]) during the day. At night, the whales spent more time in shallow (<100 m) dives. This diel variation[7] in behavior suggests that beaked whales may spend less time in surface waters during the day to avoid visually oriented predators, including sharks and killer whales.

Fahlman et al. (2009) modeled the effects of lung compression and collapse (pulmonary shunt) on the uptake and removal of oxygen, carbon dioxide, and nitrogen in blood and tissue, and on end-dive

7 Diel means "in the course of the day". Thus, a "diel variation" is a variation that occurs regularly every day or most days.

nitrogen concentrations for breath-holding marine mammals (e.g., elephant seals, Weddell seals, and beaked whales). Fahlman et al. suggested that repeated dives might result in tissue and blood levels of nitrogen sufficient to cause symptomatic bubble formation.

Based on the current knowledge of gas exchange and physiology of marine mammals, Hooker et al. (2009) developed a mathematical model to predict blood and tissue levels of nitrogen gas for three species of beaked whales: northern bottlenose, Cuvier's, and Blainville's beaked whales. Hooker et al. suggested that deep-diving marine mammals live with and manage high levels of nitrogen gas in their tissues and blood. Due to differences in dive behavior, predicted nitrogen levels were higher in Cuvier's beaked whales than in northern bottlenose whales and Blainville's beaked whales. Hooker et al. (2009) state that while the prevalence of Cuvier's beaked whale strandings after naval sonar exercises could be explained by a higher abundance of the species in the area, their results suggest that species differences in behavior and/or physiology may also play a role.

Moore et al. (2009) performed gross histologic and radiographic observations related to the presence of gas bubbles in the tissues and blood of seals and dolphins drowned in gillnets, set at a depth of approximately 80 m (263 ft). The majority (15 of 23) of the seals and dolphins had extensive bubble formation in multiple tissues and blood. In addition, computer tomography, which was performed on four randomly-selected marine mammals, identified gas bubbles in various tissues. Due to the good condition of the carcasses, absence of bacteria and autolytic (self-digestion) changes, the study concluded that peri- or post-mortem phase change of supersaturated blood and tissues was the most likely cause of the bubbles. Overall, Moore et al. (2009) found a high prevalence of vascular and interstitial bubbles in seals and dolphins drowned in gillnets set at a depth of approximately 80 m (263 ft). In contrast, a very low prevalence of bubble lesions was found for beach-stranded marine mammals in this study (one of 41) and in a study by Jepson et al. (2005) (10 of 2,376). The results of the Moore et al. (2009) analyses support the modeling of simulated dive profiles by Zimmer and Tyack (2007), which suggest an increase in risk of bubble formation caused by repetitive dives with short to medium surface durations, without exceeding the depth of alveolar collapse, which is estimated to be about 80 m (263 ft) for dolphins.

Despite the increase in research and literature, there remains scientific disagreement and/or lack of scientific data regarding the evidence for gas bubble formation as a causal mechanism between certain types of acoustic exposures and stranding events. These issues include: 1) received acoustic exposure conditions; 2) pathological interpretation; 3) acoustic exposure conditions required to directly induce physiological trauma; 4) behavioral reactions caused by sound exposure such as atypical dive patterns; and 5) the extent of postmortem artifacts (Southall et al., 2007).

The hypotheses for gas bubble formation related to beaked whale strandings is that beaked whales potentially have strong avoidance responses to MFA sonars because they sound similar to their main predator, the killer whale (Cox et al., 2006; Southall et al., 2007; Zimmer and Tyack, 2007; Baird et al., 2008; Hooker et al., 2009). Because SURTASS LFA sonar transmissions are lower in frequency (<500 Hz) and dissimilar in characteristics from those of marine mammal predators, the above scientific studies do not provide additional evidence that SURTASS LFA sonar has caused behavioral reactions, specifically avoidance responses, in beaked whales. Thus, SURTASS LFA sonar transmissions are not expected to cause gas bubble formation or beaked whale strandings.

6.1.2 INJURY CRITERIA

Southall et al. (2007) proposed injury criteria for individual LF/MF/HF marine mammal groups exposed to non-pulsed sound type, which included discrete acoustic exposures from SURTASS LFA sonar. The proposed injury criteria, which are based on onset of PTS, for LF/MF/HF cetaceans are an SEL of 215 dB RL and for pinnipeds in water an SEL of 203 dB RL. These values are then adjusted for the longer LFA signal (nominally 60 seconds), using 10 Log (T/Ti) where T is 60 sec and Ti is 1 sec. An 18-dB adjustment is made, resulting in an injury criterion for SURTASS LFA sonar of an SEL of 197 dB RL for cetaceans. For pinnipeds in water, this adjusted value would be an SEL of 185 dB RL.

6.1.3 AUDITORY EFFECTS OF SOUND ON MARINE MAMMALS

All studied marine mammals produce sound. They use sound to communicate with conspecifics, to navigate and sense their environment, to locate and capture prey, and to detect and avoid predators (Hofman, 2003; Southall et al., 2007). Marine mammals exposed to natural or man-made sound may experience physical and psychological effects, ranging in magnitude from none to severe (Southall et al., 2007). There are at least four areas of primary concern for marine mammals exposed to elevated noise levels, including: 1) PTS; 2) TTS; 3) behavioral disturbance (Nowacek et al., 2007); and 4) acoustic masking (Clark et al., 2009).

The hearing of marine mammals varies among species and individuals (Richardson et al., 1995). An auditory threshold, estimated by either behavioral or electrophysiological responses, are the levels of the quietest audible sound in a specified percent of trials (i.e., often 50% detection probability) (Southall et al, 2007). Generally, audiograms have been developed for smaller, captive odontocetes and pinnipeds. The absolute threshold is the level of sound that is barely audible when significant ambient noise is absent, which also varies based on the frequency content of the sound. Background noise may mask the sounds that a marine mammal could normally detect; masking can come from both natural and man-made noises (Richardson et al., 1995).

Southall et al. (2007) created five functional hearing groups of marine mammals by combining behavioral and electrophysiological audiograms with comparative anatomy, modeling, and response measured in ear tissues. These are:

- Low-frequency Cetaceans—this group consists of 13 species and subspecies of mysticetes with a collective functional hearing of 7 Hz to 22 kHz.
- Mid-frequency Cetaceans—includes 32 species and subspecies of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales with functional hearing of approximately 150 Hz to 160 kHz.
- High-frequency Cetaceans—incorporates eight species and subspecies of true porpoises, six species and subspecies of river dolphins, plus the franciscana, *Kogia*, and four species of Cephalorhynchids (genus in the dolphin family Delphinidae) with functional hearing estimated from 200 Hz to 180 kHz.
- Pinnipeds in Water—consists of 16 species and subspecies of sea lions and fur seals, 23 species and subspecies of true seals, and two species of walrus, with functional underwater hearing from 75 Hz to 75 kHz.
- Pinnipeds in Air—includes 16 species and subspecies of sea lions and fur seals, 23 species and subspecies of true seals, and two subspecies of walrus, with functional in air hearing from 75 Hz to 30 kHz (Southall et al., 2007).

Measured sensitivity and frequency ranges of marine mammals are shown by audiograms, which are obtained by either: 1) behavioral testing on captive, trained animals; or 2) by electrophysiological or auditory evoked potential (AEP) methods (Schlundt et al., 2007). Currently, there are no audiograms for low-frequency cetaceans available. However, predictions of their hearing have been made on the basis of cochlear anatomy (Ketten, 1997) and environmental acoustics (Clark and Ellison, 2004). Audiograms, both behavioral and AEP, for mid-frequency cetaceans include those for bottlenose dolphin, common dolphin, killer whale, beluga, false killer whale, Risso's dolphin, tucuxi, Pacific white-sided dolphin, striped dolphin, and Gervais' beaked whale. Audiograms, both behavioral and AEP, for high-frequency cetaceans include those for harbor porpoise, Amazon River dolphin, Chinese river dolphin, and finless porpoise. Audiograms, both behavioral and AEP, for pinnipeds in water, include those for California sea lion, northern fur seal, northern elephant seal, harp seal, harbor seal, gray seal, Hawaiian monk seal, harp seal, and ringed seal. Audiograms, both behavioral and AEP, for pinnipeds in air, include those for northern fur seal, California sea lion, northern elephant seal, harp seal, and harbor seal. The audiograms

and supporting technical data are provided in Richardson et al. (1995), Nedwell et al. (2004), Southall et al. (2007), Au and Hastings (2008), Houser et al. (2008), Kastelein et al. (2009), and Mulsow and Reichmuth (2010).

Despite the increased interest in characterizing the auditory system of beaked whales, direct data on their biosonar receiving systems are sparse. Cook et al. (2006) measured auditory evoked potentials (AEP) in a stranded juvenile Gervais' beaked whale between 5 and 80 kHz (lowest and highest frequencies tested, respectively). Cook et al. found that the beaked whale was most sensitive to high frequency signals between 40 and 80 kHz. At 5 kHz, there was a detectable evoked potential at an SPL of 132 dB RL, meaning that the behavioral threshold of the Gervais' beaked whale would be lower than 132 dB SPL (Cook et al., 2006). Finneran et al. (2009) used AEP measurements to determine the upper cutoff frequency of hearing in a stranded adult Gervais' beaked whale. It was determined to be 80 to 90 kHz, which is substantially lower than that seen in dolphins (~120 to 150 kHz), but similar to killer whales. The hearing sensitivities measured by Cook et al. (2006) at 5 kHz are similar to or less than those of bottlenose dolphins, and do not support the hypothesis that these species have particularly high sensitivity at the frequencies used by MFA sonar. There has been research into the procedures for audiograms, especially relating to the refinement of techniques for AEP methods and interpretation of results (Houser and Finneran, 2006; Finneran et al., 2007; Finneran, 2008, 2009; Mooney et al., 2009).

6.1.3.1 Permanent Loss of Hearing

PTS is defined as the deterioration of hearing due to prolonged or repeated exposure to sounds that accelerate the normal process of gradual hearing loss (Kryter, 1985) and the permanent hearing damage from brief exposure to extremely high sound levels (Richardson et al., 1995). PTS results in a permanent elevation in hearing threshold—an unrecoverable reduction in hearing sensitivity (Southall et al., 2007). Therefore, PTS is considered an injury.

In the 2002 Rule for SURTASS LFA sonar (NOAA, 2002), NMFS stated that TTS is not an injury. Since the boundary line between TTS and PTS is neither clear, definitive, nor predictable for marine mammals, NMFS adopted the standard that 20 dB of threshold shift defines the onset of PTS (i.e., a shift of 20 dB in hearing threshold) (NOAA, 2002). NMFS used this same standard in the second Final Rule (NOAA, 2007). Southall et al. (2007) proposed injury criteria for individual LF/MF/HF marine mammals exposed to non-pulsed sound types, which included discrete acoustic exposures from SURTASS LFA sonar. The proposed injury criteria for cetaceans and pinnipeds in water are SELs of 215 dB RL and 203 dB RL, respectively. An 18-dB adjustment must be made for the longer LFA signal (nominally 60 sec) resulting in injury criteria for SURTASS LFA sonar for LF/MF/HF cetaceans of a SEL of 197 dB RL and for pinnipeds in water an SEL of 185 dB RL. The SURTASS LFA sonar injury criterion for all marine mammals was an SPL of 180 dB RL (DoN, 2001, 2007, and 2012), which is noticeably lower and, therefore, more conservative, than the injury criteria proposed by Southall et al. (2007). Thus, the probability of SURTASS LFA sonar transmissions (with mitigation) causing PTS in marine mammals is considered negligible.

6.1.3.2 Temporary Loss of Hearing

In addition to the possibility of causing permanent injury to hearing, sound may cause TTS, a temporary and reversible loss of hearing that may last for minutes to days. The following physiological mechanisms may result in TTS:

1. reduced sensitivity of the sensory hair cells in the inner ear as a result of their being over-stimulated;
2. modification of the chemical environment within sensory cells;
3. displacement of certain inner ear membranes;
4. increased blood flow; and
5. post-stimulation reduction in both efferent (impulses traveling from the central nervous system to the peripheral sensory tissue) and sensory output (Kryter, 1994; Ward, 1997; Southall et al., 2007).

In the 2002 and 2007 SURTASS LFA Sonar Final Rules (NOAA, 2002 and 2007), NMFS stated that TTS is not an injury. The duration of TTS depends on a variety of factors including intensity and duration of the stimulus. Southall et al. (2007) considered that the temporary elevation of a hearing threshold by 6 dB was a sufficient definition for TTS onset. For cetaceans, most of the published TTS data are limited to bottlenose dolphins and belugas (Finneran et al., 2000, 2002, 2005, and 2007; Schlundt et al., 2000; Nachtigall et al., 2003 and 2004).

A study of TTS in harbor porpoises used a seismic airgun as a stimulus (Lucke et al., 2009). Airguns produce an impulsive signal and have a broad frequency range but also have substantial energy in the low frequency region. A small airgun was used in proximity to the animals (between 14 to 150 m), a context that is likely to enhance behavioral responsiveness. The harbor porpoises showed a behavioral response at a RL of 174 dB re 1 µPa (peak-to-peak), which is equivalent to an SEL of 145 dB re 1 μPa^2-sec (Lucke et al., 2009). Harbor porpoise hearing was tested at a frequency of 4 kHz and TTS was detected at a RL of 199.7 dB re 1 µPa (peak-to-peak), which is equivalent to an SEL of 164.3 dB re 1 μPa^2-sec (Lucke et al., 2009). These are the lowest received sound levels that produce TTS yet reported. These data are intriguing and clearly indicate a need for additional research. Unfortunately, only one individual was tested in this study. The applicability of these results to SURTASS LFA sonar is uncertain, given the large differences in source characteristics between airguns and LFA sonar. Furthermore, LFA sonar typically operates in water deeper and further offshore than most harbor porpoise habitats. Indeed, harbor porpoises are found in only one of the SURTASS LFA sonar OPAREAS analyzed, for which zero exposures at levels >180 dB SPL were found. Nevertheless, this study indicates that further study of TTS in porpoises is warranted. Ideally, additional harbor porpoise individuals as well as additional high-frequency hearing species would be tested. If this type of results are confirmed for harbor porpoise or found in other HF hearing species, then the analyses for those species would merit revision.

In a study on the effects of noise level and duration of TTS in a bottlenose dolphin, Mooney et al. (2009) exposed a bottlenose dolphin to octave-band noise (4 to 8 kHz) of varying durations (2 to 30 minutes) and SPL RLs (130 to 178 dB re 1 µPa). The results of the Mooney et al. study indicated that shorter-duration sound exposures often require greater sound energy to induce TTS than longer-duration exposures and also supported the trend that longer-duration exposures often induce greater amounts of TTS, which concurrently require longer recovery times.

In a controlled exposure experiment, Mooney et al. (2009a) demonstrated that MFA sonar could induce temporary hearing loss in a bottlenose dolphin (*Tursiops truncatus*). Temporary hearing loss was induced by repeated exposure to an SEL of 214 dB re 1 μPa^2-sec. Subtle behavioral alterations were also associated with the sonar exposures. At least with one odontocete species (common bottlenose dolphin), sonar can induce both TTS and mild behavioral effects; but exposures must be prolonged with high exposure levels to generate these effects. The RL used in the Mooney et al. (2009a) experiment was an SPL of 203 dB, which equates to the RL approximately 40 m (131 ft) from an MFA sonar operated at an SPL of 235 dB (SL). Mooney et al. (2009a) concluded that in order to receive an SEL of near 214 dB, an animal would have to remain in proximity of the moving sonar, which is transmitting for 0.5 sec every 24 sec over an approximately 2 to 2.5 min period, an unlikely situation.

SELs necessary for TTS onset for pinnipeds in water have been measured for harbor seals, California sea lions, and northern elephant seals. As reported by Southall et al. (2007), Kastak et al. (2005) presented comparative analysis of underwater TTS for pinnipeds. This indicated that in harbor seals, a TTS of ~6 dB occurred with a 25-min exposure to 2.5 kHz octave-band noise of 152 dB SPL (183 dB SEL); a California sea lion showed TTS-onset under the same conditions at 174 dB SPL (206 dB SEL); and a northern elephant seal under the same conditions experienced TTS-onset at 172 dB SPL (204 dB SEL). Finneran et al. (2003) exposed two California sea lions to single underwater pulses from an arc-gap transducer and found no measurable TTS following exposures of up to 183 dB SPL (215 dB SEL).

Animals suffering from TTS over longer periods of time, such as hours to days, may be considered to have a change in a biologically significant behavior, as they may be prevented from detecting sounds that are biologically relevant, including communication sounds, sounds of prey, or sounds of predators. As noted by Mooney et al. (2009), shorter duration sound exposures can require greater sound energy to induce TTS than longer duration exposures, and longer duration exposures can induce greater amounts of TTS. In assessing the potential for LFA sonar transmissions to cause TTS, the much shorter length of the LFA signal (1 min) versus the above studies (2 to 30 min) must be considered.

This recent scientific information supports the assumptions and findings of the FEIS and FSEIS (DoN, 2001 and 2007) that the likelihood that SURTASS LFA sonar, with a SPL of 180 dB RL, may cause TTS in marine mammals is negligible. Further, mitigation measures, such as mitigation zones and shutdown protocols, as outlined in the Final 2007 Rule (NOAA, 2007), are employed where there is the potential for a marine mammal to incur TTS and prevent any animal from incurring PTS.

6.1.3.3 Behavioral Change

The primary potential deleterious effect from SURTASS LFA sonar is change in a biologically significant behavior. The National Research Council (NRC, 2005) discussed biologically significant behaviors and possible effects and stated that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce. These are the effects on individuals that can have population-level consequences and affect the viability of the species (NRC, 2005). For military readiness activities, such as the use of SURTASS LFA sonar, Level B “harassment” under the MMPA is defined as any act that disturbs or is likely to disturb a marine mammal by causing disruption of natural behavioral patterns to a point where the patterns are abandoned or significantly altered. Behaviors include migration, surfacing, nursing, breeding, feeding, and sheltering.

The Low Frequency Sound Scientific Research Program (LFS SRP) in 1997 to 1998 provided important results on, and insights into, the types of responses of baleen whales to LFA sonar signals and how those responses scaled relative to RL and context. The results of the LFS SRP confirmed that some portion of the total number of whales exposed to LFA sonar responded behaviorally by changing their vocal activity, moving away from the source vessel, or both; but the responses were short-lived (Clark et al., 2001).

In the LFS SRP LFA sonar playback experiment (Phase II), migrating gray whales avoided exposure to LFA signals (source levels of 170 and 178 dB SPL) when the source was placed in the center of their migration corridor. Responses were similar for the 170-dB SL LFA stimuli and for the 170-dB SL 1/3rd-octave, band-limited noise with timing and frequency band similar to the LFA stimulus. However, during the LFA sonar playback experiments, in all cases, whales resumed their normal activities within tens of minutes after the initial exposure to the LFA signal (Clark et al., 2001). Essentially, the whales made minor course changes to go around the source. When the source was relocated within the outer portion of the migration corridor (twice the distance offshore), and the SL was increased to reproduce the same sound field for the central corridor playback condition, the gray whales showed little to no response to the LFA sonar source. This result stresses the importance of context in interpreting the animals’ behavioral responses to underwater sounds and demonstrates that RL is not necessarily a good predictor of behavioral impact.

The LFS SRP also conducted field tests to examine the effects of LFA sonar transmissions on foraging fin and blue whales off San Nicolas Island, California (Phase I). Overall, whale encounter rates and dive behavior appeared to be more strongly linked to changes in prey abundance associated with oceanographic parameters rather than LFA sound transmissions (Croll et al., 2001).

In the final phase of the LFS SRP (Phase III), the effect of LFA sonar on humpback whales during the winter mating season was investigated. Both Miller et al. (2000) and Fristrup et al. (2003) published results from tests conducted with male humpback singers off the Big Island, Hawaii during which they evaluated variation in song length as a function of exposure to LFA sounds. Fristrup et al. (2003) used a larger data set to describe song length variability and to explain song length variation in relation to LFA

broadcasts. In spite of methodological and sample size differences, the results of the two analyses were generally in agreement, and both studies indicated that humpback whales might lengthen their songs in response to LF broadcasts.

The Fristrup et al. (2003) results also provided a detailed picture of short-term response as compared to behavioral variation observed in the absence of the stimuli. These responses were relatively brief in duration, with all observed effects occurring within 2 hrs of the last LFA source transmission. It should be noted that these effects were not obvious to the acoustic observers on the scene, but were revealed by careful, complex post-test statistical analyses (Fristrup et al*.,* 2003). Aside from the delayed responses, other measures failed to indicate cumulative effects from LFA broadcasts, with song-length response being dependent solely on the most recent LFA transmission, and not the immediate transmission history. The modeled seasonal factors (changes in density of whales sighted near shore) and diurnal factors (changes in surface social activities) did not show trends that could be plausibly explained by cumulative exposure. Increases in song length from early morning to afternoon were the same on days with and without LFA transmissions, and the fraction of variation in song length that could be attributed to LFA broadcast was small (<10%). Fristrup et al. (2003) found high levels of natural variability in humpback song length and interpreted the whales' responses to LFA broadcasts to indicate that exposure to LFA sonar would not impose a risk of dramatic changes in humpback whale singing behavior that would have demographic consequences.

Southall et al. (2007) reviewed the relatively extensive behavioral observations of low frequency cetaceans exposed to non-pulse sources. While there are clearly major areas of uncertainty, Southall et al. concluded that the literature indicated that there were no (or very limited) responses to RLs of 90 dB to 120 dB SPL with an increasing probability of avoidance and other behavioral effects in the 120 to 160 dB SPL (RL) range.

6.1.3.4 Masking

The obscuring of sounds of interest by interfering sounds, generally at similar frequencies is referred to as masking (Fletcher, 1929; Richardson et al., 1995). In humans, masking has been measured as an increase in detection threshold of the sound of interest in the presence of a masking sound (compared to the detection threshold when there is no masker). Two types of masking have been described: energetic masking and informational masking (Pollack, 1975, Watson, 2005, Kidd et al., 2007). The definitions of energetic and informational masking and their physiological mechanisms, however, continue to be debated. Energetic masking is thought to result from an interfering sound(s) within the same critical band(s) as the signal of interest. It is usually ascribed to peripheral acoustic processing; i.e., the ear itself. A definition for informational masking has been even less forthcoming, and as a default position, informational masking has often been taken to mean masking that is greater than would be predicted by energetic masking alone (Kidd et al., 2007). Informational masking is associated with uncertainty of the signal of interest (Watson, 2005) and is generally assumed to occur as a result of central neural processing that includes analytic (e.g., auditory stream segregation and discrimination) and attentive components (e.g., distraction) (Kidd et al., 2007). As a general statement, the more similar the characteristics (i.e., frequency band, duration) of a masking sound are to the sound of interest, the greater its potential for masking.

Acoustic masking from low frequency ocean noise is increasingly being considered as a threat, especially to low frequency hearing specialists such as baleen whales (Clark et al., 2009). Most underwater low frequency anthropogenic noise is generated by commercial shipping, which has contributed to the increase in oceanic background noise over the past 150 years (Parks et al., 2007). Shipping noise is primarily in the 20 to 200 Hz frequency band and is increasing yearly (Ross, 2005). Andrew et al. (2002) demonstrated an increase in oceanic ambient noise of 10 dB SPL since 1963 in the 20 to 80 Hz frequency band as sampled on the continental slope off Point Sur, California, and they ascribed this increase to increased commercial shipping. McDonald et al. (2006a) compared data sets from 1964 to

1966 and 2003 to 2004 for continuous measurements west of San Nicolas Island, California, and found an increase in ambient noise levels of 10 to 12 dB SPL in the 30 to 50 Hz band. This increase in LF background noise is likely having a widespread impact on marine mammal low frequency hearing specialists by reducing their access to acoustic information essential for conspecific communication and other biologically important activities, such as navigation and prey/predator detection. Clark et al. (2009) considered this long-term, large-scale increase in low frequency background noise a chronic impact that results in a reduction in communication space, and the loss of acoustic habitat.

6.1.3.5 Marine Mammal Behavioral Responses to Masking Sounds

Parks et al. (2007) provided evidence of behavioral changes in the acoustic behaviors of the endangered North Atlantic right whale, and the South Atlantic right whale, and suggested that these were correlated to increased underwater noise levels. The study indicated that right whales might shift the frequency band of their calls to compensate for increased in-band background noise. The significance of their result is the indication of potential species-wide behavioral change in response to gradual, chronic increases in underwater ambient noise. Di Iorio and Clark (2010) showed that blue whale calling rates vary in association with seismic sparker survey activity, with whales calling more on days with survey than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

Changes in behavior are not limited to low frequency species. Holt et al. (2009) measured killer whale call source levels and background noise levels in the 1 to 40 kHz band. The whales increased their call source levels by 1 dB for every 1 dB increase in background noise level. A similar rate of increase in vocalization activity was reported for St. Lawrence River belugas in response to passing vessels (Scheifele et al., 2005).

6.1.3.6 SURTASS LFA Sonar Potential for Masking

Masking effects from SURTASS LFA sonar signals will be limited for a number of reasons. First, the bandwidth of any LFA sonar transmitted signal is limited (30 Hz), and the instantaneous bandwidth at any given time of the signal is small, on the order of $\leq$10 Hz. Therefore, within the frequency range in which masking is possible, the effect will be limited because animals that use this frequency range typically use signals with greater bandwidths. Thus, only a portion of frequency band for the animal's signal is likely to be masked by the LFA sonar transmissions. Furthermore, when LFA is in operation, the LFA source is active only 7.5 to 10% of the time (based on historical LFA operational parameters), which means that for 90 to 92.5% of the time there is no risk that an animal's signal will be masked by LFA sonar. Therefore, within the area in which energetic masking is possible, any effect of LFA sonar transmissions will be minimal because of the limited bandwidth and intermittent nature of the signal, and the fact that animals that use this frequency region typically produce signals with greater bandwidth that are repeated for many hours.

Hildebrand (2005) provided a comparison of anthropogenic underwater sound sources by their annual energy output. On an annual basis, four LFA sonar systems were estimated to have a total energy output of 6.8×10^{11} Joules/yr. Seismic airgun arrays and mid-frequency military sonars were two orders of magnitude greater, with an estimated annual output of 3.9 and 2.6×10^{13} Joules/year, respectively. Super tankers were greater at 3.7×10^{12} Joules/year. Hildebrand (2005) concluded that anthropogenic sources most likely to contribute to increased underwater noise in order of importance are: commercial shipping, offshore oil and gas exploration and drilling, and naval and other uses of sonar. The use of LFA sonar is not scheduled to increase beyond the originally analyzed four systems during the next five-year regulation under the MMPA. The percentage of the total anthropogenic acoustic energy budget added by each LFA source is estimated to be 0.21% per system (or less), when other man-made sources are considered (Hildebrand, 2005). When combined with the naturally occurring and other man-made sources of noise in the oceans, the intermittent LFA signals barely contribute a measurable portion of the total acoustic energy.

The recent research provide additional support to the conclusion that broadband LF shipping noise is likely to be more detrimental to marine mammals than low duty-cycle SURTASS LFA sonar (Andrew et al., 2002; McDonald et al., 2006a; Parks et al., 2007; Clark et al., 2009). Therefore, any masking in marine mammals due to narrowband, intermittent (low duty cycle) LFA sonar signal transmissions are expected to be minimal and unlikely.

6.1.4 ESTIMATION OF THE INFLUENCE OF LFA SIGNAL WAVEFORMS

The typical LFA signal is not a constant tone but rather is a transmission of various waveforms that vary in frequency and duration. A complete sequence of sound transmissions is referred to as a wavetrain (also known as a "ping"). LFA wavetrains last between 6 and 100 sec with an average length of 60 sec. Within each wavetrain the duration of each continuous frequency sound transmission is no longer than 10 sec. Questions have been raised concerning the characteristics of the transmitted LFA waveform type (i.e., whether the signal is a continuous wave (CW) that is a single frequency or a frequency modulated (FM) waveform—one that sweeps through a range of frequencies), could potentially affect marine mammals differently. To date, no specific scientific investigation has been made into this question, and there are no known papers that directly compare the results of various waveforms with potential impacts.

Even though there have been no definitive studies comparing the potential impacts of various waveforms, it may be possible to estimate their relative potential for impact in some cases. For example, since most physiological impacts (i.e., physical injury, PTS, and TTS) are understood to be directly related to the amount of acoustic energy received and that the severity of the injury increases with increased levels of exposure, it seems probable that auditory impacts for FM waveforms may occur at higher received levels than for CW waveforms because the FM waveforms distribute their energy over a larger frequency band. Thus, any particular frequency-dependent portion of their hearing (e.g., specific frequency bins/regimes or anatomical devices like ear hairs or bones that hear those frequency regimes) may have received less energy in their operational hearing range and therefore have less impact or damage. However, only future testing will confirm this estimation.

For non-physiological impacts such as behavioral or masking effects, the answer is more complex and less clear. In these cases, many factors like: 1) the frequency range of the signal; 2) how the signal's frequency range overlaps with an animal's hearing and transmitted signal ranges; 3) how directional the animal's hearing is at these frequencies; 4) the degree of similarity between the received signal and possible prey species' transmissions; 5) the physical orientation of the situation; and 6) many other factors, can and will affect the level of behavior or masking impacts. Therefore, there is no simple answer to this question for these cases, and depending on the situation, an FM transmission could cause either more or less impact to a marine mammal than a CW waveform.

The LF Sound Scientific Research Program (LFS SRP) in 1997 and 1998 utilized the commonly used LFA wavetrains with no discernible differences in behavior attributed to differences in waveforms. The LFA analyses are based on the LFA risk continuum, which was based on the results of the LFS SRP. Therefore, even though the LFA signals will vary within a wavetrain, any differences in potential effects have been accounted for in the risk assessments.

6.1.5 MARINE MAMMAL STRANDINGS NEAR SURTASS LFA SONAR MISSION AREAS

The use of SURTASS LFA sonar was not associated with any of the reported 27 mass stranding events that occurred globally between 2006 through 2012 (DoN, 2012). There is no evidence that LFA sonar transmissions resulted in any difference in the stranding rates of marine mammals in Japanese coastal waters adjacent to LFA sonar operating areas. As has been reported previously (DoN, 2001, 2007, 2012), the employment of SURTASS LFA sonar is not expected to result in any sonar-induced strandings of marine mammals. Given the large number of natural factors that can result in marine mammal mortality, the high occurrence of marine mammal strandings, and the many years of LFA sonar operations without any reported associated stranding events, the likelihood of SURTASS LFA sonar transmissions causing

marine mammals to strand is negligible. In summary, from the commencement of SURTASS LFA sonar in 2002 through the present, the sonar has not been associated with any mass or individual strandings of marine mammals.

6.1.6 CONCLUSIONS

The potential effects from SURTASS LFA sonar operations on any stock of marine mammals from injury (non-auditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Employment of SURTASS LFA sonar will have a negligible impact on marine mammals because:

- Potential effects on marine mammal species or stocks are expected to be limited to MMPA Level B harassment. The Navy does not expect those effects to impact rates of recruitment or survival on the associated marine mammal species and stocks. Thus, effects on recruitment or survival are expected to be negligible.
- Navy‘s impact analysis does not anticipate any mortality nor any injury of marine mammals to occur as a result of SURTASS LFA sonar operations, and the potential to cause strandings of marine mammals is negligible.
- Potential for non-injurious effects (TTS, masking, modification of biological important behavior) is minimal to negligible.
- Cumulative effects are not a reasonably foreseeable adverse impact, as auditory masking potentially resulting from the SURTASS LFA sonar contribution to cumulative effects on oceanic ambient noise levels would only occur over a very small spatial and temporal scale, due in large part to the small number of possible sonar systems operating (no more than four in the western or central North Pacific Ocean). The cumulative effects related to the potential for masking from the potential four SURTASS LFA sonar systems are not a reasonably foreseeable significant adverse impact on marine animals.

6.2 RISK ASSESSMENT OF POTENTIAL IMPACTS ON MARINE MAMMALS FROM SURTASS LFA SONAR OPERATIONS

The Navy conducted a risk assessment to analyze and assess potential impacts associated with employing up to four SURTASS LFA sonar systems for routine training, testing, and military operations in western and central North Pacific Ocean. To reduce adverse effects on the marine environment, specific areas of the marine environment will be excluded to prevent sounds of 180-dB SPL or greater within 22 km (12 nmi) range of land, in polar waters, and in OBIAs during biologically important seasons[8].

Under the MMPA, a risk assessment must provide decision-makers and regulators results that demonstrate the least practicable adverse impacts on marine mammals while including consideration of personnel safety, practicability of implementation, and impact on the effectiveness of military readiness activities. The risk analysis assessed the impacts associated with SURTASS LFA sonar operations in nine mission areas of the western North Pacific and two mission areas of the central North Pacific Ocean. The same analytical methodology and process as have been used in previous risk assessment analyses of SURTASS LFA sonar potential for impacts and documented in three environmental impact statements (EISs) (DoN, 2001, 2007, and 2012) and in the 2012 MMPA Final Rule for SURTASS LFA sonar operations (NOAA, 2012) were used in the analysis for this LOAs request.

8 Although not relevant to marine mammals, SURTASS LFA sonar will also not transmit greater than 145-dB SPL at known recreational and commercial dive sites.

6.2.1 MARINE MAMMAL IMPACT ANALYSIS

As previously discussed, the types of potential effects on marine mammals from SURTASS LFA sonar operations include: 1) non-auditory injury; 2) permanent loss of hearing; 3) temporary loss of hearing; 4) behavioral change; and 5) masking. The first two potential effects (i.e., non-auditory physical effects and permanent loss of hearing) are typically grouped together and constitute "injury effects" or Level A harassments as defined in the MMPA. Based on Southall et al. (2007) and adjusting for the longer LFA signal, the proposed injury criteria for SURTASS LFA sonar of a SEL of 197 dB RL for cetaceans. For pinnipeds in water, this adjusted value would be an SEL of 185 dB RL. Please note that due to the long duration of the LFA signal (i.e., nominally 60 sec), the SEL criteria from Southall et al. (2007) is always the dominant of the dual criteria identified there. Additionally, based on simple spherical spreading (i.e., a transmission loss [TL] based on 20×Log10 [range in meters]) and assuming that the LFA array is a point source, a cetacean would need to approach and remain within approximately 8 m (26 ft) of the LFA source array (while a pinniped would need to be within 32 m [105 ft] of the array) for the complete 60 sec of the transmission to exceed the Southall et al. (2007) injury thresholds. Based on the mitigation procedures used during LFA sonar operations, the chances of this occurring are negligible. Therefore, no Level A harassment under the MMPA is expected. Potential masking effects on marine mammals from SURTASS LFA sonar operations has been covered previously in this chapter.

The next two potential effects listed above (temporary loss of hearing and behavioral change) are also typically grouped together and constitute "non-injury or harassment effects" or Level B harassments as defined in the MMPA. The underlying scientific studies and reports that are documented earlier in this chapter show that the potential impacts to marine mammal hearing varies not only from species to species, but may also vary from animal to animal within a species. Thus, the utilization of a risk continuum to attempt to capture the variability of acoustic impacts to a species, as was first done for the Navy environmental compliance documents in the SURTASS LFA FOEIS/EIS (DoN, 2001), has become the standard approach for the Navy (further details regarding the risk continuum methodology may be found in Appendix C of the supplemental EIS [DoN, 2012]). The risk continuum function is a means of predicting the potential impacts associated with acoustic operations on marine mammal species near the operational area of sonar systems. The inputs to the risk continuum are typically the amount of acoustic exposure an animal is likely to receive during the proposed operation.

To estimate the risk to marine mammals in each of the 11 potential mission areas, a list of marine mammals likely to be encountered in each region was developed (Table 5) and abundance and density estimates derived for each species at each potential SURTASS LFA sonar mission area during all seasons (Table 6; Appendix A). These population data were derived from the most current, available published literature and documentation. To determine the likely acoustic exposure, the movement of animals in the area is modeled, along with the acoustic field generated by the sonar system. Acoustic impact modeling of 11 potential SURTASS LFA sonar-mission areas was conducted for this LOAs request, resulting in estimated percent harassment for each stock at each mission area as well as the cumulative potential impact on each stock in total.

The Acoustic Integration Model© (AIM) was used to simulate and integrate potential acoustic effects of SURTASS LFA sonar operations. The sound fields produced by the LFA source in the different mission areas were modeled based on the system's specifications (i.e., source level, frequency, and location of the sonar system). Details of the physical acoustic environment as well as details of marine species' presence and their movement come from numerous sources. AIM convolves the sound field data generated by an acoustic model with animal movement data generated from an animal movement engine. The result is an exposure history for each simulated animal (animat); i.e., as if each animal was fitted with an "acoustic dosimeter." These exposure data for individually modeled animats are then scaled and summed to predict the risk of impact for each animal species.

Potential effects to marine mammal stocks during the 12-month period commencing 15 August 2013 have been estimated based on 16 collective 7-day missions in the western North Pacific and four collective 7-day missions in the central North Pacific (Hawaii-North and Hawaii-South) mission areas. Analyses to determine the percentage of marine mammal stocks and number of each stock potentially affected (with mitigation) for exposures from 120 to 180 dB re 1 µPa (rms) and ≥180 dB re 1 µPa (rms) (with mitigation methods applied) have been conducted on the marine mammal species or species groups potentially occurring during all seasons in the western and central North Pacific mission areas for the number of potential SURTASS LFA sonar missions by proposed mission area (Tables 7 to 17). In the analysis results, the total percent affected has been rounded up to two decimal places and fractional numbers of animals potentially affected have been rounded up to the next whole number.

The results of the Navy's analysis demonstrate that no exposures of marine mammals at sound levels ≥180 dB re 1 µPa (rms) are expected as 0.00% of any stock or 0 animals in any mission area would be effected; and, as such, no marine mammals are expected to be harmed, injured, or killed from exposure to SURTASS LFA sonar transmissions during the requested LOAs period from 15 August 2013 through 14 August 2014. The highest estimated percentage of any stock of marine mammals potentially affected at exposures of 120 to 180 dB re 1 µPa (rms) during operation of SURTASS LFA sonar is 7.99% of the Western North Pacific stock of humpback whales, or 92 whales, during the proposed annual missions in western North Pacific mission areas (Appendix B). The second highest percentage of any stock potentially affected at SURTASS LFA sonar exposures of 120 to 180 dB re 1 µPa (rms) is 7.91% of the Western North Pacific stock of the Longman's beaked whale, or 87 Longman's beaked whales. Percentages of individual potentially affected stocks range from 0.00% to 6.89% at exposures of 120 to 180 dB re 1 µPa (rms) during operation of SURTASS LFA sonar. Of the 16 collective missions in the western North Pacific mission areas, the total percentages per stock affected at the 120 to 180 dB re 1 µPa (rms) ranged from 0.00% to 6.89%. For the four collective missions in the central North Pacific mission areas, the total percentages per stock affected at the 120 to 180 dB re 1 µPa (rms) ranged from 0.01% to 3.81%.

Per Condition 8J of the annual LOAs authorized for the operation of SURTASS LFA sonar, no more than 12% of any potentially occurring marine mammal stock can be taken by Level B harassment annually. According to the Navy's analysis, this condition of the LOAs is met as the highest percentage for any potentially occurring stock during the annual LOA reporting period, 15 August 2013 through 14 August 2014, is estimated as 7.99%. Upon completion of the SURTASS LFA sonar missions under the requested LOAs, per additional conditions of the LOAs and Final Rule, these impact estimates will be refined and submitted to NMFS under the reporting requirements pursuant to the MMPA Final Rule (NOAA, 2012) and the conditions of the LOAs, as issued (NOAA, 2012a).

Table 7. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during a summer mission (one total) in the East of Japan mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

MISSION AREA #1—EAST OF JAPAN—1 MISSION			
MARINE MAMMAL SPECIES	STOCK[9]	SUMMER	
		PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120 TO 180 D[11]
Bryde's whale	WNP	0.03	6
Common minke whale	WNP "O"	0.06	15
Fin whale	WNP	0.02	3
North Pacific right whale	WNP	—[12]	—
Sei whale	NP	0.07	6
Baird's beaked whale	WNP	0.26	21
Common bottlenose dolphin	WNP	0.08	139
Cuvier's beaked whale	WNP	0.02	23
False killer whale	WNP Pelagic	0.19	32
Ginkgo-toothed beaked whale	NP	0.02	4
Hubbs' beaked whale	NP	0.02	4
Killer whale	WNP	0.01	2
Kogia spp.	WNP	0.01	28
Pacific white-sided dolphin	WNP	0.01	65
Pantropical spotted dolphin	WNP	0.02	79
Pygmy killer whale	WNP	0.06	19
Risso's dolphin	WNP	0.11	95
Rough-toothed dolphin	WNP	0.03	51
Short-beaked common dolphin	WNP	0.02	696
Short-finned pilot whale	WNP	0.22	117
Sperm whale	NP	0.01	8
Spinner dolphin	WNP	0.01	3
Striped dolphin	WNP	0.01	34

9 Stock names: WNP=Western North Pacific; NP= North Pacific; CNP=Central North Pacific; ECS=East China Sea; SOJ=Sea of Japan; IA=Inshore Archipelago

10 The total percent (%) affected has been rounded up to two decimal places.

11 Fractional animals potentially affected have been rounded up to the next whole number.

12 "—" indicates that an animal is not expected to occur in the LFA mission area during that season.

Table 8. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter, spring, and summer missions (three total) in the North Philippine Sea mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

North Philippine Sea—Mission Area #2—3 Missions, One per Season									
		Winter		Spring		Summer		Total	
Marine Mammal Species	Stock[9]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]
Blue whale	CNP	0.00	1	0.00	1	—[12]	—	0.01	2
Bryde's whale	WNP	0.13	26	0.03	7	0.13	27	0.29	60
Common minke whale	WNP "O"	0.70	176	0.40	101	0.72	180	1.82	457
Fin whale	WNP	0.09	9	0.09	9	—	—	0.18	18
Humpback whale	WNP	3.44	39	3.44	39	—	—	6.89	78
North Pacific right whale	WNP	0.05	1	0.01	1	—	—	0.06	2
Blainville's beaked whale	WNP	0.19	16	0.06	5	0.21	17	0.46	38
Common bottlenose dolphin	WNP	0.34	566	0.05	93	0.34	582	0.73	1,241
Cuvier's beaked whale	WNP	0.18	164	0.05	49	0.20	182	0.43	395
False killer whale	WNP Pelagic	0.68	113	0.21	36	0.73	123	1.62	272
Fraser's dolphin	WNP	0.07	162	0.04	95	0.08	173	0.19	430
Ginkgo-toothed beaked whale	NP	0.07	16	0.02	5	0.07	17	0.16	38
Killer whale	WNP	0.03	4	0.01	2	0.03	4	0.07	10
Kogia spp.	WNP	0.03	123	0.03	93	0.04	131	0.10	347
Longman's beaked whale	WNP	0.75	8	0.25	3	0.83	9	1.83	20
Melon-headed whale	WNP	0.45	167	0.14	53	0.49	181	1.09	401
Pacific white-sided dolphin	WNP	0.05	478	0.02	165	—	—	0.07	643
Pantropical spotted dolphin	WNP	0.13	559	0.04	188	0.12	544	0.29	1,291
Pygmy killer whale	WNP	0.27	82	0.08	26	0.29	89	0.65	197
Risso's dolphin	WNP	0.50	416	0.33	278	0.54	451	1.37	1,145
Rough-toothed dolphin	WNP	0.16	230	0.11	162	0.17	253	0.44	645
Short-beaked common dolphin	WNP	0.07	2,189	0.02	553	0.07	2,423	0.16	5,165
Short-finned pilot whale	WNP	1.02	549	0.51	276	1.05	562	2.59	1,387
Sperm whale	NP	0.05	48	0.02	20	0.05	49	0.12	117
Spinner dolphin	WNP	0.00	34	0.00	12	0.00	33	0.01	79
Striped dolphin	WNP	0.24	1,341	0.08	452	0.23	1,305	0.54	3,098

Table 9. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter, summer, and fall missions (three total) in the West Philippine Sea mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

West Philippine Sea—Mission Area #3—3 Missions, One per Season									
		Winter		Summer		Fall		Total	
Marine Mammal Species	Stock[9]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]
Blue whale	CNP	0.00	1	—[12]	—	0.00	1	0.01	2
Bryde's whale	WNP	0.11	24	0.11	24	0.07	14	0.29	62
Common minke whale	WNP "O"	0.50	127	0.50	127	0.19	48	1.20	302
Fin whale	WNP	0.09	8	—	—	—	—	0.09	8
Humpback whale	WNP	0.55	7	—	—	0.55	7	1.10	14
Blainville's beaked whale	WNP	0.23	19	0.19	15	0.08	7	0.50	41
Common bottlenose dolphin	WNP	0.33	550	0.34	572	0.09	157	0.76	1,279
Cuvier's beaked whale	WNP	0.01	12	0.01	9	0.00	4	0.03	25
False killer whale	WNP Pelagic	0.70	118	0.68	113	0.26	44	1.64	275
Fraser's dolphin	WNP	0.07	158	0.08	168	0.03	66	0.18	392
Ginkgo-toothed beaked whale	NP	0.08	19	0.07	15	0.03	7	0.18	41
Killer whale	WNP	0.03	4	0.03	4	0.03	4	0.09	12
Kogia spp.	WNP	0.02	68	0.02	68	0.01	35	0.05	171
Longman's beaked whale	WNP	0.92	10	0.74	8	0.25	3	1.92	21
Melon-headed whale	WNP	0.47	174	0.45	167	0.17	65	1.10	406
Pantropical spotted dolphin	WNP	0.12	526	0.12	518	0.02	101	0.26	1,145
Pygmy killer whale	WNP	0.28	85	0.27	82	0.10	32	0.66	199
Risso's dolphin	WNP	0.51	428	0.50	420	0.23	191	1.24	1,039
Rough-toothed dolphin	WNP	0.17	246	0.16	233	0.08	113	0.41	592
Short-finned pilot whale	WNP	0.55	295	0.56	301	0.13	73	1.25	669
Sperm whale	NP	0.05	49	0.04	44	0.01	14	0.10	107
Spinner dolphin	WNP	0.00	32	0.00	32	0.00	7	0.01	71
Striped dolphin	WNP	0.11	630	0.11	620	0.02	121	0.24	1,371

Table 10. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter, spring, and summer missions (three total) in the Offshore Guam mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Offshore Guam—Mission Area #4—3 Missions, One per Season									
		Winter		Spring		Summer		Total	
Marine Mammal Species	Stock[9]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]	Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]
Blue whale	CNP	0.00	1	0.00	1	—[12]	—	0.01	2
Bryde's whale	WNP	0.06	13	0.06	13	0.02	5	0.14	31
Common minke whale	WNP "O"	0.04	10	0.04	10	—	—	0.08	20
Fin whale	WNP	0.00	1	0.00	1	—	—	0.01	2
Humpback whale	CNP	0.09	9	0.09	9	—	—	0.18	18
Sei whale	NP	0.10	9	0.10	9	—	—	0.21	18
Blainville's beaked whale	WNP	0.44	36	0.44	36	0.15	12	1.03	84
Common bottlenose dolphin	WNP	0.02	42	0.02	42	0.01	14	0.06	98
Cuvier's beaked whale	WNP	0.21	188	0.21	188	0.07	63	0.49	439
Dwarf sperm whale	WNP	0.06	223	0.06	223	0.06	223	0.19	669
False killer whale	WNP Pelagic	0.19	33	0.19	33	0.07	12	0.46	78
Fraser's dolphin	WNP	0.06	130	0.06	130	0.02	43	0.14	303
Ginkgo-toothed beaked whale	NP	0.12	29	0.12	29	0.04	10	0.29	68
Killer whale	WNP	0.03	5	0.03	5	0.01	2	0.08	12
Longman's beaked whale	WNP	1.23	13	1.23	13	0.41	5	2.88	31
Melon-headed whale	WNP	0.34	125	0.34	125	0.12	45	0.80	295
Pantropical spotted dolphin	WNP	0.17	731	0.17	731	0.04	195	0.38	1,657
Pygmy killer whale	WNP	0.01	5	0.01	5	0.00	2	0.03	12
Pygmy sperm whale	WNP	0.03	91	0.03	91	0.01	38	0.06	220
Risso's dolphin	WNP	0.04	31	0.04	31	0.01	12	0.09	74
Rough-toothed dolphin	WNP	0.07	102	0.07	102	0.03	41	0.17	245
Short-finned pilot whale	WNP	0.24	127	0.24	127	0.08	43	0.56	297
Sperm whale	NP	0.04	41	0.04	41	0.01	11	0.09	93
Spinner dolphin	WNP	0.00	27	0.00	27	0.00	8	0.01	62
Striped dolphin	WNP	0.03	199	0.03	199	0.01	54	0.08	452

Table 11. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter and fall missions (two total) in the Sea of Japan mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

SEA OF JAPAN—MISSION AREA #5—2 MISSIONS, ONE PER SEASON							
		WINTER		FALL		TOTAL	
MARINE MAMMAL SPECIES	STOCK[9]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]
Bryde's whale	WNP	0.02	5	0.01	3	0.03	8
Common minke whale	WNP "O"	0.07	17	0.03	8	0.10	25
Common minke whale	WNP "J"	0.74	7	0.33	3	1.07	10
Fin whale	WNP	0.36	34	0.23	22	0.60	56
North Pacific right whale	WNP	0.05	1	—[12]	—	0.05	1
Western North Pacific gray whale	WNP	0.06	1	0.00	1	0.07	2
Baird's beaked whale	WNP	0.11	9	0.11	9	0.22	18
Common bottlenose dolphin	IA	0.03	31	0.01	13	0.04	44
Cuvier's beaked whale	WNP	0.10	91	0.10	89	0.20	180
Dall's porpoise	SOJ	2.60	1,993	0.92	708	3.52	2,701
False killer whale	IA	0.93	92	0.82	81	1.75	173
Killer whale	WNP	0.03	4	0.03	4	0.06	8
Kogia spp.	WNP	0.02	60	0.00	11	0.02	71
Pacific white-sided dolphin	IA	0.01	119	—	—	0.01	119
Risso's dolphin	IA	0.29	244	0.21	177	0.50	421
Rough-toothed dolphin	WNP	0.08	116	0.03	41	0.11	157
Short-beaked common dolphin	WNP	0.10	3,417	0.05	1,738	0.16	5,155
Short-finned pilot whale	WNP	0.10	54	0.03	17	0.13	71
Sperm whale	NP	0.04	38	0.03	33	0.07	71
Spinner dolphin	WNP	—	—	0.01	9	0.01	9
Stejneger's beaked whale	WNP	0.18	15	0.18	15	0.36	30
Striped dolphin	IA	0.04	229	0.01	68	0.05	297

Table 12. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during a summer mission (one total) in the East China Sea mission area; 0.00% affected/0 animals affected >180 dB (with mitigation measures applied).

East China Sea—Mission Area #6—1 Mission			
Marine Mammal Species	Stock[9]	Summer	
		Percent Affected 120-180 dB[10]	Number Animals Affected 120-180 dB[11]
Bryde's whale	WNP	0.04	8
Common minke whale	WNP "O"	0.23	58
Common minke whale	WNP "J"	2.62	24
Fin whale	ECS	0.62	4
North Pacific right whale	WNP	—[12]	—
Western North Pacific gray whale	WNP	—	—
Blainville's beaked whale	WNP	0.07	6
Common bottlenose dolphin	IA	0.01	6
Cuvier's beaked whale	WNP	0.01	4
False killer whale	IA	0.17	17
Fraser's dolphin	WNP	0.03	58
Ginkgo-toothed beaked whale	NP	0.02	6
Killer whale	WNP	0.03	4
Kogia spp.	WNP	0.01	11
Longman's beaked whale	WNP	0.25	3
Melon-headed whale	WNP	0.17	65
Pacific white-sided dolphin	IA	—	—
Pantropical spotted dolphin	IA	0.07	160
Pygmy killer whale	WNP	0.01	3
Risso's dolphin	IA	0.18	153
Rough-toothed dolphin	WNP	0.03	46
Short-beaked common dolphin	WNP	0.02	664
Short-finned pilot whale	WNP	0.05	27
Sperm whale	NP	0.01	10
Spinner dolphin	WNP	0.01	10
Striped dolphin	IA	0.01	68

Table 13. Estimated percentage of marine mammals that may be affected at RLs of 120 to 180 dB SPE (with mitigation measures applied) by the operation of SURTASS LFA sonar during a spring mission (one total) in the South China Sea mission area; 0.00% affected/0 animals affected ≥180 dB.

SOUTH CHINA SEA—MISSION AREA #7—1 MISSION			
MARINE MAMMAL SPECIES	STOCK[9]	SPRING	
		PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]
Bryde's whale	WNP	0.04	9
Common minke whale	WNP "O"	0.17	43
Fin whale	WNP	0.04	4
North Pacific right whale	WNP	0.04	1
Western North Pacific gray whale	WNP	0.31	1
Blainville's beaked whale	WNP	0.08	7
Common bottlenose dolphin	IA	0.01	5
Cuvier's beaked whale	WNP	0.01	4
False killer whale	IA	0.19	19
Fraser's dolphin	WNP	0.03	60
Ginkgo-toothed beaked whale	NP	0.03	7
Killer whale	WNP	0.03	4
Kogia spp.	WNP	0.01	31
Longman's beaked whale	WNP	0.92	10
Melon-headed whale	WNP	0.19	71
Pantropical spotted dolphin	IA	0.06	142
Pygmy killer whale	WNP	0.01	3
Risso's dolphin	IA	0.21	173
Rough-toothed dolphin	WNP	0.04	61
Short-finned pilot whale	WNP	0.04	23
Sperm whale	NP	0.01	13
Spinner dolphin	WNP	0.01	9
Striped dolphin	IA	0.01	61

Table 14. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during a summer mission (one total) in the Offshore Japan/Pacific (25° to 40°N) mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

OFFSHORE JAPAN/PACIFIC (25° TO 40°N)—MISSION AREA #8—1 MISSION			
MARINE MAMMAL SPECIES	STOCK[9]	SUMMER	
		PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]
Bryde's whale	WNP	0.10	21
Common minke whale	WNP "O"	0.05	12
Fin whale	WNP	0.05	5
Sei whale	NP	0.17	15
Baird's beaked whale	WNP	0.03	3
Blainville's beaked whale	WNP	0.20	17
Common bottlenose dolphin	WNP	0.01	23
Cuvier's beaked whale	WNP	0.09	85
Dwarf sperm whale	WNP	0.08	269
False killer whale	WNP	0.70	117
Hubbs' beaked whale	NP	0.03	8
Killer whale	WNP	0.05	7
Longman's beaked whale	WNP	0.07	1
Melon-headed whale	WNP	0.24	87
Mesoplodon spp.	WNP	0.07	17
Pacific white-sided dolphin	WNP	0.01	105
Pantropical spotted dolphin	WNP	0.04	191
Pygmy killer whale	WNP	0.01	2
Pygmy sperm whale	WNP	0.03	111
Risso's dolphin	WNP	0.02	17
Rough-toothed dolphin	WNP	0.05	71
Short-beaked common dolphin	WNP	0.11	3,746
Short-finned pilot whale	WNP	0.06	33
Sperm whale	NP	0.04	41
Spinner dolphin	WNP	0.01	32
Striped dolphin	WNP	0.02	99
Hawaiian monk seal	Hawaiian	0.01	1

Table 15. Estimated percentage and number of marine mammals that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during a winter mission (one total) in the Offshore Japan (10° to 25°N) mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

OFFSHORE JAPAN/PACIFIC (10° TO 25°N)—MISSION AREA #9—1 MISSION			
MARINE MAMMAL SPECIES	STOCK[9]	WINTER	
		PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]
Blue whale	CNP	0.01	1
Bryde's whale	WNP	0.06	13
Fin whale	WNP	0.01	1
Sei whale	NP	0.06	6
Blainville's beaked whale	WNP	0.11	10
Common bottlenose dolphin	WNP	0.02	32
Cuvier's beaked whale	WNP	0.15	138
Dwarf sperm whale	WNP	0.05	175
False killer whale	WNP	0.14	24
Fraser's dolphin	WNP	0.05	104
Killer whale	WNP	0.03	4
Longman's beaked whale	WNP	0.04	1
Melon-headed whale	WNP	0.30	110
Pantropical spotted dolphin	WNP	0.11	474
Pygmy killer whale	WNP	0.01	3
Pygmy sperm whale	WNP	0.02	72
Risso's dolphin	WNP	0.02	19
Rough-toothed dolphin	WNP	0.05	76
Short-finned pilot whale	WNP	0.17	92
Sperm whale	NP	0.09	88
Spinner dolphin	WNP	0.01	79
Striped dolphin	WNP	0.04	245

Table 16. Estimated percentage and number of marine mammal species that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter and summer missions (two total) in the Hawaii-North mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

HAWAII NORTH—MISSION AREA #10—2 MISSIONS, ONE PER SEASON							
MARINE MAMMAL SPECIES	STOCK[9]	WINTER		SUMMER		TOTAL	
		PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]	PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]	PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]
Blue whale	CNP	0.14	14	—[12]	—	0.14	14
Bryde's whale	Hawaiian	2.62	13	1.19	6	3.81	19
Common minke whale	Hawaiian	0.05	13	—	—	0.05	13
Fin whale	Hawaiian	3.59	7	—	—	3.59	7
Humpback whale	CNP	0.09	10	—	—	0.09	10
Sei whale	Hawaiian	0.11	1	—	—	0.11	1
Blainville's beaked whale	Hawaiian	2.95	85	0.67	20	3.62	105
Common bottlenose dolphin	Hawaii Pelagic	0.11	4	3.03	97	3.14	101
	Kauai/Niihau	2.70	4	0.04	1	2.74	5
Cuvier's beaked whale	Hawaiian	2.95	451	0.67	103	3.62	554
False killer whale	Hawaii Pelagic	2.75	42	2.75	42	5.51	84
	Main Hawaiian Islands Insular	0.19	1	0.19	1	0.38	2
	Northwestern Hawaiian Islands	0.01	1	0.01	1	0.02	2
Fraser's dolphin	Hawaiian	2.58	264	0.76	78	3.34	342
Killer whale	Hawaiian	1.81	7	0.79	.3	2.60	10
Kogia spp.	Hawaiian	2.53	624	1.03	254	3.56	878
Longman's beaked whale	Hawaiian	2.88	30	0.65	7	3.53	37
Melon-headed whale	Hawaiian	2.81	83	0.86	26	3.67	109
Pantropical spotted dolphin	Hawaiian	2.71	244	0.23	22	2.94	266
Pygmy killer whale	Hawaiian	2.89	28	0.89	9	3.78	37
Risso's dolphin	Hawaiian	2.63	63	0.91	22	3.54	85

Table 16. Estimated percentage and number of marine mammal species that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during winter and summer missions (two total) in the Hawaii-North mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

HAWAII NORTH—MISSION AREA #10—2 MISSIONS, ONE PER SEASON							
		WINTER		SUMMER		TOTAL	
MARINE MAMMAL SPECIES	STOCK[9]	PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]	PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]	PERCENT AFFECTED 120-180 dB[10]	NUMBER ANIMALS AFFECTED 120-180 dB[11]
Rough-toothed dolphin	Hawaiian	2.62	229	0.94	82	3.56	311
Short-finned pilot whale	Hawaiian	2.76	245	0.37	33	3.13	278
Sperm whale	Hawaiian	2.47	171	0.53	37	3.00	208
Spinner dolphin	Hawaii Pelagic	2.30	78	0.20	7	2.50	85
	Kauai/Niihau	0.41	3	0.04	1	0.45	4
Striped dolphin	Hawaiian	2.71	357	0.23	31	2.95	388
Hawaiian monk seal	Hawaiian	0.59	7	0.14	2	0.73	9

Table 17. Estimated percentage and number of marine mammal species that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during spring and fall missions (two total) in the Hawaii-South mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

HAWAII SOUTH—MISSION AREA #11—2 MISSIONS, ONE PER SEASON							
MARINE MAMMAL SPECIES	STOCK[9]	SPRING		FALL		TOTAL	
		PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]
Blue whale	CNP	0.02	2	0.02	2	0.04	4
Bryde's whale	Hawaiian	0.55	3	0.55	3	1.11	6
Common minke whale	Hawaiian	0.01	2	0.01	2	0.02	4
Fin whale	Hawaiian	0.75	2	0.75	2	1.51	4
Humpback whale	CNP	0.00	1	0.00	1	0.01	2
Sei whale	Hawaiian	0.44	1	0.44	1	0.88	2
Blainville's beaked whale	Hawaiian	0.40	12	0.40	12	0.80	24
Common bottlenose dolphin	Hawaii Pelagic	0.19	7	0.19	7	0.38	14
	Oahu	0.01	1	0.01	1	0.02	2
	4-Islands	0.07	1	0.07	1	0.14	2
	Hawaii Island	0.58	1	0.58	1	1.16	2
Cuvier's beaked whale	Hawaiian	0.40	61	0.40	61	0.80	122
False killer whale	Hawaii Pelagic	0.45	7	0.45	7	0.90	14
	Main Hawaiian Islands Insular	0.47	1	0.47	1	0.94	2
Fraser's dolphin	Hawaiian	0.40	42	0.40	42	0.81	84
Killer whale	Hawaiian	0.38	2	0.38	2	0.76	4
Kogia spp.	Hawaiian	0.52	129	0.52	129	1.04	258
Longman's beaked whale	Hawaiian	0.39	4	0.39	4	0.78	8
Melon-headed whale	Hawaiian	0.46	14	0.46	14	0.92	28
Pantropical spotted dolphin	Hawaiian	0.29	27	0.29	27	0.59	54

Table 17. Estimated percentage and number of marine mammal species that may be affected at RLs of 120 to 180 dB SPE by the operation of SURTASS LFA sonar during spring and fall missions (two total) in the Hawaii-South mission area; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

HAWAII SOUTH—MISSION AREA #11—2 MISSIONS, ONE PER SEASON							
		SPRING		FALL		TOTAL	
MARINE MAMMAL SPECIES	STOCK[9]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]	PERCENT AFFECTED 120-180 DB[10]	NUMBER ANIMALS AFFECTED 120-180 DB[11]
Pygmy killer whale	**Hawaiian**	**0.47**	**5**	**0.47**	**5**	**0.94**	**10**
Risso's dolphin	Hawaiian	0.48	12	0.48	12	0.96	24
Rough-toothed dolphin	Hawaiian	0.49	43	0.49	43	0.99	86
Short-finned pilot whale	Hawaiian	0.35	32	0.35	32	0.71	64
Sperm whale	Hawaiian	0.34	24	0.34	24	0.68	48
Spinner dolphin	Hawaii Pelagic	0.22	8	0.22	8	0.44	16
	Oahu/4-Islands	0.02	1	0.02	1	0.05	2
	Hawaii Island	0.05	1	0.05	1	0.10	2
Striped dolphin	Hawaiian	0.29	39	0.29	39	0.59	78
Hawaiian monk seal	Hawaiian	0.10	2	0.10	2	0.20	4

7 IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

Requirement 7: *Anticipated impact of the activity upon the species or stocks.*

MMPA Level A harassment can result from auditoriallly or non-auditorially induced injury. Auditory injury or PTS has been defined by the SURTASS LFA sonar program as the deterioration of hearing due to prolonged or repeated exposure to sounds that accelerate the normal process of gradual hearing loss (Kryter, 1985) and the permanent hearing damage from brief exposure to extremely high sound levels (Richardson et al., 1995). PTS results in a permanent elevation in hearing threshold—an unrecoverable reduction in hearing sensitivity (Southall et al., 2007), which is thus, considered to be an injury. For the employment of SURTASS LFA sonar, NMFS adopted the standard that a 20-dB threshold shift defines the onset of PTS (i.e., a shift of 20 dB in hearing threshold) or injury (MMPA Level A harassment) (NOAA, 2002 and 2007). The injury criterion for all marine mammals in the Navy's risk/impact assessments of SURTASS LFA sonar was an SPL of 180 dB RL, which is noticeably lower and, therefore, more conservative, than the injury criteria proposed by Southall et al. (2007).

This conservative injury criterion was used in the analysis and modeling of SURTASS LFA sonar transmissions at 11 North Pacific mission areas for the annual reporting period 15 August 2013 through 14 August 2014 to assess the potential for auditory injury to marine mammals resulting from use of the sonar. The Navy's analysis showed that the potential for physiological effects from exposure to SURTASS LFA sonar sound levels ≥180 dB SPL rms, including the application of mitigation, during the proposed 20 missions is estimated as 0.0000% or 0 of any marine mammal stock in any of the 11 mission areas (Tables 7 to 17). The results of the current analysis are consistent with those of the Navy's comprehensive modeling and analysis effort undertaken since the beginning of the SURTASS LFA sonar program, which demonstrated with the incorporation of the effects of preventative measures, an estimated 0.0000% of any marine mammal stock would result in Level A harassment.

Non-auditory injury or Level A harassment may be possible as the result of direct acoustic impact on tissue, indirect acoustic impact on tissue surrounding a structure, and acoustically mediated bubble growth within tissues from supersaturated dissolved nitrogen gas. Physical effects, such as direct acoustic trauma or acoustically enhanced bubble growth, require relatively intense received energy that would only occur at short distances from high-powered sonar sources (Nowacek et al., 2007; Zimmer and Tyack, 2007). While resonance can occur in marine animals, this resonance does not necessarily cause injury, and any such injury is not expected to occur below a received sound pressure level (RL) of 180 dB re 1 μPa (rms). Damage to the lungs and large sinus cavities of cetaceans from air space resonance is not regarded as a likely significant non-auditory injury because resonance frequencies of marine mammal lungs are below that of the LFA sonar signal (Finneran, 2003).

An additional type of non-auditory injury, nitrogen gas bubble formation that results in a form of decompression sickness, is an area of much research and theorization recently. Gas bubble lesions were originated noted in stranded marine mammals, some of which stranded after acoustic naval exercises. Gas bubble lesions can form with repeated lengthy dives with short to medium surface durations (Zimmer and Tyack, 2007; Fahlman et al., 2009; Moore et al., 2009). Despite the increased scientific research and discussion on gas bubble formation, scientists agree that there is insufficient evidence to support gas bubble formation as the likely cause for certain types of acoustic exposures and marine mammal stranding events (Southall et al., 2007). Regardless, since LFA sonar signals are lower in frequency (<500 Hz) and not similar in characteristic to the vocalizations of marine mammal predators, there is no evidence that SURTASS LFA sonar has or would cause behavioral reactions such as avoidance responses in beaked whales that may have led ultimately to the formation of gas bubble lesions and

potentially stranding. Thus, SURTASS LFA sonar transmissions are not reasonably expected to cause injury such as gas bubble formation or beaked whale strandings.

Indeed, to date, no strandings of marine mammals have been associated with the employment of SURTASS LFA sonar since its employment began the early 2000s. Operation of SURTASS LFA sonar, with the comprehensive suite of mitigation measures implemented, have produced no known lethal removal impacts (i.e., Level A takes) to marine mammal stocks or species as reported in the Navy's Annual Reports from 2003 through 2012.

In summary, the Navy has concluded that the likelihood of SURTASS LFA sonar transmissions (with mitigation measures implemented) causing injury or Level A harassment in marine mammals is considered negligible and are not reasonably expected from deployment and use of LFA sonar. Thus, for this application, the only impacts anticipated from SURTASS LFA sonar transmission are short-term Level B behavioral harassment that will affect only a relatively small percentage of the potentially affected marine mammal stocks.

Based on the results of the analyses conducted for SURTASS LFA sonar operations for the 2013 to 2014 annual reporting period and the nearly 10 years of documented operational results presented in the NEPA documentation, as well as quarterly, annual, and comprehensive reports, operation of SURTASS LFA sonar, when employed in accordance with the mitigation measures (geographic restrictions and monitoring/reporting), support a negative impact determination. In summary:

- Potential effects on marine mammals are reasonably expected to be limited to Level B harassment. The Navy does not estimate the Level B effects to impact rates of recruitment or survival on the associated marine mammal species and stocks. Thus, effects on recruitment or survival are expected to be negligible.
    - Level B harassment of marine mammals will not occur in ocean areas that are biologically important to marine mammals (e.g., foraging, reproductive areas, rookeries, ESA critical habitat) or that are where small, localized populations occur. Twenty-two areas of global importance to marine mammals (i.e., OBIAs) have been restricted from LFA sonar use, so no harassment of marine mammals will occur in these essential marine mammal habitats.
- Potential for non-injurious effects (TTS, masking, modification of biological important behavior) is minimal to negligible for marine mammals.
- Based on the Navy's impact analysis results, no mortality nor injury (i.e., Level A) of marine mammals is predicted to occur as a result of LFA sonar operations, and the potential of the sonar to cause strandings of marine mammals is considered negligible.
- The employment of SURTASS LFA sonar 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 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 is more likely to affect marine mammals than narrowband, low duty cycle SURTASS LFA sonar. Moreover, the bandwidth of any SURTASS LFA sonar transmitted signal is limited (approximately 30 Hz), the average maximum pulse length is 60 sec, signals do not remain at a single frequency for more than 10 sec, and the system is off nominally 90 to 92.5% of the time during an at-sea operation. Moreover, with the nominal duty cycle of 7.5 to 10%, masking by LFA sonar would only occur over a very small spatial and temporal scale. Also, only four SURTASS LFA sonar vessels operate in the central and western North Pacific Ocean. The cumulative effects related to the potential for masking from the potential four SURTASS LFA sonar systems are not a reasonably foreseeable significant adverse impact on marine animals.

- Employment of SURTASS LFA sonar will not impact the habitat of marine mammals nor result in loss or modification of marine habitat.
- Annually, each of the four SURTASS LFA sonar vessels will spend no more than 240 days performing active operations with a maximum of 432 hr of sonar transmission per vessel per year. Realistically, the historical use of SURTASS LFA sonar indicates that the maximum duration of LFA sonar transmissions will likely be far less.
- A comprehensive suite of mitigation measures, including three types of monitoring (passive acoustic, active acoustic, and visual) during LFA sonar operations, the coastal standoff range (transmission of an 180 dB SPL sound field restricted to 22 km [12 nmi] from shore), and OBIA restrictions (sound field produced by sonar below 180 dB RL with 2 km [1.1 nmi] of OBIA boundary), will be implemented to reduce the potential for harassment to marine mammals.

Consideration of negligible impact is required for NMFS to authorize incidental take of marine mammals. By definition, an activity has a “negligible impact” on a species or stock when ‘‘an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival’’ (50 CFR 216.103). The Navy has concluded that the incidental taking of marine mammals by the employment of SURTASS LFA sonar in any of the potential 11 mission areas in the central and western North Pacific Ocean will have a negligible impact on the affected marine mammal stocks or species of marine mammals.

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.*

Proposed SURTASS LFA sonar operations will take place in the western and central 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 11 potential mission areas of the western and central 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.

9.1 PHYSICAL HABITAT

Use of SURTASS LFA sonar entails the periodic deployment of acoustic transducers and receivers into the water column from ocean-going ships. SURTASS LFA sonar is deployed from ocean surveillance ships that are U.S. Coast Guard-certified for operations and operate in accordance with all applicable Federal, international, and U.S. Navy rules and regulations related to environmental compliance, especially for discharge of potentially hazardous materials. In particular, SURTASS LFA sonar ships comply with all requirements of the Clean Water Act (CWA) and Act to Prevent Pollution from Ships (APPS). SURTASS LFA vessel movements are not unusual or extraordinary and are part of routine operations of seagoing vessels. Therefore, no discharges of pollutants regulated under the APPS or CWA will result from the operation of the sonar systems nor will unregulated environmental impacts from the operation of the SURTASS LFA sonar vessels occur.

9.2 SOUND IN THE ENVIRONMENT

Deployment and use of the sonar systems results in no physical alterations to the marine environment other than the 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 are commercial shipping, offshore seismic exploration, as well as naval and other sonar (ICES, 2005; MMC, 2007). Hildebrand (2005) concluded that increases in anthropogenic oceanic sound sources most likely to contribute to increased noise in order of importance are: commercial shipping, offshore oil and gas exploration and drilling, and naval and other uses of sonar.

The potential effects that up to four SURTASS LFA sonars may have on the overall oceanic ambient noise level are reviewed in the following contexts:

- Recent reports on ambient sound levels in the world's oceans;
- Operational parameters of the SURTASS LFA sonar system, including proposed mitigation;
- Contribution of SURTASS LFA sonar to oceanic noise levels relative to other human-generated sources of oceanic noise; and
- Cumulative effects from concurrent LFA and mid-frequency sonar operations.

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. Ambient noise can be generated by 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 sources (Bradley and Stern, 2008). Andrew et al. (2002) compared ocean ambient sound over three decades and found that ambient noise levels increased 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. McDonald et al. (2006) found that oceanic ambient noise levels in the northeastern Pacific Ocean 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., 2006). In most of the

world's oceans, anthropogenic noise from shipping and seismic exploration activities dominate the low frequency bands of oceanic ambient noise. Over the last several decades, noise from shipping has increased by as much as 12 dB, coincident with a significant increase in the number and size of vessels comprising the world's commercial shipping fleet (Hildebrand, 2009).

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 Effects of Ambient Noise

As oceanic ambient noise levels increase due to the global escalation in numbers of anthropogenic sources, scientific evidence indicates that effects on marine mammals are due to this escalation. Parks et al. (2007) correlated increased underwater ambient noise levels with the change in sound production behavior by North and South Atlantic right whales, which indicated that right whales might shift their call frequency to compensate for the increasing band-limitations caused by 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). 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. Di Iorio and Clark (2009) 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.

9.2.1.2 SURTASS LFA Sonar Combined with Other Human-Generated Sources of Oceanic Noise

Increases in ambient noise levels have the potential to cause masking and decrease the distances that underwater sound can be detected by marine animals. These effects have the potential to cause a long-term decrease in a marine mammal's efficiency at foraging, navigating, or communicating (ICES, 2005). NRC (2003) discussed acoustically-induced stress in marine mammals and stated that sounds resulting from one-time exposure are less likely to have population-level effects than sounds that animals are exposed to repeatedly over extended periods of time.

SURTASS LFA transmissions in conjunction with other anthropogenic sources have the potential for the cumulative effect of increasing the overall oceanic ambient noise level, including the potential for LFA sound to add to overall ambient levels of anthropogenic noise. Broadband, continuous low-frequency ambient noise is more likely to affect marine mammals than narrowband, low duty cycle SURTASS LFA sonar. Moreover, the bandwidth of any SURTASS LFA sonar transmitted signal is limited (approximately 30 Hz), the average maximum pulse length is 60 sec, signals do not remain at a single frequency for more than 10 sec, and during an operation the system is off nominally 90 to 92.5% of the time. Most mysticete vocalizations are in the low frequency band below 1 kHz, and it is generally believed that their frequency band of best hearing is below 1 kHz, where their calls have the greatest energy (Clark, 1990;

Edds-Walton, 2000; Ketten, 2000). However, with the nominal duty cycle of 7.5 to 10%, masking by LFA would only occur over a very small spatial and temporal scale. For these reasons, any masking effects from SURTASS LFA sonar are expected to be negligible.

With only four SURTASS LFA sonar systems operate in the vast ocean area of the western and central North Pacific Ocean, and these systems not necessarily transmitting concurrently, LFA transmissions will not significantly increase anthropogenic oceanic noise, and the cumulative effects related to the potential for masking from the proposed four SURTASS LFA sonar systems are not a reasonably foreseeable significant adverse impact on marine animals.

9.3 PROTECTED MARINE HABITATS

Many habitats in the marine environment are protected for a variety of reasons but typically, habitats are designated to conserve and manage natural and cultural resources. Protected marine and aquatic habitats have defined boundaries and are typically enabled under some Federal, State, or international legal authority. Habitats are protected for a variety of reasons including intrinsic ecological value; biological importance to specific marine species or taxa, which are often also protected by federal or international agreements; management of fisheries; and cultural or historic significance. Due to their importance as marine mammal habitat, two types of marine habitats protected under U.S. legislation or Presidential Executive Order (EO) are considered here. These marine habitats include critical habitat designated under the ESA and marine protected areas (MPAs) designated under the National Marine Sanctuaries Act and EO 13158.

9.3.1 ESA CRITICAL HABITAT

The ESA, and its amendments, require the responsible agencies of the Federal government to designate critical habitat for any species that it lists under the ESA. Critical habitat is defined under the ESA as:

1. the specific areas within the geographic area occupied by a listed threatened or endangered species on which the physical or biological features essential to the conservation of the species are found, and that may require special management consideration or protection; and
2. specific areas outside the geographic area occupied by a listed threatened or endangered species that are essential to the conservation of the species (16 U.S.C. §1532(5)(A), 1978).

Critical habitat designations are not required for foreign species or those species listed under the ESA prior to the 1978 amendments to the ESA that added critical habitat provisions. Under Section 7 of the ESA, all Federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or destroy or adversely modify its designated critical habitat. Of the marine mammal species listed under the ESA, critical habitat has only been designated for six of those species (Table 18). Of the designated critical habitat for marine mammals, the critical habitat for only three species, the North Atlantic and Pacific right whales and the eastern DPS of Steller sea lions are located in the marine environment at a distance sufficient from shore to potentially be affected by SURTASS LFA sonar.

For this reason, the more extensive OBIA analysis considered these critical habitat areas and designated all but the critical habitat of the Steller sea lion as a marine mammal OBIA for SURTASS LFA sonar. Much of the critical habitat for the Steller sea lion is located in the Bering Sea, where SURTASS LFA sonar will not operate. The remainder of the eastern critical habitat for the Steller sea lion is located in the western Gulf of Alaska and some of that habitat lies outside of 22 km (12 nmi) from shore. However, this request for renewal of LOAs does not encompass operation of SURTASS LFA sonar in the waters of the Gulf of Alaska. Thus, the likelihood of SURTASS LFA sonar adversely affecting critical habitats is not reasonably foreseeable.

Table 18. ESA-listed marine mammal species for which critical habitat has been designated.

SPECIES	STATUS UNDER ESA	LISTED DISTINCT POPULATION SEGMENT (DPS) / POPULATION/EVOLUTIONARILY SIGNIFICANT UNIT (ESU)	CRITICAL HABITAT—TYPE OF HABITAT DESIGNATED
Beluga whale	Endangered	Cook Inlet	Inshore
Killer whale	Endangered	Southern Resident	Inshore
North Atlantic right whale	Endangered		Marine, nearshore and >12 nmi
North Pacific right whale	Endangered		Marine, nearshore and >12 nmi
Hawaiian monk seal	Endangered		Marine, nearshore <12 nmi
Steller sea lion	Threatened	Eastern	Marine, nearshore and >12 nmi
	Endangered	Western	Marine, nearshore <12 nmi

9.3.2 MARINE PROTECTED AREAS

The term MPA is very generalized and is used to describe specific regions of the marine and aquatic environments that have been set aside for protection, usually by individual nations within their territorial waters, although a small number of internationally recognized MPAs exist. The variety of names and uses of MPAs has led to confusion over what the term really means and where MPAs are used. In the U.S., a MPA is defined by EO 13158 as “any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." MPAs have conservation or management purposes, defined boundaries, a permanent protection status, and some legal authority to protect marine or aquatic resources. In practice, U.S. MPAs are defined marine and aquatic geographic areas where natural and/or cultural resources are given greater protection than is given in the surrounding waters. Of the more than 200 U.S. MPAs, only two Hawaiian MPA, are located in or near potential SURTASS LFA sonar mission areas These MPAs include the Hawaiian Islands Humpback Whale National Marine Sanctuary (only Penguin Bank area) and the Papahānaumokuākea Marine National Monument.

9.3.2.1 Effects of Sonar on Marine Protected Areas

Many MPAs around the world that were established specifically to protect marine mammals have been considered during the OBIA designation process for SURTASS LFA sonar. Several of the MPAs for marine mammal are amongst the 22 global OBIAs where SURTASS LFA sonar use will be restricted to keeping the ≥180 dB re 1 µPa (rms) sound field out of the areas during biologically important seasons. Areas such as Penguin Bank and the portion of the Hawaiian Islands Humpback Whale National Marine Sanctuary have been designated as an OBIA for SURTASS LFA sonar. The waters of the Papahānaumokuākea Marine National Monument are not included in the Hawaii North mission area for SURTASS LFA operations. Thus, SURTASS LFA sonar will not be operated in the waters of either of the two MPAs that are in proximity to the proposed mission areas for the 2013 to 2014 reporting period.

10 IMPACTS TO MARINE MAMMALS FROM HABITAT LOSS OR MODIFICATION

Requirement 10: *Anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.*

Employment of up to four SURTASS LFA sonar systems in ocean areas beyond 22 km (12 nmi) from shore and outside of potential OBIAs will not impact the habitat of marine mammals nor result in loss or modification of marine habitat. The only alteration to the marine habitat associated with the use of SURTASS LFA sonar is the transient addition to the oceanic ambient noise environment. The addition to the ambient noise environment from SURTASS LFA sonar operation is limited by the small number of vessels operating in the vast ocean area of the western and central North Pacific Ocean, the low duty cycle at which the sonar is operated, and the equally low duration of sonar transmissions.

11 MEANS OF EFFECTING LEAST PRACTICABLE ADVERSE IMPACTS—MITIGATION MEASURES

Requirement 11: 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.

Mitigation includes measures to minimize impacts by limiting the degree or magnitude of a proposed action and its implementation. The objective of the mitigation and monitoring measures presented for use when SURTASS LFA sonar is transmitting are designed to effect the least practicable adverse impact on marine mammal species or stocks and to avoid risk of injury to marine mammals, sea turtles, and human divers. These objectives are met by:

- Making sure that coastal waters within 22 km (12 nmi) of any shore are not exposed to SURTASS LFA sonar signal RLs ≥180 dB re 1 µPa (rms) (SPL);
- Assuring that no OBIAs are exposed to SURTASS LFA sonar signal RLs ≥180 dB re 1 µPa (rms) during biologically important seasons; and
- Ensuring that no marine mammal is subjected to a sound pressure level of ≥180 dB re 1 µPa (rms).

Strict adherence to these measures will minimize impacts on marine mammal stocks and species as well as on sea turtle stocks and recreational or commercial divers.

11.1 GEOGRAPHIC RESTRICTIONS

The mitigation objectives are achieved by the SURTASS LFA sonar vessels adherence to the following geographic restrictions that apply to the employment of SURTASS LFA sonar:

- SURTASS LFA sonar-generated sound field will be below RLs of 180 dB re 1 µPa (rms) (SPL) within 22 km (12 nmi) of any coastline;
- SURTASS LFA sonar-generated sound field would be below RLs of 180 dB re 1 µPa (rms) in the boundaries of the 22 potential OBIAs for SURTASS LFA;
- SURTASS LFA sonar operators would estimate LFA sound field RLs (SPL) prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, so that the RL sound field criteria (below 180-dB re 1 µPa rms) are not exceeded.

11.1.1 OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS)

Restrictions have been placed on the transmission of SURTASS LFA sonar within areas of the world's oceans that are biologically important to marine mammals during specific times of year. Twenty-two of such areas, or OBIAs, have been designated solely for SURTASS LFA sonar (Table 19). Sonar transmissions in these areas would be conducted so that the generated sound field is below RLs of 180 dB re 1 µPa (rms) at the boundary of an OBIA. In the 2012 MMPA regulations for SURTASS LFA sonar (NOAA, 2012), NMFS imposed an additional geographic restriction on the transmission of LFA sonar at OBIA boundaries. The sound field generated by SURTASS LFA sonar cannot exceed 180 dB re 1 µPa (rms) at a distance of ≤1 km (0.54 nmi) seaward of the OBIA outer boundary. This OBIA restriction is also a condition of the existing LOAs for SURTASS LFA sonar use (Condition 8h).

Table 19. SURTASS LFA OBIAs for marine mammals and their period of effectiveness.

OBIA	PERIOD OF EFFECTIVENESS
Georges Bank	Year-round
Roseway Basin Right Whale Conservation Area	June through December, annually
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS)	January 1 to November 14, annually
Southeastern U.S. Right Whale Seasonal Habitat	November 15 to April 15, annually
North Pacific Right Whale Critical Habitat	March through August, annually
Silver Bank and Navidad Bank	December through April, annually
Coastal waters of Gabon, Congo and Equatorial Guinea	June through October, annually
Patagonian Shelf Break	Year-round
Southern Right Whale Seasonal Habitat	May through December, annually
Central California National Marine Sanctuaries	June through November, annually
Antarctic Convergence	October through March, annually
Piltun and Chayvo Offshore Feeding Grounds in the Sea of Okhotsk	June through November, annually
Coastal waters off Madagascar	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales
Madagascar Plateau, Madagascar Ridge, and Walters Shoal	November through December, annually
Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary in the Mediterranean Sea	July to August, annually
Hawaiian Islands Humpback Whale NMS and Penguin Bank	November through April, annually
Costa Rica Dome	Year-round
Great Barrier Reef Between 16° S and 21° S	May through September, annually
Bonney Upwelling on the southern coast of Australia	December through May, annually
Northern Bay of Bengal and Head of Swatch-of-No-Ground	Year-round
Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon	Olympic NMS: December, January, March, and May, annually The Prairie, Barkley Canyon, and Nitnat Canyon: June through September, annually
Abrolhos Bank	August through November

11.2 MITIGATION ZONE FOR SURTASS LFA SONAR

The LFA mitigation zone covers a volume ensonified to a RL >180 dB re 1 µPa (rms) by the SURTASS LFA sonar VLA. Based on spherical spreading, this zone will vary between the nominal ranges of 0.75 to 1.0 km (0.40 to 0.54 nmi) from the source array, ranging over a water depth of approximately 87 to 157 m (285 to 515 ft). (The center of the VLA is at an approximate water depth of 122 m [400 ft]). Under rare conditions (e.g., strong acoustic duct), this mitigation range could be somewhat greater than 1 km (0.54 nmi). Knowledge of local environmental conditions (such as sound speed profiles [depth vs. temperature] and sea state) that affect sound propagation is critical to the successful operation of SURTASS LFA sonar and is monitored on a near-real-time basis. Therefore, the SURTASS LFA sonar operators would have foreknowledge of such anomalous acoustic conditions and would mitigate to the LFA mitigation zone even when this was beyond 1 km (0.54 nmi).

11.2.1 SOUND FIELD MODELING

SURTASS LFA sonar operators estimate LFA sound field RL (SPL) prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, so that the sound field criteria are not exceeded. Sound field limits are estimated using near-real-time environmental data and underwater acoustic performance prediction models. These models are an integral part of the SURTASS LFA sonar processing system. The acoustic models help determine the sound field by predicting the SPLs, or RLs, at various distances from the SURTASS LFA sonar source location. Acoustic model updates are nominally made every 12 hr, or more frequently when meteorological or oceanographic conditions change.

If the sound field criteria were exceeded, the sonar operator would notify the Officer in Charge (OIC), who would order the delay or suspension of transmissions. If it were predicted that the SPLs would exceed the criteria within the next 12 hr period, the OIC would also be notified in order to take the necessary action to ensure that the sound field criteria would not be exceeded.

11.2.2 OPERATIONAL RESTRICTIONS

Per the Final Rule under the MMPA (NOAA, 2012)[13] for SURTASS LFA sonar operations, NMFS added an operational restriction to preclude the potential for injury to marine mammals from resonance effects by establishing a 1-km (0.54-nmi) buffer shutdown zone outside of the LFA mitigation zone. This restriction has proven to be practical under current Navy operations. However, analysis conducted by the Navy demonstrates that the additional 1-km (0.54 nmi) buffer did not appreciably minimize adverse impacts below 180-dB re 1 µPa (rms) RL. Thus, the removal of this operational restriction would not generate a change of any significance in the percentage of animals potentially affected. Regardless, the Navy will continue to adhere to the 1-km (0.54 nmi) buffer zone if authorized in the LOAs for the 2013 to 2014 reporting period.

11.3 MONITORING TO PREVENT INJURY TO MARINE ANIMALS

The following monitoring to prevent injury to marine animals is required when employing SURTASS LFA sonar:

- **Visual monitoring** for marine mammals and sea turtles from the vessel during daylight hours by personnel trained to detect and identify marine mammals and sea turtles;
- **Passive acoustic monitoring** using the passive (low frequency) SURTASS array to listen for sounds generated by marine mammals as an indicator of their presence; and

13 The previous MMPA rulemaking regulations (i.e., Final Rules) for the operation also applied the 1-km (0.54-nmi) additional buffer area to the LFA mitigation zone.

- **Active acoustic monitoring** using the High Frequency Marine Mammal Monitoring (HF/M3) sonar, which is a Navy-developed, enhanced HF commercial sonar, to detect, locate, and track marine mammals and, to some extent, sea turtles, that may pass close enough to the SURTASS LFA sonar's VLA to enter the LFA mitigation zone.

All sightings are recorded in detection logs that provided to and archived as part of the Long Term Monitoring (LTM) Program so that potential long-term environmental effects can be monitored.

11.3.1 VISUAL MONITORING

Visual monitoring includes daytime observations for marine mammals and sea turtles from the SURTASS LFA sonar vessel. Daytime is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring begins 30 min before sunrise or 30 min before the SURTASS LFA sonar is deployed. Monitoring continues until 30 min after sunset or until the SURTASS LFA sonar is recovered. Observations are made by personnel trained in detecting and identifying marine mammals and sea turtles. Marine mammal biologists qualified in conducting at-sea marine mammal visual monitoring from surface vessels train and qualify designated ship personnel to conduct at-sea visual monitoring. The objective of these observations is to detect marine mammals (and/or sea turtles) and then maintain a track of animal's movements to ensure that none enter the LFA mitigation zone or approach the LFA source.

The ship personnel trained in visual observation maintain a topside watch and marine mammal observation log during operations that employ SURTASS LFA sonar in the active mode. The number(s) and identification (if possible) of marine mammals sighted, as well as any unusual behavior, is entered into the log. A designated ship's officer (OIC) monitors the conduct of the visual watches and periodically reviews the log entries. If marine mammals are observed by the visual observers, two possible scenarios may occur.

First, if a marine mammal is sighted outside of the LFA mitigation zone, the visual observer notifies the OIC. The OIC then notifies the HF/M3 sonar operator to determine the range and projected track of the animal. If it's estimated that the animal will travel into the LFA mitigation or buffer zone, the OIC orders the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation-buffer zone. If the animal is visually observed within 2 km (1.1 nmi) and 45° on either side of the bow, the OIC orders the immediate delay or suspension of SURTASS LFA sonar transmissions. The observer continues visual monitoring/recording until the animal is no longer seen. Second, if a marine mammal is sighted anywhere within the LFA mitigation-buffer zone, the observer notifies the OIC who orders the immediate delay or suspension of SURTASS LFA sonar transmissions. All sightings are recorded in the log and maintained as part of the LTM Program.

11.3.2 PASSIVE ACOUSTIC MONITORING

Passive acoustic monitoring is conducted when SURTASS is deployed and uses the SURTASS towed HLA to listen for vocalizing marine mammals as an indicator of their presence. If the passive acoustic technician detects a sound that is estimated to be generated by a marine mammal that may be potentially affected by SURTASS LFA sonar, the technician notifies the OIC, who alerts the HF/M3 sonar operator and visual observers. If the detection occurs prior to or during LFA sonar transmissions, the OIC then orders the delay or suspension of SURTASS LFA sonar transmissions when the animal is estimated to enter the LFA mitigation-buffer zone. All contacts are recorded in a log and archived as part of the LTM Program.

11.3.3 ACTIVE ACOUSTIC MONITORING

High-frequency active acoustic monitoring uses the HF/M3 sonar system to detect, locate, and track marine mammals that could pass close enough to enter the LFA mitigation-buffer zone. HF/M3 acoustic monitoring begins 30 min before the first SURTASS LFA sonar transmission of a given mission is

scheduled to commence and continues until transmissions are terminated. Prior to full-power operations, the HF/M3 sonar power level is ramped up over a period of 5 min from the source level of 180 dB re 1 µPa @ 1 m (SPL) in 10-dB increments until full power (if required) is attained to ensure that there are no inadvertent exposures of local animals to received levels ≥180 dB re 1 µPa (rms) from the HF/M3 sonar. There are two potential scenarios for mitigation via active acoustic monitoring if marine mammals are detected.

If a detection is observed outside of the LFA mitigation-buffer zone, the HF/M3 sonar operator determines the range and projected track of the animal. If the operator determines that the animal will pass within the LFA mitigation-buffer zone, the sonar operator notifies the OIC. The OIC then orders the delay or suspension of LFA sonar transmissions when the animal is predicted to enter the LFA mitigation-buffer zone. Second, if a contact is detected by the HF/M3 sonar within the LFA mitigation-buffer zone, the observer notifies the OIC, who orders the immediate delay or suspension of transmissions. All contacts are recorded in the log that is provided to and maintained as part of the LTM Program.

11.3.4 RESUMPTION OF SURTASS LFA SONAR TRANSMISSIONS

SURTASS LFA sonar transmissions can commence/resume 15 min after there are no further detections by the HF/M3 sonar or visual observations of the animal within the LFA mitigation-buffer zone.

12 MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USES

Requirement 12: *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.*

Pursuant to this application for renewal of LOAs for the operation of SURTASS LFA sonar, only areas in the western and central (Hawaii-North and -South) are being requested for the employment of SURTASS LFA sonar. Thus, no SURTASS LFA sonar activities will take place in or near an Arctic subsistence hunting area. For this reason, the operation of SURTASS LFA sonar will not affect the availability of a species or stock of marine mammals for Arctic 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. Guidelines for developing site-specific monitoring plan may be obtained by writing to the Director, Office of Protected Resources.*

13.1 MONITORING AND REPORTING

During the routine operations of the SURTASS LFA sonar system, the Navy records technical and environmental data from visual and acoustic monitoring, ocean environmental measurements (sound speed profile, ambient noise level, and others), and technical and operational inputs. This information becomes part of the LTM Program.

Further, the Navy submits quarterly classified and unclassified mission reports to the Director, Office of Protected Resources, NMFS no later than 30 days after the end of each quarter. Each quarterly mission report includes information about all active-mode missions that have been completed during the quarter (some information is not included in unclassified reports). Specifically, the classified quarterly reports include dates/times of missions, location of vessel (not provided in unclassified report), LOA mission area (not provided in unclassified report), location of the mitigation and buffer zones in relation to the LFA VLA, marine mammal detections, and records of any delays or suspensions of operations. Marine mammal observations will include animal type and/or species, number of animals sighted, date and time of observations, type of detection (visual, passive acoustic, HF/M3 sonar), bearing and range from the vessel, abnormal behavior (if any), and remarks/narrative (as necessary). The report will include the Navy's assessment of whether any taking occurred within the SURTASS LFA sonar mitigation and buffer zone (if required) and estimates of the percentage of marine mammal stocks affected by SURTASS LFA sonar operations (both within and outside the safety and buffer zones), using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics.

The Navy will also submit an annual, unclassified report to the Director, Office of Protected Resources, NMFS. This report will provide NMFS with an unclassified summary of the year's quarterly reports and will include the Navy's assessment of whether any taking occurred within the SURTASS LFA sonar mitigation and buffer zones and estimates of the percentage of marine mammal stocks affected by SURTASS LFA sonar operations (both within and outside the mitigation and buffer zones), using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics. The annual report will also include an analysis of the effectiveness of the mitigation measures with recommendations for improvements where applicable, an assessment of any long-term effects from SURTASS LFA sonar operations, and any discernible or estimated cumulative impacts from SURTASS LFA sonar operations.

13.2 LONG TERM MONITORING PROGRAM (LTM)

The principal objectives of the LTM Program for the SURTASS LFA sonar system are to:

A. Conduct Navy and independent scientific analyses of the effectiveness of proposed mitigation measures, make recommendations for improvements where applicable, and incorporate them as early as possible, with NMFS' concurrence.

B. Provide the necessary input data for LOA reports to NMFS on assessment of whether any taking of marine mammal(s) occurred within the LFA mitigation zone (180-dB sound field) during SURTASS LFA sonar operations. This would entail tabular information that includes: date/time; vessel name; LOA area; marine mammals affected (number and type); assessment basis (observed injury, behavioral response, or model calculation); LFA mitigation zone radius; bearing from vessel; whether operations were delayed, suspended, or terminated; and narrative.

C. Study the potential effects of Navy SURTASS LFA sonar-generated underwater sound on long-term ecological processes relative to LF sound-sensitive marine mammals and sea turtles, focusing on the application of Navy technology for the detection, classification, localization, and tracking of these animals, using data from the seafloor arrays, as feasible, and the SURTASS towed passive horizontal line array, coupled with results from annual acoustic analyses conducted for LOA applications.

D. Collaborate, as feasible, with pertinent Navy, academic, and industry laboratories and research organizations on field research efforts to help fill scientific data gaps.

13.2.1 LTM PROGRAM ELEMENTS

The LTM Program includes the elements described below. The primary product from the LTM Program is annual reports submitted to NMFS (public record) that include the following:

- Summary of the unclassified SURTASS LFA sonar operations during the past year;
- Summary of unclassified plans for the following year;
- Assessment of the efficacy of mitigation measures used during the past year, as well as the value-added from the various LTM elements, with recommendations for improvements (and NMFS concurrence where applicable);
- Synopsis of LOA reports to NMFS on estimates of percentages of marine mammal stocks affected by SURTASS LFA sonar operations; and
- Assessment of any long-term ecological processes that may be exhibiting effects from SURTASS LFA sonar operations, and reports or scientific papers on discernible or estimated cumulative impacts from such operations.

13.2.1.1 Ambient Noise Data Monitoring

Several efforts (federal and academic) are underway to develop a comprehensive ocean noise budget (i.e., an accounting of the relative contributions of various underwater sources to the ocean noise field) for the world's oceans that include both anthropogenic and natural sources of noise. Ocean noise distributions and noise budgets are used in marine mammal masking studies, habitat characterization, and marine animal impact analyses.

The Navy will collect ambient noise data when the SURTASS passive towed HLA is deployed. The Navy is exploring the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts. Thus, the SURTASS LFA sonar vessels could serve as *ad hoc* ships of opportunity for monitoring data that could provide validation of marine mammal-relevant global ocean noise budgets by supplying up-to-date measurements of the underwater noise field in data-poor and/or littoral areas not previously surveyed.

13.2.2 MARINE MAMMAL MONITORING (M3) PROGRAM

The Navy's Integrated Undersea Surveillance System's Marine Mammal Monitoring (M3) Program uses the Navy's permanent seafloor sensor arrays in designated ocean areas to passively monitor the movements of some large cetaceans, including their migration and feeding patterns, by tracking them through their vocalizations. Analysts not only count numbers of whales, but in some cases, also note the interaction and influence of underwater noise sources on the animals. Some whales are vocal enough to allow long-term tracking; e.g., in 2010 a blue whale was tracked for 67 days, with the animal travelling over 3,333 km (1,800 nmi). Recently, upgraded acoustic signal processing systems have allowed for detection of sperm whale clicks—the longest record to date was 12 hr, of one sperm whale that included 14 dives. At present, most of the data resulting from the M3 Program are classified. However, the Navy is currently working toward the de-classification of portions of the data so that they can be shared with other organizations and ultimately released to the public.

13.3 ADAPTIVE MANAGEMENT

The Navy's understanding of the potential effects of SURTASS LFA sonar on marine mammals is continually evolving, as the science in this field addresses new hypotheses as to the reasoning behind the effects of anthropogenic underwater sound on marine species. Adaptive management allows the Navy, in concert with NMFS, to consider, on a case-by-case basis, new/revised peer-reviewed and published scientific data and information from different qualified and recognized sources within academia, industry, and government/non-government organizations, to determine (with input regarding practicability) whether consideration should be given to the modification of current SURTASS LFA sonar mitigation and monitoring measures (including additions or deletions) or the designation of additional OBIAs for SURTASS LFA sonar, if new scientific data indicate that such modifications would be appropriate. It also allows for updates to marine mammal stock estimates which, in turn, provide for the use of the best available scientific data for predictive models.

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 Navy sponsors significant research and monitoring projects for marine living resources to study the potential effects of its activities on marine mammals. Navy-funded research has produced, and is producing, many peer-reviewed articles in professional journals. Publication in open professional literature thorough 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, noise impacts, beaked whale global distribution, modeling of beaked whale hearing and response, tagging of free-ranging marine animals at-sea, and radar-based detection of marine mammals from ships. The Navy sponsors 70% of all U.S. research on the effects of human-generated underwater sound on marine mammals and 50% of such research conducted worldwide.

The Navy continues to fund national and international research on the responses of deep diving odontocetes to sonar signals by independent scientists for whale behavioral response studies (BRSs) with Navy and NOAA funding support for the 2007, 2008, and 2009 BRSs. Findings from the Deep-Diving Odontocetes BRSs will be published in peer-reviewed literature. SOCAL-10 (Southern California) is the first phase of a multi-year research effort (2010 to 2015), notionally referred to as SOCAL-BRS, which is designed to contribute to emerging understanding of marine mammal behavior and changes in behavior as a function of sound exposure. It is in some ways an extension of previous Navy-sponsored BRS efforts in the Bahamas and Mediterranean Sea in 2007 through 2009, but is being constructively integrated with several related, ongoing, successful field efforts (e.g., population surveys of Navy range areas and satellite tagging before active sonar operations) already ongoing in southern California. The research is continuing as SOCAL-BRS (2010 to 2015) to study diving, foraging, and vocal behavior in various marine mammals and their response to controlled sound exposures. The initial phase off southern California was successfully completed during the summer of 2010.

14.1 MONITORING TO INCREASE KNOWLEDGE OF AFFECTED MARINE MAMMAL SPECIES

A requirement of the LOAs for the reporting period of 2012 through 2013 for SURTASS LFA sonar operations is that the Navy conduct monitoring to increase the knowledge of affected marine mammal species (LOAs Condition 12). The Navy is conducting long-term independent scientific research to fill data gaps and further the overall understanding of anthropogenic sound and noise effects on the marine environment in fulfillment of the conditions of the ITS, MMPA Final Rule, and LOAs. Notable progress has been made in two Navy research programs relevant to SURTASS LFA sonar.

14.1.1 MARINE MAMMAL MONITORING (M3) PROGRAM

The Navy has and is continuing to sponsor multi-year studies regarding the acoustic monitoring of marine mammals using fixed passive acoustic monitoring systems. Beginning in 1993, the Marine Mammal Monitoring (M3) Program originated to assess the feasibility of detecting and tracking baleen whales using a Navy seafloor sensor system to collect data. The Navy (OPNAV N2/N6F24) has continued to assess and analyze M3 data collected by a fixed passive acoustic monitoring system and is working toward making some portion of that data, after appropriate review, available to scientists with appropriate clearances. These data may also include ambient noise data to the extent available and feasible. To initiate sharing of M3 data with other Federal agencies, the Deputy Assistant Secretary of the Navy for

Environment is leading a cooperative effort between the Navy and the Department of Interior's (DoI's) Bureau of Ocean Energy Management (BOEM). A Memorandum of Agreement (MOA) between Navy and DoI has been drafted and is currently under review for the express purpose of ensuring maximum benefit to the U.S. by the Navy granting access, on a case-by-case basis, to M3-generated classified and unclassified data. These underwater acoustic data may provide insight on marine mammal (cetacean) distribution, relative abundance and density, and the potential for effects to cetaceans associated with underwater anthropogenic sound. The goal of the MOA will be to ensure existing Federal capabilities are maximized to achieve the marine research and environmental stewardship needs of both the Navy and DoI as well as assure the protection of Navy's classified systems and classified data. Based on the successful execution of the Navy-BOEM MOA, cooperative agreements may be established with other Federal agencies, including NMFS.

14.1.2 BEAKED WHALE AND HARBOR PORPOISE MONITORING AND RESEARCH

During the first year of the 2012 MMPA Final Rule for the employment of SURTASS LFA sonar, the Navy convened an independent Scientific Advisory Group (SAG), which was one of the conditions for operation of the SURTASS LFA sonar under the Final Rule. The purpose of the SAG is to analyze different types of monitoring methods and research studies that could increase understanding of the potential effects to beaked whales and the harbor porpoise from exposure to SURTASS LFA sonar transmissions. The SAG is responsible for preparing a report describing their monitoring and research recommendations.

The impetus for investigating the effect of SURTASS LFA sonar on beaked whales and the harbor porpoise is the results of recent research that indicated these taxa may be particularly sensitive to a range of underwater sound exposures. As a result, the potential sensitivity of beaked whales and the harbor porpoise to low-frequency sonar systems has arisen as an important monitoring and research need. The Executive Oversight Group, whose purpose is to evaluate the recommendations of the SAG, joined the SAG members on 13 and 14 March 2013 in Arlington, Virginia to discuss their review comments on the SAG's Draft Report. The SAG's Final Report is due to be completed in June 2013 and at that time will be made available to the public.

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APPENDIX A: MISSION AREA SPECIFIC OCCURRENCE INFORMATION FOR POTENTIALLY AFFECTED MARINE MAMMAL STOCKS IN THE WESTERN AND CENTRAL NORTH PACIFIC OCEAN

The following information describes the estimation approach and scientific literature sources used to derive density and stock abundance estimates in this LOAs request for the marine mammal species potentially occurring in each of the SURTASS LFA sonar mission areas. Information is listed by mission area with marine mammal species occurring in the waters of each mission area listed in alphabetical order within the three general taxonomic groups: mysticetes, odontocetes, and pinnipeds. Citations for literature cited in this appendix may be found in Chapter 15, Literature Cited.

1. MISSION AREA #1—EAST OF JAPAN

A. **Bryde's whale**: Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific. The International Whaling Commission (IWC) provides the best available population estimate for the western North Pacific stock of 20,501 whales (IWC, 2009). The all-season density estimate (0.0006 animals/km^2) for the Western North Pacific stock is derived from whaling sighting data (Ohsumi, 1977). Barlow (2006) observed Bryde's whales around the Hawaiian Islands, deriving a similar density estimate (0.00019 animals/km^2) to that derived for the western North Pacific stock.

B. **Common minke whale**: Two stocks of minke whales are recognized in the western North Pacific Ocean, the "O" stock, which ranges from the Okhotsk Sea to the waters off eastern Japan, and the "J" stock, which is located in waters around the Korean peninsula and in the Sea of Japan (Pastene et al., 1998). Minke whales potentially occurring in the waters of this mission area are believed to be part of the "O" stock. Buckland et al. (1992) conducted sighting surveys during July and August in the western North Pacific and Sea of Okhotsk, from which density (0.0022 animals/km^2) and abundance (25,049 individuals) estimates for the western North Pacific "O" stock were derived (Buckland et al., 1992). The density estimates that Ferguson and Barlow (2001; 2003) computed for this species in the offshore areas of the ETP are an order of a magnitude lower than those derived by Buckland et al. (1992).

C. **Fin whale**: Density, 0.0002 animals/km^2, and abundance, 9,250 individuals, estimates fin whales in the Western North Pacific stock were derived from encounter rates during Japanese whaling in the northwest Pacific Ocean (Tillman, 1977; Mizroch et al., 2009). This density is comparable to density estimates in offshore areas of the eastern tropical Pacific (ETP) (Ferguson and Barlow 2001, 2003).

D. **North Pacific right whale**: The western North Pacific stock of North Pacific right whales is considered distinct from the eastern North Pacific population, arbitrarily separated by the 180° line of longitude (Best et al., 2001). Data from Japanese sighting cruises in the Okhotsk Sea provide an abundance estimate of 922 animals for the Western North Pacific stock (CV=0.433, 95% CI=404-2,108) (Best et al., 2001). Although no density estimates are available for this very rare marine mammal species, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis to reflect the very low probability of occurrence in this region.

E. **Sei whale**: Tillman (1977) derived an abundance estimate of 8,600 individuals for sei/Bryde's[14] whale in the North Pacific from whaling catch statistics. Initial estimates for a portion of the sei whale population off Japan indicate abundance estimates of similar magnitude (7,744 for May to June and 5,406 for July to September; Hakamada et al., 2009). Whale sighting data obtained from Japanese whaling records were used to derive the density estimate of 0.0006 animals/km^2 for the sei whale (Masaki, 1977; Tillman, 1977).

F. **Baird's beaked whale**: Based on Kasuya's (1986) encounter rate and effective search width from 25 years of aerial surveys and shipboard sightings in 1984 off the Pacific coast of Japan, an all-season density estimate of 0.0029 animals/km^2 was derived for this species. Kasuya's (1986) abundance

14 Sei and Bryde's whales are difficult to distinguish from one another at sea.

estimate of 4,220 (CV=0.295) covered the region from about 32° to 40°N and seaward of the Pacific Japanese coast out to about 150°E. Since Kasuya's surveys did not include habitat further north, the Kasuya (1986) abundance estimate of 4,220 individuals was increased to 8,000 individuals to account for unsurveyed areas and is the abundance estimate used for the Western North Pacific stock of Baird's beaked whales.

G. **Common bottlenose dolphin**: Miyashita (1993) reports an abundance estimate of 168,791 individuals (CV=0.261) and a density estimate (0.0171 animals/km^2) for the Western North Pacific stock of common bottlenose dolphins off the Pacific coast of Japan. Miyashita's (1993) density is comparable to that observed for common bottlenose dolphins in nearshore Hawaii waters (0.0103 animals/km^2; Mobley et al., 2000) but is an order of magnitude larger than that derived for this species in the Hawaii exclusive economic zone (EEZ) (0.00131 animals/km^2; Barlow, 2006).

H. **Cuvier's beaked whale**: No density or abundance estimate data are available for Cuvier's beaked whales of the Western North Pacific stock. Considering habitat preferences (e.g., water temperature and bathymetry), the best population data available to extrapolate for the Cuvier's Western North Pacific stock in this mission area are the Ferguson and Barlow (2001 and 2003) long-time series from the ETP, from which a density of 0.0031 animals/km^2 and an abundance of 90,725 animals were estimated. These population estimates are comparable to those estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

I. **False killer whale**: Miyashita (1993) estimated the abundance (16,668 animals, CV=0.263) of false killer whales from 34 sighting cruises associated with the Japanese drive fishery and also derived density estimates in 1° latitude by 1° longitude boxes from which an average density was derived for the Western North Pacific Pelagic stock of false killer whales in this mission area (0.0036 animals/km^2). Miyashita's (1993) density is comparable to the density estimated for pelagic false killer whales in the Hawaii EEZ (0.0001 animals/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

J. **Ginkgo-toothed beaked whale**: The ginkgo-toothed whale is only known from strandings in the temperate and tropical waters of the Pacific (Palacios, 1996). Since no data on density or abundance estimates are available for ginkgo-toothed beaked whales in the western North Pacific Ocean, the best population estimations from which to extrapolate for this species in this region are those derived for *Mesoplodon* spp. from the ETP (Ferguson and Barlow, 2001 and 2003). Using Ferguson and Barlow's (2001, 2003) northernmost strata, a density of 0.0005 animals/km^2 and an abundance of 22,799 animals are estimated for the North Pacific stock of ginkgo-toothed whales. This derived density estimate is comparable to that computed for unidentified beaked whales in the Hawaiian EEZ (0.00015 animals/km^2, Barlow, 2006) and the mean predicted density estimate for *Mesoplodon* spp. in the ETP (0.000296 animals/km^2; Ferguson et al., 2006).

K. **Hubbs' beaked whale**: All known occurrences to date of Hubb's beaked whales in the western North Pacific Ocean having been strandings along Japan's shore (MacLeod et al., 2006). Miyazaki et al. (1987) reported five strandings of Hubbs' beaked whales along the Pacific coast of northern Honshu. Since no data on density or stock estimates are available for the Hubb's beaked whale in the waters of this mission area, *Mesoplodon* spp. data from the ETP (Ferguson and Barlow, 2001 and 2003) are considered to be the most appropriate population estimates available from which to extrapolate population estimates for mission area #1. Using the northernmost strata from Ferguson and Barlow's (2001, 2003) data, a density of 0.0005 animals/km^2 and an abundance of 22,799 animals are estimated for the North Pacific stock of Hubb's beaked whales. Ferguson and Barlow's (2001, 2003) density is comparable to that estimated for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow, 2006) and the mean predicted density estimated for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

L. **Killer whale**: Killer whales have been observed off the southeast coast of Honshu but none were taken in Japanese drive fisheries (Miyashita, 1993). With no population data for killer whales in the Western North Pacific stock, the best available data from which to extrapolate abundance or density estimates are the ETP long-term time series data, where Ferguson and Barlow (2001, 2003) derived an abundance estimate of 12,256 animals, and the data from LGL (2011), from which a density of 0.0001 animals/km^2 was estimated. The LGL (2011) density estimated for the Western North Pacific stock akin to the density, 0.00014 animals/km^2, estimated for killer whales in the Hawaii EEZ (Barlow, 2006).

M. ***Kogia* spp.**: Few occurrence data are available for *Kogia* spp. in the western North Pacific. In the ETP, Ferguson and Barlow (2001; 2003) summed the abundances of *Kogia breviceps, Kogia sima,* and *Kogia* spp. for an estimated overall abundance of 350,553 animals. Although only *Kogia breviceps* (pygmy sperm whale) is expected at the northern latitude of this area, the abundance from the ETP remains the best estimate for *Kogia* spp. in the Western North Pacific stock. The density estimate of 0.0031 animals/km^2 calculated for *Kogia* spp. from the ETP at about 30° N is considered the best estimate (Ferguson and Barlow, 2001; 2003) from which to extrapolate a density of undifferentiated *Kogia* in the Western North Pacific stock. Ferguson and Barlow's (2001, 2003) density is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2 [CV=1.12]) and dwarf sperm whale (0.00714 animals/km^2 [CV=0.74]) estimated within the Hawaii EEZ (Barlow, 2006).

N. **Pacific white-sided dolphin**: No data on density or abundance estimates are available for this gregarious, pelagic species in this mission area (Miyashita, 1993). Recent research on genetic differentiation suggests that animals found in coastal Japanese waters and the Sea of Japan belong to a different Pacific white-sided dolphin population than animals found in offshore North Pacific waters (Hayano et al., 2004). Data from sighting surveys in the North Pacific were analyzed to estimate an abundance of 931,000 individuals in the Western North Pacific stock of Pacific white-sided dolphins (Buckland et al., 1993). This estimate is over an order of magnitude larger than the abundance estimated for this species in waters of the eastern North Pacific (Ferguson and Barlow, 2001, 2003). Ferguson and Barlow's (2001, 2003) density estimates of 0.0082 animals/km^2 from the ETP is appropriate to extrapolate as a density for the Western North Pacific stock in this mission area. No sightings of Pacific white-sided dolphins were reported in Hawaiian surveys (Mobley et al., 2000; Barlow, 2006).

O. **Pantropical spotted dolphin**: Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Japan. Miyashita (1993) reports an abundance estimate of 438,064 individuals (CV=0.174) and a density estimate, 0.0259 animals/km^2, for pantropical spotted dolphins occurring east of Japan. In the high latitude waters of this mission area, pantropical spotted dolphins are not expected to occur during winter or spring. Miyashita's (1993) density for the Western North Pacific stock of pantropical spotted dolphins can be compared to that observed in nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000), although it is an order of magnitude higher than that estimated for pantropical spotted dolphins in the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006).

P. **Pygmy killer whale:** Kishiro and Kasuya (1993) reported that no pygmy killer whales were taken in Japanese drive fisheries, but Leatherwood and Reeves (1983) reported that pygmy killer whales were seen relatively frequently in the tropical Pacific off Japan. However, since no population data are available for pygmy killer whales in the western North Pacific, density (0.0021 animals/km^2) and abundance (30,214 individuals) estimates were extrapolated from the ETP data (Ferguson and Barlow, 2001 and 2003) and used to reflect the population levels of the Western North Pacific stock of pygmy killer whales. Ferguson and Barlow's (2001 and 2003) density is almost an order of magnitude larger than that observed for pygmy killer whales in the Hawaii EEZ (0.00039 animals/km^2; Barlow, 2006).

Q. **Risso's dolphin**: Miyashita (1993) reports an abundance for the Western North Pacific stock of 83,289 individuals (CV=0.179) and a density estimate of 0.0097 animals/km^2 derived for Risso's dolphins in waters off the Pacific coast of Japan. Miyashita's (1993) density is an order of magnitude larger than that observed for this species in the Hawaii EEZ (0.00097 animals/km^2; Barlow, 2006); no Risso's dolphins were observed in nearshore Hawaii waters (Mobley et al., 2000).

R. **Rough-toothed dolphin**: No data on abundance or density estimates for the Western North Pacific stock of rough-toothed dolphins are available. Therefore, density (0.0059 animals/km^2) and abundance (145,729 individuals) estimates from the waters of the ETP (Ferguson and Barlow, 2001 and 2003) were used to represent rough-toothed dolphins in the Western North Pacific stock. While the density estimated for rough-toothed dolphins in the waters of the Hawaii EEZ (0.00355 animals/km^2; Barlow, 2006) is comparable, the density estimated for nearshore Hawaii waters is lower (0.0017 animals/km^2; Mobley et al., 2000).

S. **Short-beaked common dolphin**: No data on density or abundance estimates of short-beaked common dolphins are available for the waters of the western North Pacific (Miyashita, 1993). Due to this lack, the population data derived from ETP surveys of 3,286,163 animals and 0.0761 animals/km^2 (Ferguson and Barlow, 2001, 2003) are the most appropriate for use to represent the Western North Pacific stock of short-beaked common dolphins in this region.

T. **Short-finned pilot whale**: The stock delineation of the short-finned pilot whale in the western North Pacific is not fully resolved. Kasuya et al. (1988) suggested two stocks of short-finned pilot whales occurred in the western North Pacific Ocean off Japan and Taiwan, with a southern stock found south of the Kuroshio Current front (south of 35° N), and a northern stock found between the frontal boundaries of the Kuroshio and Oyashio Currents (~35° to 43° N). Miyashita (1993) questioned whether only one stock of short-finned pilot whales in this region occurred but had no way of defining stock boundaries. Miyashita (1993), however, estimated an abundance (53,608 animals, CV=0.224) of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery and also derived density estimates in 1° latitude by 1° longitude boxes, from which an average density estimate (0.0128 animals/km^2) was derived to represent the Western North Pacific stock.

U. **Sperm whale**: Sperm whale stock structure in the western North Pacific Ocean is not well defined. Kasuya and Miyashita's (1988) data suggest that there are two stocks of sperm whales in the western North Pacific: a northwestern stock with females that summer off the Kuril Islands (~50°N) and winter off Hokkaido and Sanriku (~40°N), and a southwestern stock with females that summer off Hokkaido and Sanriku (~40°N) and winter around the Bonin Islands (~25°N). The males of both stocks are found north of the range of the corresponding females, i.e., in the Bering Sea (~55°N) and off Hokkaido and Sanriku (~40°N), respectively, during the summer (Kasuya and Miyashita, 1988). Since population level data are not available to quantify two North Pacific stocks, abundance can be estimated for the North Pacific Stock as a whole. The best available population estimate for sperm whales occurring in the North Pacific stock is Kato and Miyashita's (1998) estimate of 102,112 animals (CV=0.155). The density estimate of sperm whales, 0.0012 animals/km^2, calculated from the winter/spring survey around Guam and the Mariana Islands, is the best representative estimate for sperm whales of the North Pacific stock in this mission area (Fulling et al., 2011).

V. **Spinner dolphin**: The spinner dolphin is not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or abundance estimates are available for this species in the western North Pacific Ocean (Miyashita, 1993). Due to this lack, the abundance of the Western North Pacific stock, 1,015,059 animals, is estimated from the ETP population data (Ferguson and Barlow, 2001 and 2003) while the density, 0.0111 animals/km^2, is estimated from offshore stratum of the Hawaii EEZ survey data (Barlow, 2006). Due to the high latitude at which this mission area occurs, spinner dolphins are only expected to occur in these waters during summer and fall.

W. **Striped dolphin**: Although two stocks of striped dolphins may be present in the waters of the western North Pacific Ocean, boundaries between the stocks have not been fully resolved (Miyashita, 1993). Therefore, for striped dolphins, Miyashita (1993) derived a total Western North Pacific population estimate of 570,038 individuals (CV=0.186). Miyashita's (1993) density estimate of striped dolphins in the Pacific coast waters of Japan was used for this mission area (0.0111 animals/km^2).

2. MISSION AREA #2—NORTH PHILIPPINE SEA

A. **Blue whale**: Due to the lack of occurrence data, stock structure of the blue whale in the North Pacific Ocean remains uncertain[15]. Stafford et al. (2001) studied the geographic variation of blue whale calls in the North Pacific Ocean using hydrophones off the Kamchatka Peninsula and along the western Aleutian Islands chain and found that all recorded blue whale calls were of north-central and north-west Pacific blue whales. Based on this acoustic information from Stafford et al. (2011), the best available occurrence data for blue whales in the northwestern Pacific Ocean are the sighting survey data associated with Japanese whaling (Tillman, 1977). Blue whales of the central North Pacific stock, found at this mission area (Stafford et al., 2001; Carretta et al., 2013), winter in western North Pacific waters and less frequently, in the central North Pacific, but summer off southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska. Although the blue whale was the initial focus of Japanese whaling effort in the North Pacific, limited data were reported on blue whales. Therefore, whaling data on fin whales were judged to be the most appropriate proxy for blue whale occurrence estimates. From the fin whale estimates from Japanese whaling data, an abundance of 9,250 individuals (Tillman, 1977) was used for blue whales in mission area #2. A density of 0.0001 whales/km^2 was estimated for all seasons but summer (Tillman, 1977; Ferguson and Barlow, 2001 and 2003; LGL, 2008). This density for blue whales occurring in winter, spring, and fall seasons in the north Philippine Sea is comparable to density estimates of the blue whale in offshore areas of the eastern tropical Pacific (ETP) (Ferguson and Barlow, 2003) and to the waters surrounding Guam (Fulling et al., 2011).

B. **Bryde's whale**: Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific. The IWC (2009) provides the best available population estimate, 20,501 whales, for the Western North Pacific stock of Bryde's whales. The density estimate (0.0006 animals/km^2) for the Western North Pacific stock is derived from scouting vessel sighting data (Ohsumi, 1977). Barlow (2006) observed Bryde's whales around the Hawaiian Islands, deriving a comparable density estimate (0.00019 animals/km^2).

C. **Common minke whale**: Two stocks of minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al., 1998). Minkes in this region are part of the "O" stock. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk. The density estimate, 0.0044 animals/km^2, for this area was derived from the encounter rates and effective search widths for the offshore population (Standard Error (SE) = 0.17), while the stock estimate for the Western North Pacific "O" stock is estimated as 25,049 individuals by Buckland et al. (1992). Ferguson and Barlow (2001; 2003) computed density estimates in offshore areas of the ETP that are an order of a magnitude lower.

D. **Fin whale**: Fin whales of the Western North Pacific stock are expected to occur in summer and fall in LFA mission area #2. Density, 0.0002 animals/km^2, and abundance, 9,250 individuals, estimates of the Western North Pacific stock were derived from encounter rates of scouting boats during Japanese

15 The International Whaling Commission (IWC) recognizes only one stock of blue whales in the North Pacific Ocean (Donovan, 1991), and Reeves et al. (1998) estimated that up to five populations existed in the entire North Pacific basin. NMFS delineates two stocks in U.S. EEZ waters (eastern and central North Pacific stocks) while acoustic data suggest two populations (Stafford et al., 2001).

whaling in the northwest Pacific (Tillman, 1977; Mizroch et al., 2009). The 0.0002 animals/km^2 density estimate is comparable to those of fin whales in offshore areas of the ETP (Ferguson and Barlow, 2001 and 2003).

E. **Humpback whale**: Recent research conducted by the Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) consortium of scientists throughout the North Pacific Ocean has shown that humpback whale movement patterns between feeding areas in high latitudes and wintering grounds in lower latitudes are extremely complex but indicate a high level of population structure (Calambokidis et al., 2008). In the western North Pacific during winter and early spring, humpback whale distribution is centered along the Ogasawara Islands, Ryukyu Islands, Taiwan, the Philippines, and the Mariana Islands (Calambokidis et al., 2008). The remainder of the year, humpback whales are largely absent from these regions as they move northward to other regions of the North Pacific to feed, principally off Russia but also to the Bering Sea and the Gulf of Alaska (Calambokidis et al., 2008). Thus, humpback whales are only expected to occur in the north Philippine Sea mission area during winter, spring, and fall. The SPLASH consortium derived an average abundance for the Asian wintering grounds of 1,107 humpback whales (Calambokidis et al., 2008). A density of 0.0009 animals/km^2 was estimated for the Western North Pacific stock of humpback whales (Acebes et al., 2007; LGL, 2008).

F. **North Pacific right whale**: The western North Pacific right whale population is considered distinct from the eastern population, arbitrarily separated by the 180° line of longitude (Best et al., 2001). Data from Japanese sighting cruises in the Okhotsk Sea provide an abundance estimate of 922 animals (CV=0.433, 95% CI=404-2,108) (Best et al., 2001) for the Western North Pacific stock of North Pacific right whales. The western North Pacific population may occur in the waters of the North Philippine Sea only in winter and spring. Although no density estimates are available for this very rare marine mammal species, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis to reflect the very low probability of occurrence in this region.

G. **Blainville's beaked whale**: Without any data on abundance or density estimates of the Blainville's beaked whale for the western North Pacific, extrapolation from ETP data is appropriate (Ferguson and Barlow, 2001, 2003). A density estimate of 0.0005 animals/km^2 represents Blainville's beaked whales in mission area #2. The abundance estimate of 8,032 individuals was derived by adding the *Mesoplodon densirostris* abundance estimate to one-fifth of the *Mesoplodon* spp. abundance estimate (Ferguson and Barlow, 2001, 2003). The ETP density estimate is lower than the density of Blainville's beaked whales estimated in the Hawaii EEZ (0.00117 animals/km^2; Barlow, 2006) and the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), although the mean predicted density estimate (0.000296 animals/km^2; Ferguson et al., 2006) for the ETP *Mesoplodon* spp. is comparable.

H. **Common bottlenose dolphin**: Miyashita (1993) abundance (168,791 animals CV=0.261) and density (0.0146 animals/km^2) estimates for common bottlenose dolphins off southern Japan were used to represent the Western North Pacific stock. Miyashita's (1993) density is comparable to that derived for the bottlenose dolphins in nearshore Hawaii waters (0.0103 animals/km^2; Mobley et al., 2000) but is an order of magnitude larger than that derived for the species in the waters of the Hawaii EEZ (0.00131 animals/km^2; Barlow, 2006).

I. **Cuvier's beaked whale**: No density or abundance estimate data are available for the Cuvier's beaked whale in this region. Considering the Cuvier's habitat preferences (e.g., water temperature, bathymetry), the best data available to represent the Western North Pacific stock of Cuvier's beaked whales is the density (0.0054 animals/km^2) and abundance (90,725 animals) estimated for the Cuvier's in the ETP (Ferguson and Barlow, 2001 and 2003). Ferguson and Barlow's (2001 and 2003)

density is comparable to that estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

J. **False killer whale**: Miyashita (1993) estimated an abundance of 16,668 (CV=0.263) individuals from 34 sighting cruises associated with the Japanese drive fishery and derived a density estimate of 0.0029 animals/km^2 for the Western North Pacific Pelagic stock of false killer whales. Miyashita's (1993) estimated density is much higher than the density estimated in the Hawaii EEZ (0.0001 animals/km^2; Barlow 2006) but is more similar to the nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al. 2000).

K. **Fraser's dolphin**: Without data on abundance or density estimates for the western North Pacific, Ferguson and Barlow's (2001, 2003) abundance estimate of 220,789 animals is extrapolated to represent the Western North Pacific stock of Fraser's dolphins. However, the density estimate derived for Hawaiian waters, 0.0050 animals/km^2, is most appropriate (Barlow, 2006).

L. **Ginkgo-toothed beaked whale**: The ginkgo-toothed whale is only known from strandings in the temperate and tropical waters of the Pacific (Palacios, 1996). With no data available on density or abundances of the North Pacific stock of ginkgo-toothed beaked whales, the best population estimations are those extrapolated from the ETP derivations of Ferguson and Barlow (2001 and 2003) for *Mesoplodon* spp. Using Ferguson and Barlow's (2001, 2003) northernmost strata, a density of 0.0005 animals/km^2 and an abundance of 22,799 animals are estimated. Ferguson and Barlow's density estimate is similar to that for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow 2006) and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al. 2006).

M. **Killer whale**: Killer whales have been observed off the southeast coast of Honshu, Japan, but no killer whales were taken in Japanese drive fisheries (Miyashita, 1993). Without any population or occurrence data on killer whales for the western North Pacific, the best available data to use as a proxy for the Western North Pacific stock of killer whales are from the long time series in the ETP, where Ferguson and Barlow (2001, 2003) derived an abundance estimate of 12,256 animals. The most appropriate density, 0.0001 animals/km^2, is derived by LGL (2011). LGL's (2011) density can be compared to the density estimate of 0.00014 animals/km^2 derived from the waters of the Hawaii EEZ (Barlow, 2006).

N. ***Kogia* spp.**: Few occurrence data are available for *Kogia* spp. in the western North Pacific. In the ETP, Ferguson and Barlow (2001; 2003) summed the abundances of *Kogia breviceps, Kogia sima,* and *Kogia* spp. for an estimated overall abundance of 350,553 animals. Although only *Kogia breviceps* (pygmy sperm whale) is expected at the northern latitude of this mission area, the abundance from the ETP remains the best population estimate for the Western North Pacific stock of *Kogia* spp. The density estimate of 0.0031 animals/km^2 calculated for *Kogia* spp. from the ETP at about 30° N is considered the best estimate for *Kogia* sp. in this western region of the North Pacific (Ferguson and Barlow, 2001, 2003). Ferguson and Barlow's (2001, 2003) density is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2, CV=1.12) and dwarf sperm whale (0.00714 animals/km^2, CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

O. **Longman's beaked whale**: Longman's beaked whales are known from tropical waters of the Pacific and Indian Oceans (Pitman et al., 1999; Dalebout et al., 2003). Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings in their surveys were south of 25ºN. Considering the lack of occurrence or population data for the Western North Pacific stock of Longman's beaked whales, the abundance of 1,007 animals estimated for Longman's beaked whales in offshore Hawaiian waters (Barlow, 2006) and the density of 0.0003 animals per km^2 (LGL, 2011) derived from the Marianas regions are considered most appropriate to represent the Western North Pacific stock.

P. **Melon-headed whale**: An abundance estimated by Ferguson and Barlow (2001, 2003) from the ETP of 36,770 animals and a density estimated by Fulling et al. (2011) of 0.0043 animals/km^2 from the

Marianas Island area were the best available data to use to represent the Western North Pacific stock of melon-headed whales. The density of Fulling et al. (2011) is higher than the density (0.0021 animals/km^2) estimated by Mobley et al. (2000) for melon-headed whales near the Main Hawaiian Islands.

Q. **Pacific white-sided dolphin**: No data on density or abundance estimates are available on the Pacific white-sided dolphin in the western North Pacific (Miyashita, 1993). Recent research on genetic differentiation suggests that Pacific white-sided dolphins found in coastal Japanese waters and the Sea of Japan belong to a different population than Pacific white-sided dolphins found in offshore North Pacific waters (Hayano et al., 2004). Sighting surveys in the North Pacific were analyzed to estimate the abundance of Pacific white-sided dolphins in the Western North Pacific stock as 931,000 individuals (Buckland et al., 1993). This estimate is over an order of magnitude larger than the abundance estimated for this species in the eastern North Pacific by Ferguson and Barlow (2001, 2003). Without any data on density estimates for the western North Pacific (Miyashita, 1993), the data from the ETP (Ferguson and Barlow, 2001, 2003) are most appropriate as a proxy for the density of 0.0119 animals/km^2 of Pacific white-sided dolphins occurring in winter and spring. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Mobley et al., 2000; Barlow, 2006).

R. **Pantropical spotted dolphin**: Miyashita's (1993) abundance, 438,064 animals, (CV=0.174) and density, 0.0137 animals/km^2, estimated for waters off southern Japan/east Taiwan are the best available data to represent the Western North Pacific stock of pantropical dolphins. Miyashita's density is comparable to the density derived for the species in nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000) but is higher than that derived for these dolphins in the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006).

S. **Pygmy killer whale**: Kishiro and Kasuya (1993) reported that no pygmy killer whales were taken in Japanese drive fisheries, but Leatherwood and Reeves (1983) reported that pygmy killer whales were seen relatively frequently in the tropical Pacific off Japan. With no population data available for the Western North Pacific (WNP) stock of pygmy killer whales, a density of 0.0021 animals/km^2 and abundance of 30,214 animals estimated from eastern Pacific by Ferguson and Barlow (2001, 2003) were used to represent the WNP stock. Ferguson and Barlow's (2001, 2003) density estimate is an order of magnitude larger than that observed in the Hawaii EEZ (0.00039 animals/km^2; Barlow, 2006). No pygmy killer whales were sighted in nearshore Hawaii waters (Mobley et al., 2000).

T. **Risso's dolphin**: Miyashita (1993) reported an abundance estimate of 83,289 animals (CV=0.179) and density estimate of 0.0106 animals/km^2 for Risso's dolphins in the Western North Pacific stock off southern Japan/east Taiwan. Miyashita's (1993) density is an order of magnitude larger than that observed in the Hawaii EEZ (0.00097 animals/km^2; Barlow, 2006); no Risso's dolphins were observed in nearshore Hawaii waters (Mobley et al. 2000).

U. **Rough-toothed dolphin**: Rough-toothed dolphins are reportedly rare off Japan and in the heavily studied ETP. Since there are no data on abundance or density estimates for the Western North Pacific stock of rough-toothed dolphins, a density estimate of 0.0059 animals/km^2 and an abundance estimate of 145,729 animals from eastern Pacific waters (Ferguson and Barlow, 2001, 2003) was used to represent the Western North Pacific stock. Ferguson and Barlow's (2001, 2003) density is comparable to those observed for this species in the Hawaii EEZ (0.00355 animals/km^2; Barlow, 2006) but was higher than those estimated in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

V. **Short-beaked common dolphin**: No data on density or abundance estimates are available for the short-beaked common dolphin in the western Pacific Ocean (Miyashita, 1993). With no data on the Western North Pacific stock, the abundance and density data derived by Ferguson and Barlow (2001, 2003) from ETP surveys of 3,286,163 animals and 0.0562 animals/km^2, respectively, are most appropriate to represent the Western North Pacific stock of short-beaked common dolphins.

W. **Short-finned pilot whale**: The stock delineation of the short-finned pilot whale in the western North Pacific is not fully resolved. Kasuya et al. (1988) suggested two stocks of short-finned pilot whales occurred in the western North Pacific Ocean off Japan and Taiwan, with a southern stock found south of the Kuroshio Current front (south of 35° N), and a northern stock found between the frontal boundaries of the Kuroshio and Oyashio Currents (~35° to 43° N). Miyashita (1993) questioned whether only one stock of short-finned pilot whales in this region occurred but had no way of defining stock boundaries. Miyashita (1993) estimated the abundance of short-finned pilot whales in the Western North Pacific stock from 34 sighting cruises associated with the Japanese drive fishery as 53,608 individuals (CV=0.224), while the average density estimated in 1° blocks was 0.0153 animals/km^2 derived.

X. **Sperm whale**: Stock structure of this species has not been completely delineated for sperm whales in the North Pacific. NMFS considers historical and current abundance estimates to be unreliable (Allen and Angliss, 2013). Sightings collected by Kasuya and Miyashita (1988) suggest that two stocks of sperm whales occur in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands (~50°N) and winter off Hokkaido and Sanriku (~40°N), and the southwestern North Pacific stock with females that summer off Hokkaido and Sanriku (~40°N) and winter around the Bonin Islands (~25°N). The males of these two stocks are found north of the range of the corresponding females, i.e., in the Bering Sea (~55°N) and off Hokkaido and Sanriku (~40°N), respectively, during the summer. Since the stock structure has not been well delineated, an abundance is estimated for the North Pacific stock of sperm whales as 102,112 individuals (CV=0.155) (Kato and Miyashita, 1998). The density estimate of sperm whales, 0.0012 animals/km^2, calculated from the winter/spring survey around Guam and the Mariana Islands is the best representative estimate for sperm whales in this mission area (Fulling et al., 2011).

Y. **Spinner dolphin**: Gilpatrick et al. (1987) did not report any sightings from the Pacific coast of Japan, and this species was not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993). No data on density or abundance estimates are available for spinner dolphins in this region (Miyashita, 1993). Lacking density or abundance data on the Western North Pacific stock of spinner dolphins, the abundance estimate, 1,015,059 animals derived spinners in waters of the ETP (Ferguson and Barlow, 2001, 2003) at a similar latitude is appropriate to characterize this stock in mission area #2. Barlow's (2006) density estimate, 0.0008 animals/km^2, derived for spinner dolphins in the waters of the outer Hawaii EEZ is the best available.

Z. **Striped dolphin**: As many as three stocks of striped dolphins (one south of 30°N, one inshore north of 30°N, and one offshore north of 30°N, east of 145°E) may be present in the waters of the western North Pacific Ocean, but boundaries between the stocks have not been fully resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a population estimate for the total Western North Pacific stock as 570,038 animals (CV=0.186) and estimated a density of striped dolphins off southern Japan/east Taiwan as 0.0329 animals/km^2.

3. MISSION AREA #3—WEST PHILIPPINE SEA

1. **Blue whale**: Few data are available on blue whale occurrence in the North Pacific Ocean, especially in the Philippine Sea, and the stock structure in the North Pacific remains uncertain[15]. Stafford et al. (2001) studied the geographic variation of blue whale calls in the North Pacific Ocean using hydrophones off the Kamchatka Peninsula and along the western Aleutian Islands chain, and found that all recorded blue whale calls were of north-central and north-west Pacific blue whales. Based on Stafford et al. (2011) acoustic information, the best available occurrence data for blue whales in the northwestern Pacific Ocean are the sighting survey data associated with Japanese whaling (Tillman, 1977). Blue whales of the central North Pacific stock, found at this mission area (Stafford et al., 2001; Carretta et al., 2013), winter in western North Pacific waters and less frequently, in the central North Pacific, but summer off southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska.

Although the blue whale was the initial focus of Japanese whaling effort in the North Pacific, limited data were reported on blue whales. Therefore, whaling data on fin whales were judged to be the most appropriate proxy for blue whale occurrence estimates. From the fin whale estimates from Japanese whaling data, an abundance of 9,250 individuals was used for blue whales in mission area #2 (Tillman, 1977; Stafford et al., 2001; Carretta et al., 2013). A density of 0.0001 whales/km^2 was estimated for winter, spring, and fall seasons (Tillman, 1977, Ferguson and Barlow, 2001 and 2003; LGL, 2008). This density for blue whales is comparable to density estimates of the blue whale in offshore areas of the eastern tropical Pacific (ETP) (Ferguson and Barlow, 2003).

2. **Bryde's whale**: Three stocks of Bryde's whales are currently recognized in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific (Yoshida and Kato, 1999). Ohsumi's (1977) density estimate (0.0006 animals/km^2) and the IWC (2009) abundance estimate of 20,501 whales provide the best available estimates for the western North Pacific stock Bryde's whales. Barlow (2006) observed Bryde's whales around the Hawaiian Islands, deriving a higher density estimate (0.00019 animals/km^2).

3. **Common minke whale**: Two stocks of minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al., 1998). Minke whales occurring in mission area #3 are believed to be part of the "O" stock. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk and derived density estimates from encounter rates and effective search widths for the offshore population. Buckland et al. (1992) estimated the abundance of the Western North Pacific/"O" stock as 25,049 individuals and the density was estimated at 0.0033 animals/km^2 (Buckland et al., 1992). The density computed by Ferguson and Barlow (2001; 2003) for common minke whales in offshore areas of the ETP is an order of a magnitude lower.

4. **Fin whale**: Since fin whales migrate south from offshore waters of the northwest Pacific Ocean, the density of 0.0002 animals/km^2 for winter and spring and the abundance of 9,250 animals for the Western North Pacific stock occurring in mission area #3 were estimated from encounter rates of Japanese scouting boats in the northwest Pacific Ocean (Tillman, 1977; Mizroch, 2009). This density estimated for fin whales in the Western North Pacific stock are comparable to the density estimated for this species in offshore areas of the ETP (Ferguson and Barlow, 2001 and 2003).

5. **Humpback whale**: Recent research conducted by the SLASH consortium of scientists in the North Pacific Ocean has shown that humpback whale movement patterns between feeding areas in high latitudes and wintering grounds in lower latitudes are extremely complex but are indicative of a high level of population structure (Calambokidis et al., 2008). In the western North Pacific during winter and early spring, humpback whale distribution is centered along the Ogasawara Islands, Ryukyu Islands, Taiwan, the Philippines, and the Mariana Islands (Calambokidis et al., 2008). The remainder of the year, humpback whales are largely absent from these regions as they move northward to other regions of the North Pacific to feed, principally off Russia but also to the Bering Sea and the Gulf of Alaska (Calambokidis et al., 2008). The Western North Pacific stock of humpback whales are only expected in the western Philippine Sea mission area during winter, spring, and fall as they reside in or transit through the waters of this area. The SPLASH consortium derived an average abundance for the Asian wintering grounds of 1,107 humpback whales (Calambokidis et al., 2008), while a density of 0.0009 animals/km^2 was estimated for the Western North Pacific stock in mission area #3 (Acebes et al., 2007; LGL, 2008).

6. **Blainville's beaked whale**: Lacking data on population estimates for the Blainville's beaked whale in the western North Pacific, the data derived for this species in waters of the ETP (Ferguson and Barlow, 2001, 2003) are deemed most appropriate to represent the species in the Western North Pacific stock. Ferguson and Barlow's (2001, 2003) abundance derived for *Mesoplodon densirostris*

added to one-fifth of the *Mesoplodon* spp. abundance provides an estimate of 8,032 animals to represent this stock. The density estimate for *Mesoplodon* spp. at the same latitudes in the eastern Pacific, 0.0005 animals/km^2; is most appropriate (Ferguson and Barlow, 2001 and 2003). This density estimate is lower than that derived for Blainville's beaked whales in the Hawaii EEZ (0.00117 animals/km^2; Barlow, 2006) and in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), but is comparable to the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

7. **Common bottlenose dolphin**: Miyashita's (1993) abundance estimate of 168,791 (CV=0.261) and density estimate off southern Japan of 0.0146/km^2 represent the stock of Western North Pacific common bottlenose dolphins. Miyashita's (1993) density is similar to that observed in the nearshore Hawaii waters (0.0103/km^2; Mobley et al., 2000) but is an order of magnitude larger than that observed in the Hawaii EEZ (0.00131/km^2; Barlow, 2006).

8. **Cuvier's beaked whale**: No data are available for Cuvier's beaked whales in this region. Considering Cuvier's habitat preferences (e.g., water temperature, bathymetry), the best data available to use as a proxy for the Western North Pacific stock of Cuvier's beaked whales that occur in mission area #3 are Ferguson and Barlow's (2001 and 2003) density estimate of 0.0003 animals/km^2 and abundance estimate of 90,725 animals derived for the species in waters at the same latitudes in the eastern Pacific. This eastern Pacific density is much lower than those estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

9. **False killer whale**: From 34 sighting cruises associated with the Japanese drive fishery, Miyashita (1993) estimated an abundance of 16,668 (CV=0.263) and an average density of 0.0029 animals/km^2 of false killer whales in the Western North Pacific stock. Miyashita's (1993) average density is higher than the density estimated for false killer whales in the waters of the Hawaii EEZ (0.0001 animals/km^2; Barlow, 2006) but is comparable to the density derived for the species in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

10. **Fraser's dolphin**: Lacking occurrence or population data on the Fraser's dolphins in the western North Pacific, the abundance estimated at 220,789 animals for the species in the waters of the ETP by Ferguson and Barlow (2001, 2003) and the density of 0.0042 animals/km^2 estimated for Fraser's dolphins in the waters of the Hawaii EEZ by Barlow (2006).

11. **Ginkgo-toothed beaked whale**: Since no data on density or stock estimates are available for the Ginkgo-toothed beaked whale in this region, the density of 0.0005 animals/km^2 and abundance of 22,799 animals was estimated for *Mesoplodon* spp. at the same latitudes in the eastern Pacific (Ferguson and Barlow, 2001, 2003) are most appropriate to represent the North Pacific stock of ginkgo-toothed beaked whales in this region. The ETP density estimate is comparable to that for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

12. **Killer whale**: Killer whales have been observed off the southeast coast of Honshu, Japan, but no killer whales were taken in Japanese drive fisheries (Miyashita, 1993). Without any population or occurrence data on killer whales for the western North Pacific, the best available abundance estimate of 12,256 animals is from Ferguson and Barlow's (2001, 2003) long time series in the ETP while the best available density estimate of 0.0001 animals/km^2 is from LGL (2011) compilation of data for the Marianas area. LGL's (2011) density is very close to the density estimate of killer whales derived in waters of the Hawaii EEZ of 0.00014 animals/km^2 (Barlow, 2006).

13. ***Kogia* spp.**: Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution that are not believed to be concentrated anywhere specific. Summing the abundances of *Kogia breviceps, Kogia sima, and Kogia* spp. in the geographic strata defined by

Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals was computed in the ETP and considering the lack of data for the western North Pacific, is the most appropriate for this mission area. At this latitude, *Kogia breviceps* and *Kogia sima* are both expected to occur. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N (Ferguson and Barlow, 2001, 2003), a density estimate of 0.0017 animals/km^2 was derived, which is considered the best available for the Western North Pacific stock of *Kogia* spp. Ferguson and Barlow's (2001, 2003) density is slightly lower than the densities for pygmy sperm whale (0.00291 animals/km^2, CV=1.12) and dwarf sperm whale (0.00714 animals/km^2, CV=0.74) estimated within the Hawaii EEZ (Barlow, 2006).

14. **Longman's beaked whale:** Longman's beaked whales are known from tropical waters of the Pacific Ocean (Pitman et al., 1999; Dalebout et al., 2003). Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings in their ETP surveys were south of 25ºN. Considering the lack of occurrence or population data for the Western North Pacific stock of Longman's beaked whales, the abundance of 1,007 animals estimated for Longman's beaked whales in offshore Hawaiian waters (Barlow, 2006) and the density of 0.0003 animals per km^2 (LGL, 2011) derived from the Marianas regions are considered most appropriate to represent the Western North Pacific stock.

15. **Melon-headed whale:** With a lack of population data on melon-headed whales in the western North Pacific, the abundance estimated from the eastern Pacific of 36,770 animals (Ferguson and Barlow, 2001, 2003) and the density estimate of 0.0043 animals/km^2 (Fulling et al., 2011) derived for the Marianas region are the best available estimations for the Western North Pacific stock. The Fulling et al. (2011) density value is comparable to the estimate from Mobley et al. (2000) for near the Main Hawaiian Islands: 0.0021 animals/km^2.

16. **Pantropical spotted dolphin**: The Miyashita (1993) abundance estimate of 438,064 (CV=0.174) and density estimate, 0.0137 animals/km^2, derived for waters off southern Japan/east Taiwan were used to represent the Western North Pacific stock of pantropical spotted dolphins in this mission area. Miyashita's (1993) density is higher than that observed in the Hawaii EEZ (0.00366/km^2; Barlow, 2006) but is comparable to that derived for nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000).

17. **Pygmy killer whale**: Lacking data on the pygmy killer whale in the western North Pacific, density, 0.0021 animals/km^2, and abundance, 30,214 animals, estimates from eastern Pacific (Ferguson and Barlow, 2001 and 2003) were considered the best available as a proxy to represent the Western North Pacific stock of pygmy killer whales in this mission area. The Ferguson and Barlow density is an order of magnitude larger than that observed in the Hawaii EEZ (0.00039 animals/km^2; Barlow, 2006), while no pygmy killer whales were sighted in nearshore Hawaii waters (Mobley et al., 2000).

18. **Risso's dolphin**: Miyashita's (1993) abundance estimate of 83,289 animals (CV=0.179) and density estimate of 0.0106 animals/km^2 derived for Risso's dolphins off southern Japan/east Taiwan were used to represent the Western North Pacific stock of Risso's dolphin in this region. Miyashita's (1993) density is an order of magnitude larger than that observed in the Hawaii EEZ (0.00097 animals/km^2; Barlow, 2006); no Risso's dolphins were observed in nearshore Hawaii waters (Mobley et al., 2000).

19. **Rough-toothed dolphin:** Since no data on abundance or density estimates are available for the western North Pacific stock of Rough-toothed dolphins, a density estimate, 0.0059 animals/km^2, and an abundance estimate, 145,729 animals, from the ETP were used to represent this stock in this mission area (Ferguson and Barlow, 2001, 2003). This density is comparable to those observed in the Hawaii EEZ (0.00355 animals/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

20. **Short-finned pilot whale**: Kasuya et al. (1988) suggest that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the fronts of the Kuroshio Current and the Oyashio Current (from approximately 35° to 43°N). However,

since the northern form was not been harvested by Japanese drive fisheries (Kishiro and Kasuya, 1993), it was, thus not included in Miyashita's (1993). 0From 34 sighting cruises associated with the Japanese drive fishery, Miyashita (1993) estimated an abundance of short-finned pilot whales of 53,608, CV=0.224 and a density estimate of 0.0076 animals/km^2 that are appropriate for this species in the West Philippine Sea.

21. **Sperm whale**: Stock structure of this species has not been completely delineated for sperm whales in the North Pacific. Even though sightings collected by Kasuya and Miyashita (1988) were interpreted to indicate that two stocks of sperm whales exists in the western North Pacific Ocean, insufficient population-level data exist to adequately define a fine-scale population structure, except for the populations of sperm whales in U.S. EEZ waters (Allen and Angliss, 2013). For this reason, the number of sperm whales in the entire North Pacific stock is taken from Kato and Miyashita's (1998) estimate of 102,112 animals (CV=0.155). Since no densities of sperm whales have been estimated for this region, the density of 0.0012 animals/km^2 (Fulling et al., 2011), calculated from the winter/spring survey around Guam and the Mariana Islands, is the best representative estimate for this mission area.

22. **Spinner dolphin**: Records of spinner dolphins are not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or abundance estimates for this species are available (Miyashita, 1993). Lacking data on abundance or density estimates for the Western North Pacific stock of spinner dolphins, Ferguson and Barlow's (2001, 2003) abundance of 1,015,059 animals derived from the ETP, while the density estimated by Barlow (2006) of 0.0008 animals/km^2 for the offshore stratum of the outer Hawaiian EEZ are considered most appropriate to represent this stock in this mission area.

23. **Striped dolphin**: Though two stocks of striped dolphins may exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N, the boundaries between these populations have not been resolved (Miyashita 1993). Therefore, Miyashita's (1993) derived a total stock estimate, 570,038 animals (CV=0.186) for the Western North Pacific stock, while the density, 0.0164 animals/km^2, was estimated as one-half of Miyashita's (1993) density estimate from off southern Japan/east Taiwan.

4. MISSION AREA #4—GUAM

Eldredge (1991) compiled the first list of published and unpublished records or marine mammals in the waters of the Guam and the lower Marianas Islands, reporting 19 species. The waters in the vicinity of Guam and nearby Marianas Islands were most recently surveyed for marine mammals from January to April 2007 (Fulling et al., 2011), in August 2007 (Mobley et al., 2007), and from February to March 2010, when waters around Guam and Saipan were surveyed by small-boat (Ligon et al., 2011).

A. **Blue whale**: Although Stafford et al. (2001) showed that recordings made near Kaneohe, Hawaii from August 1992 through April 1993 consisted of approximately 30% of the northwest Pacific blue whale call type and 70% of northeast Pacific call type, stock structure of blue whales in the North Pacific Ocean remains uncertain. Due to the uncertainty in the stock structure of blue whales throughout the North Pacific Ocean[15] and limited occurrence data for this species, blue whales found in waters near Guam are considered part of the Central North Pacific stock (Stafford et al., 2001; Carretta et al., 2013), and proxy data are used for the estimated abundance of this stock in mission area #4. The estimated abundance of 9,250 whales is derived from fin whale data recording by Japanese whalers (Tillman, 1977). Due to the sparse occurrence data for blue whales in the region, a density of 0.0001 whales/km^2 was estimated for the winter, spring, and fall seasons of occurrence (Tillman, 1977, Ferguson and Barlow, 2001 and 2003; LGL, 2008; Fulling et al., 2011). This density for blue whales occurring in winter, spring, and fall seasons in the west Philippine Sea is comparable to the density estimate of the blue whale in offshore areas of the eastern tropical Pacific (ETP) (Ferguson and Barlow, 2003).

B. **Bryde's whale**: The IWC provides the best available population estimate for the western North Pacific stock at 20,501 whales (IWC, 2009). The best available density estimate (0.00041 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). The Fulling et al. (2011) density is comparable to density estimates from the ETP (0.0009/km^2) (Ferguson and Barlow, 2001, 2003) and the Hawaii EEZ (0.00019 animals/km^2; Barlow, 2006).

C. **Common minke whale**: A recent survey around Guam and the Mariana Islands (Fulling et al., 2011) heard but did not observe minke whales (Fulling et al., 2011). Two stocks of common minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al., 1998). Minke whales occurring in mission area #4 are believed to be part of the "O" stock. Buckland et al. (1992) estimated the abundance of the Western North Pacific/"O" stock as 25,049 individuals. The best available density for common minke whales is 0.0003 animals/km^2, the highest density reported for minke whales in the ETP (Ferguson and Barlow, 2001, 2003).

D. **Fin whale**: Fin whales are not typically expected to occur south of 20°N (Mizroch et al., 2009), and during recent surveys, no fin whales were detected (Fulling et al., 2011). Due to the lack of data available for fin whales in this region, any rare fin whales potentially occurring in this region are considered part of the Western North Pacific stock, with an abundance estimated as 9,250 whales (Tillman, 1977; Mizroch, 2009). The density estimate of 0.0001 for the waters of mission area #4 was derived from data from the eastern North Pacific stock (Ferguson and Barlow, 2001 and 2003). It is conservative to use the eastern North Pacific data especially because McDonald and Fox (1999) derived an average calling fin whale density estimate of 0.000027 animals/km^2 based on recordings made north of Oahu, Hawaii.

E. **Humpback whale**: Humpback whales are only expected in waters of this mission area during the winter, spring, and fall seasons, when they typically occur in water depths less than 183 m (100 fm) (Mobley et al., 2001). A central North Pacific stock has been identified as individuals that migrate from summer/fall feeding grounds of northern British Columbia and southeast Alaska (Prince William Sound west to Kodiak), to winter/spring breeding and calving grounds of the Hawaiian Islands (Carretta et al., 2013); some exchange between winter/spring areas has been documented, as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Calambokidis et al. 1997). Humpbacks in the Guam region are part of the central North Pacific stock, with an estimated abundance of 10,103 animals, from mark-recapture model estimates for North Pacific data from 2004 to 2006 (Calambokidis et al., 2008). A density of 0.0009 animals/km^2 for humpbacks occurring in the waters of mission area #4 has been estimated based on data from Acebes et al. (2007) and LGL (2008).

F. **Sei whale**: The IWC recognizes one stock of sei whales in the North Pacific (Donovan, 1991), although some evidence exists for several populations (Carretta et al., 2013). Very few sightings of sei whales have occurred in any region of the North Pacific. Until the recent survey conducted in the waters surrounding Guam (Fulling et al., 2011), where a total of 16 sei whale sightings were observed, sei whales were considered rare in the Marianas region. The best density estimate is 0.0003 animals animals/km^2 is derived from that survey (Fulling et al., 2011). The Marianas survey derived an abundance estimate of 177 animals, which is similar to other site-specific estimates in the eastern North Pacific where limited sightings have occurred (Carretta et al., 2013). Therefore, the best available estimate for the entire North Pacific stock, of which sei whales found in the waters of mission area #4 belong, is 8,600 animals based on very old whaling data (Tillman, 1977). Initial estimates for a portion of the sei whale stock off Japan indicate abundance estimates of similar magnitude (7,744 for May to June and 5,406 for July to September [Hakamada et al., 2009]).

G. **Blainville's beaked whale**: The density estimate of 0.0012 animals/km^2 derived from the Hawaii EEZ (Barlow, 2006) is the most appropriate for this species in this mission area. Lacking abundance data for this region, Ferguson and Barlow's (2001 and 2003) abundance estimate from the eastern Pacific that included the *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate for a total of 8,032 animals. Barlow's (2006) density estimate is comparable to that for Blainville's beaked whales in the eastern Pacific (0.0013 animals/km^2; Ferguson and Barlow, 2003), in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296/km^2; Ferguson et al., 2006).

H. **Common bottlenose dolphin:** Miyashita (1993) reports an abundance estimate of 168,791 animals (CV=0.261). The best available density estimate, 0.0013 animals/km^2, is calculated from the Hawaii EEZ survey data (Barlow, 2006). This density is comparable to that derived for this species in the eastern North Pacific at similar latitudes (0.0025 animals/km^2) (Ferguson and Barlow, 2003).

I. **Cuvier's beaked whale:** The best data available on density and abundance estimates are 0.0062 animals/km^2 for the Hawaii EEZ (Barlow, 2006) and 90,725 animals from the ETP (Ferguson and Barlow, 2003). The Hawaii density is comparable to the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

J. **Dwarf sperm whale**: Ferguson and Barlow's (2001 and 2003) derived an abundance estimate for *Kogia* spp. of 350,553 in the ETP, which is the most appropriate for the dwarf sperm whale in the Guam area. The 0.0071 animals/km^2 (CV=0.74) for dwarf sperm whales derived for the Hawaii EEZ (Barlow, 2006) is the best available density for the dwarf sperm whale in the Guam region.

K. **False killer whale**: Miyashita (1993) estimated the abundance of false killer whales as 16,668 animals (CV=0.263) from 34 sighting cruises associated with the Japanese drive fishery. The best available density estimate (0.0011 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is an order of magnitude larger than the density estimate (0.0001 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and comparable to nearshore Hawaii waters (0.0017 animals/km^2) during the spring, summer and fall (Mobley et al., 2000).

L. **Fraser's dolphin**: Barlow (2006) estimated the density of the Fraser's dolphin in Hawaii waters during a recent summer/fall survey as 0.0042 animals/km^2, which is the most appropriate density for this species in this mission area. Ferguson and Barlow's (2001 and 2003) abundance estimate of 10,226 individuals (CV=1.16) for the Fraser's dolphin is the best available for mission area #4.

M. **Ginkgo-toothed beaked whale**: Since no data on density or stock estimates are available for this species, the best available density and abundance estimates for *Mesoplodon* spp. at the same latitudes in the ETP are most appropriate for this region (Ferguson and Barlow, 2001, 2003). Using Ferguson and Barlow's (2001, 2003) northernmost strata, a density estimate of 0.0009 animals/km^2 and abundance estimate of 22,799 animals were used for analyses at this site.

N. **Killer whale**: Killer whales are considered rare with limited sightings reported (Carretta et al., 2013). The best available density estimate, 0.0001 animals/km^2, are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). An abundance of 12,256 animals was estimated by Ferguson and Barlow (2001 and 20003) and is the most appropriate for this region. Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nm of the Main Hawaiian Islands, nor did the Fulling et al. (2011) surveys around the Mariana Islands.

O. **Longman's beaked whale:** There was no density estimate for Longman's beaked whales available from the Mariana Islands (Fulling et al., 2011), so a density estimate of 0.0004 animals per km^2 (CV = 1.26) and an abundance estimate of 1,007 animals were derived from the Hawaii offshore area (Barlow, 2006).

P. **Melon-headed whale**: The best available density estimate (0.0043 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.0012 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and in nearshore Hawaii waters (0.0021 animals/km^2) during the spring, summer and fall (Mobley et al., 2000). An abundance estimate in the eastern North Pacific (36,770) (Ferguson and Barlow, 2001 and 2003) was used.

Q. **Pantropical spotted dolphin**: Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Japan. Miyashita (1993) reports an abundance estimate of 438,064 animals, (CV=0.174). The best available density estimate, 0.0226 animals/km^2, is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This density is comparable to that observed in the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006) and an order of magnitude less than that observed in nearshore waters of Hawaii (0.0407 animals/km^2; Mobley et al., 2000).

R. **Pygmy killer whale**: One sighting of six animals was observed during surveys around the Mariana Islands, from which a density estimate (0.0001 animals/km^2) was derived (Fulling et al., 2011). Data from the eastern North Pacific was used to derive a stock-wide abundance estimate (30,214 animals) (Ferguson and Barlow, 2001 and 2003). This is comparable to that observed in the Hawaii EEZ (0.00039 animals/km^2; Barlow, 2006). None were sighted in nearshore Hawaii waters (Mobley et al., 2000).

S. **Pygmy sperm whale**: Ferguson and Barlow's (2001 and 2003) derived an abundance estimate for *Kogia* spp. of 350,553 for in the ETP, which is the best estimate available for the Guam area. The combined densities of 0.0029 animals/km^2 (CV=1.12) for pygmy sperm whales was derived for the Hawaii EEZ (Barlow, 2006) and was used for this species in the Guam region. Mobley et al. (2000) observe two pods of five individuals during the 1993 to 1998 surveys in Hawaii, but no density or abundance estimates were derived.

T. **Risso's dolphin:** Neither Fulling et al. (2011) or Mobley et al. (2000) collected sufficient sighting data to derive density or abundance estimates for this species. Miyashita (1993) reports a western North Pacific stock estimate of 83,289 animals (CV=0.179). The density estimate of 0.0010 animals/km^2 was used for this site was derived from surveys in the Hawaii EEZ (Barlow, 2006). This density is comparable to the density estimate calculate for the eastern North Pacific (0.0007 animals/km^2; Ferguson and Barlow, 2003).

U. **Rough-toothed dolphin**: Fulling et al. (2011) did not collect sufficient sighting data to derive density or abundance estimates for this species. Thus, the best available density estimate (0.0036/km^2) is calculated from Hawaii EEZ data (Barlow, 2006) while the best available data for abundance is estimated from the eastern North Pacific (145,729 individuals) (Ferguson and Barlow, 2001 and 2003).

V. **Short-finned pilot whale:** Fulling et al. (2011) did not collect sufficient sighting data to derive density or abundance estimates for this species. Miyashita (1993) estimated abundance of short-finned pilot whales as 53,608 animals (CV=0.224) from 34 sighting cruises associated with the Japanese drive fishery is thus most appropriate. The best available density estimate (0.0036 animals/km^2) is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). This density is an order of magnitude less than in nearshore Hawaii waters (0.0237 animals/km^2) during the spring, summer and fall (Mobley et al., 2000).

W. **Sperm whale**: Insufficient population-level data exist to currently adequately define the stock structure of sperm whales in the North Pacific, except in U.S. EEZ waters, where for management purposes, three stocks have been defined: a North Pacific stock that migrates between Alaska and the western North Pacific, a central North Pacific stock around Hawaii, and a California/Oregon/Washington stock off the U.S. west coast (Allen and Angliss, 2013). Further, the

NMFS considers both currently available and historical population estimates for the North Pacific stock to be unreliable (Allen and Angliss, 2013). The IWC recognizes two stocks in the North Pacific Ocean (eastern and western stocks), but stock boundary review by the IWC is woefully out of date (Donovan, 1991). Sperm whales in the Guam mission area are part the North Pacific stock. Regardless, since an abundance estimate is needed for the calculation of impacts, the best available abundance estimate for the North Pacific stock is the estimate is Kato and Miyashita's (1998) of 102,112 individuals. In the 2007 surveys in the southern Marianas Island including Guam, Fulling et al. (2011) reported that the sperm whale was the most frequently encountered marine mammal. The density estimated for sperm whales in waters of the southern Marianas Islands, 0.0012 animals/km^2, was calculated from the 2007 winter/spring surveys reported in Fulling et al. (2011).

X. **Spinner dolphin:** The best available density estimate (0.0008 animals/km^2) is calculated from the Hawaii EEZ survey data (Barlow, 2006) while the best available abundance estimated for WNP stock of spinner dolphins (1,015,059 animals) is from the ETP (Ferguson and Barlow, 2001 and 2003). The density of Barlow (2006) is an two orders of magnitude less than that observed in nearshore waters of Hawaii (0.0443 animals/km^2; Mobley et al., 2000).

Y. **Striped dolphin**: Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for two populations in the area: one inshore north of 30°N, and one offshore north of 30°N, east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate of 570,038 (CV=0.186). The best available density estimate (0.0062 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to that observed in the Hawaii EEZ (0.00536 animals/km^2; Barlow, 2006) and in nearshore waters of Hawaii (0.0016 animals/km^2; Mobley et al., 2000).

5. MISSION AREA #5—SEA OF JAPAN

A. **Bryde's whale**: Omura (1977) refers to four major whaling grounds on the coast of Japan: waters off Bonin Islands, Sanriku, Wakayama (Taiji), and West Kyushu. None of these are in the Sea of Japan. However, Evans (1987) says that Bryde's whales are found from northern Japan to the equator in the western North Pacific. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best density data available are the long-term time series from the ETP (Ferguson and Barlow, 2001 and 2003): density estimate (0.0001 animals/km^2). The IWC population estimate of 20,501 whales for the western North Pacific stock was used for in analyses for this site (IWC, 2009). Barlow (2006) observed Bryde's whales around the Hawaiian Islands, deriving a comparable density estimate (0.00019 animals/km^2).

B. **Common minke whale**: The west coast of Honshu was seldom used for whaling, but the west side of Hokkaido had established whaling grounds (Ohsumi, 1978). As such, there are limited data on density and stock estimates in the southern portion of the Sea of Japan. However, based on the data available for the northern portion of the Sea of Japan, minke whales are relatively common in these waters. Two stocks of minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al., 1998). Animals in this region are believed to be part of the "O" and "J" stocks (Butterworth et al., 1996; Gong, 1988). The modeled density estimate (0.0004 animals/km^2) of "O" stock animals was derived from the ETP (Ferguson and Barlow, 2001, 2003). An abundance estimate for the western North Pacific (25,049 individuals) was used to represent the O stock (Buckland et al., 1992). The Pastene and Goto (1998) abundance of 893 animals and Ferguson and Barlow's (2001 and 2003) density of 0.0002 animals/km^2 estimated from the ETP best represent the J stock of common minke whales.

C. **Fin whale**: Fin whales migrate south in the winter to about 10°N, and are found in the summer from a line near Japan north to the Chukchi Sea and Aleutian Islands (Evans, 1987). Fin whales are known to winter in the Sea of Japan and are probably found there throughout the year (Mizroch et al., 2009). Historic stock estimates for the western North Pacific stock of fin whales were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977). The current density estimate (0.0009 animals/km^2) for the western North Pacific is roughly estimated from data of the ETP (Ferguson and Barlow, 2001, 2003).

D. **North Pacific right whale**: The western North Pacific right whale population is considered distinct from the eastern population, arbitrarily separated by the 180° line of longitude (Best et al., 2001). The Okhotsk Sea, Kuril Islands, and eastern Kamchatka coast represent major feeding grounds for the western population (Brownell et al., 2001) where animals are typically found May through September (Clapham et al. 2004). Various areas have been proposed for breeding and calving grounds, including the Ryukyu Islands, Yellow Sea, Sea of Japan, offshore waters far from land, and the Bonin Islands, but a lack of winter sightings (December-February) makes a definitive assessment impossible (Brownell et al., 2001). Clapham et al. (2004) note the extensive offshore component to the right whale's distribution in the 19th century data. Movement north in spring (peak months of February-April) and south in fall (peak months September-December) suggest the possibility of two putative sub-populations in the western population that are kept apart by the Japanese islands, though this seems unlikely (Brownell et al., 2001, Clapham et al., 2004). Data from Japanese sighting cruises in the Okhotsk Sea provide an abundance estimate of 922 animals (CV=0.433, 95% CI=404 to 2,108) (Best et al., 2001) for the western North Pacific population. The western population may be affected by proposed LFA operations in the spring, fall, and winter in the Sea of Japan. Although no density estimates are available for this very rare marine mammal species, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis to reflect the very low probability of occurrence in this region.

E. **Western North Pacific gray whale**: Gray whales in the western North Pacific Ocean are genetically distinct from those gray whales occurring in the eastern North Pacific Ocean (LeDuc et al., 2002). The present day distribution of the western North Pacific gray whale stock appears to range from summering grounds in west central Okhotsk Sea off the northeast coast of Sakhalin Island to wintering grounds in the South China Sea (Meier et al., 2007; Weller et al., 2002). The western North Pacific gray whales migrate through the Sea of Japan in November to December. The exact migration route is not known, and Omura (1988) indicated that gray whales were caught along the Chinese and North Korea coasts in the Sea of Japan. Gray whales presumably maintain a shallow water/nearshore affinity throughout the southern portion of their range. Current IWC abundance estimates report less than 121 animals in the western Pacific stock (IWC, 2009). With no density estimate for this rare species available, a minimal density of 0.0001 animals/km^2 was used in risk computation for this mission area to reflect the extremely low potential for this species occurring.

F. **Baird's beaked whale**: Kasuya (1986) reported catches of Baird's in the Sea of Japan around approximately 37°N (Toyama Bay) and off southern Hokkaido (41°-42°N). From Kasuya's (1986) encounter rate and effective search widths, an abundance estimate of 4,200 animals and a density of 0.0003 animals/km^2 were derived. This covered the region from about 32° to 40°N and seaward of the Pacific Japanese coast out to about 150°E. However, since Kasuya's surveys did not include habitat further north, the stock estimate is increased to 8,000 to account for unsurveyed areas. The density estimate (0.0003) is comparable to the most western strata density estimates in the eastern Pacific (Ferguson and Barlow, 2003).

G. **Common bottlenose dolphin**: Kishiro and Kasuya (1993) reported that bottlenose dolphins were caught at Ohmishima in Yamaguchi Prefecture in the Sea of Japan. Miyashita (1993) reported that reproductive differences suggest that animals from the Sea of Japan and East China Sea are a

separate, inshore Archipelago stock than animals in the western North Pacific. Kishiro and Kasuya (1993) cite Miyashita (1986) as estimating the abundance of the stock in the East China Sea as 35,046. Since these data represent only about one-third of the habitat of bottlenose dolphins in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (105,138 animals). No density estimates are available for this stock; therefore the density estimate (0.0008 animals/km^2) was calculated from LGL (2011) data.

H. **Cuvier's beaked whale:** No density or stock estimate data are available for this region, Leatherwood and Reeves (1983) state that Cuvier's beaked whales are relatively common in the Sea of Japan. Considering habitat preferences (e.g., water temperature, bathymetry), the best available density and abundance data are derived from Ferguson and Barlow (2001, 2003): density estimate (0.0031 animals/km^2), abundance estimate (90,725 animals). This density is comparable to the density estimate for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

I. **Dall's porpoise**: Dall's porpoise are found only in the North Pacific, primarily north of 36°N in the western North Pacific. This species has two distinct color morphs: one with a white flank patch that extends forward to the dorsal fin (*dalli* type) and one with a flank patch extending all the way to the front flippers (*truei* type). These morphological differences have been noted between animals from the Pacific coast of Japan (the *truei*-type), the Sea of Japan and Sea of Okhotsk (the *dalli*-type), and the offshore northwestern Pacific and western Bering Sea (the *dalli*-type) (Hayano et al., 2003). Hayano et al. (2003) conducted genetic studies on the three populations and found a low, but significant, difference between the Sea of Japan-Okhotsk population and the other two populations. Based on surveys of the eastern North Pacific, a density estimate of 0.0520 animals/km^2 and an abundance estimate of 76,720 animals were derived and best represent this species in this region (Ferguson and Barlow, 2001, 2003). This density estimate is probably higher than what would be encountered by LFA operations in the Sea of Japan since it includes survey effort in nearshore waters where animals are more often found.

J. **False killer whale**: Kishiro and Kasuya (1993) reviewed the history of Japanese coastal whaling, reporting that false killer whales were caught on the Noto coast of Japan in the Sea of Japan. Miyashita (1993) suggested that animals summering in the Sea of Japan were probably from a separate, inshore Archipelago stock, by analogy from Pacific white-sided dolphins, than animals in the western North Pacific. Kishiro and Kasuya (1993) cited Miyashita (1986) as estimating the population wintering in Iki Island waters (in the Korea Strait) and part of the East China Sea at 3,259 animals. Since these data represent only about one-third of the habitat of false killer whales in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (9,777 animals). This is smaller than the estimated abundance of false killer whales off the Pacific coast of Japan (16,668 animals CV=0.263) (Miyashita, 1993). Since no sightings of false killer whales were made during the survey effort in the Sea of Japan and East China Sea (Miyashita, 1993), the western North Pacific density estimate (0.0027 animals/km^2) is estimated from the northernmost region of eastern North Pacific (Ferguson and Barlow, 2001 and 2003). This is an order of magnitude larger than the density estimate in the Hawaii EEZ (0.0001 animals/km^2; Barlow, 2006) and comparable to nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

K. **Killer whale**: Killer whales are considered rare with limited sightings reported (Carretta et al., 2013). The best available density estimate (0.0001 animals/km^2) was derived from LGL (2011). The most representative abundance estimate of 12,256 animals was calculated from the Ferguson and Barlow's (2001 and 2003) eastern North Pacific data. Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nm of the Main Hawaiian Islands, nor did the Fulling et al. (2011) surveys around the Mariana Islands.

L. ***Kogia* spp.:** Ferguson and Barlow's (2001, 2003) derived an abundance estimate for *Kogia* spp. of 350,553 for in the ETP and a density of 0.0017 animals/km^2, which are the best estimate available for the Guam area. Mobley et al. (2000) observe two pods of five individuals during the 1993 to 1998 surveys in Hawaii, but no density or abundance estimates were derived.

M. **Pacific white-sided dolphin**: Recent research on genetic differentiation suggests that animals found in coastal Japanese waters and the Sea of Japan belong to a separate, inshore Archipelago stock than animals found in offshore North Pacific waters (Miyashita, 1993; Hayano et al., 2004). Sighting surveys in the North Pacific were analyzed to estimate the abundance of Pacific white-sided dolphins as 931,000 individuals (Buckland et al. 1993). This estimate is over an order of magnitude larger than the abundance estimate in the eastern North Pacific (Ferguson and Barlow, 2001, 2003). Without any data for the inshore Archipelago population, it is roughly estimated that the abundance estimate from the western North Pacific (931,000 animals) and the density estimate (0.0030 animals/km^2) from the ETP (Ferguson and Barlow, 2001, 2003) are appropriate. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Barlow, 2006; Mobley et al., 2000).

N. **Risso's dolphin**: Kishiro and Kasuya (1993) reported that Risso's dolphins were caught on islands in the Korea Strait. Miyashita (1993) reported sightings in the Sea of Japan during June surveys (no effort during other months), and suggested by analogy to bottlenose dolphins and Pacific white-sided dolphins that animals summering in Sea of Japan are a separate, inshore Archipelago stock from the western North Pacific stock. There are no separate data reported for the Sea of Japan or East China Sea, however. Therefore, the western North Pacific stock estimate (83,289 animals, CV=0.179) and density estimate (0.0073 animals/km^2) were derived from the Pacific coast of Japan (Miyashita, 1993). This is an order of magnitude larger than that observed in the Hawaii EEZ (0.00097 animals/km^2; Barlow, 2006) and no Risso's dolphins were observed in nearshore Hawaii waters (Mobley et al., 2000) or around Guam and the Mariana Islands (Fulling et al., 2011).

O. **Rough-toothed dolphin**: The best available density estimate (0.0036 animals/km^2) is calculated from the survey data in the Hawaii EEZ (Barlow, 2006), while the best available data on for an abundance estimate is from the eastern North Pacific (145,729 individuals) (Ferguson and Barlow, 2001, 2003). The density is comparable to that in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000).

P. **Short-beaked common dolphin:** Common dolphins have been caught on the Tsushima Islands in the Korea Strait (Kishiro and Kasuya, 1993). There are no data on density or stock estimates (Miyashita, 1993). The density estimate (0.0860 animals/km^2) and abundance estimate of 3,286,163 animals were calculated from Ferguson and Barlow (2001, 2003) in the eastern North Pacific at similar latitudes.

Q. **Short-finned pilot whale**: Kishiro and Kasuya (1993) reported that short-finned pilot whales are uncommon in the Sea of Japan and that insufficient information exists from which to determine whether the southern or northern form occurs in the region. Because of limited data specific to this region, data from the Pacific coast of Japan and Taiwan and the eastern North Pacific was used. Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 animals, CV=0.224) and also derived density estimates in 1° latitude by 1° longitude boxes as 0.0014 animals/km^2. This estimate was similar to a density estimate derived from analogous latitudes in the eastern North Pacific (Ferguson and Barlow, 2003).

R. **Sperm whale**: Stock structure of sperm whales in the North Pacific Ocean remains unclear except in U.S. EEZ waters (Allen and Angliss, 2013). Kasuya and Miyashita (1988) reported no Japanese whaling stations processing sperm whales in the Sea of Japan (Leatherwood and Reeves, 1983). Gregr and Trites (2001) reviewed sperm whale catch data off the coast of British Columbia to determine habitat preferences, and it is possible that the Sea of Japan provides adequate habitat

conditions for sperm whales. The density, 0.0012 animals/km^2, estimated for sperm whales from the dedicated surveys in the waters around the Marianas Islands (Fulling et al., 2011) represent the best available density for this mission area. Kato and Miyashita's (1998) sperm whale abundance estimate for the North Pacific stock that migrates between Alaska and the western North Pacific is the best currently available for the overall stock. The ETP density is comparable to that (0.0010 animals/km^2) estimated for the main Hawaiian Islands (Mobley et al., 2000) and the density estimate (0.00123 animals/km^2) calculated from the winter/spring surveys around Guam and the Mariana Islands (Fulling et al., 2011).

S. **Stejneger's beaked whale**: Miyazaki et al. (1987) reported four Stejneger's beaked whales that stranded in the Sea of Japan at about 37°N/135°E. Density or stock estimate data are not available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), Stejneger's density estimate (0.0005 animals/km^2) is ETP data of Ferguson and Barlow (2001, 2003) and the abundance estimate is approximated as that of Baird's beaked whales (8,000 animals) (Kasuya, 1986).

T. **Striped dolphin**: Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for two populations in the area: one inshore north of 30°N, and one offshore north of 30°N, east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate of 570,038 (CV=0.186). The best available density estimate (0.0058 animals/km^2) is calculated from LGL (2011) data. This is comparable to that observed in the Hawaii EEZ (0.00536 animals/km^2; Barlow, 2006) and in nearshore waters of Hawaii (0.0016 animals/km^2; Mobley et al., 2000).

6. MISSION AREA #6—EAST CHINA SEA

A. **Bryde's whale:** Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia stock (mainly Philippine waters and the Gulf of Thailand), East China Sea, and offshore western North Pacific. The best available population estimate for the western North Pacific stock is estimated by the IWC as 20,501 whales (IWC, 2009). Ohsumi (1977) reported the most appropriate density estimate of 0.0006 animals/km^2 for the western North Pacific, which is comparable to the Hawaii EEZ (0.00019 animals/km^2; Barlow, 2006), the ETP (0.0009 animals/km^2; Ferguson and Barlow, 2001, 2003) and Guam and the Mariana Islands (0.00041 animals/km^2) (Fulling et al., 2011).

B. **Common minke whale**: Minke whales have been reported from the East China Sea and the Yellow Sea. Individuals in this area are believed to be from the J-stock (Butterworth et al., 1996; Gong, 1988), migrating into the region in the winter. To be conservative, however, estimates were made for both the "O" stock and the "J" stock, given the limited amount of data. Therefore, an estimate for the "O" stock was derived based on encounter rates in the favored whaling grounds of the western North Pacific and the western North Pacific stock estimate of 25,049 animals was used along with the density of 0.0044 animals/km^2 (Buckland et al., 1992). The density, 0.0018 animals/km^2, estimated by Buckland et al. (1992) for the J stock was used to represent this stock in this mission area but the abundance of 893 animals is estimated by Pastene and Goto (1998). These estimates are an order of magnitude higher than any calculated in the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

C. **Fin whale**: Fin whales winter in the East China Sea and Yellow Sea. The East China Sea population of fin whales is thought to be resident and may represent a distinct population (Evans, 1987). There are limited data on distribution and abundance, however in this region (Mizroch et al., 2009). Density and stock estimates (Mizroch et al., 2009) were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977). These data are comparable to density estimates in other areas of the ETP (Ferguson and Barlow, 2001, 2003) and around Hawaii (Barlow, 2006).

D. **North Pacific right whale**: The western North Pacific right whale population is considered distinct from the eastern population, arbitrarily separated by the 180° line of longitude (Best et al., 2001). The Okhotsk Sea, Kuril Islands, and eastern Kamchatka coast represent major feeding grounds for the western population (Brownell et al., 2001) where animals are typically found May through September (Clapham et al., 2004). Various areas have been proposed for breeding and calving grounds, including the Ryukyu Islands, Yellow Sea, Sea of Japan, offshore waters far from land, and the Bonin Islands, but a lack of winter sightings (December to February) makes a definitive assessment impossible (Brownell et al., 2001). Clapham et al. (2004) noted the extensive offshore component to the right whale's distribution in the 19th century data. Movement north in spring (peak months of February to April) and south in fall (peak months September to December) suggest the possibility of two putative sub-populations in the western population that are kept apart by the Japanese islands, though this seems unlikely (Brownell et al., 2001, Clapham et al., 2004). Data from Japanese sighting cruises in the Okhotsk Sea provide an abundance estimate of 922 animals (CV=0.433, 95% CI=404-2,108) (Best et al., 2001) for the western North Pacific population. Although no density estimates are available for this very rare marine mammal species, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis to reflect the very low probability of occurrence in this region.

E. **Western North Pacific gray whale**: Gray whales in the western North Pacific Ocean are genetically distinct from those gray whales occurring in the eastern North Pacific Ocean (LeDuc et al., 2002). The exact location of winter breeding grounds for this species is not known, though it is hypothesized that western Pacific gray whales winter in the East and South China Seas, in the vicinity of Korea and China (Evans, 1987, Omura, 1988). The exact migration route is not known, but they are believed to migrate directly across the East China Sea, which is one of the few times that they leave their shallow, nearshore habitat (Omura, 1988). During migration, western North Pacific gray whales may be found up to 741 km (400 nmi) offshore (Weller et al., 2002). A current abundance of 121 gray whales is estimated for the western Pacific stock by the IWC (IWC, 2009). With no density estimate for this rare species available, a minimal density of 0.0001 animals/km^2 was used in risk computation for this mission area to reflect the extremely low potential for this species occurring.

F. **Blainville's beaked whale:** The best available data are a density estimate (0.0005 animals/km^2) and an abundance estimate of 8,032 animals from the eastern Pacific (Ferguson and Barlow, 2001, 2003). The *Mesoplodon densirostris* estimate was added to one-fifth of the *Mesoplodon* spp. abundance estimate for an estimate of 8,032 animals. The density estimate is comparable to that for Blainville's beaked whales in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296/km^2; Ferguson et al., 2006).

G. **Common bottlenose dolphin**: Kishiro and Kasuya (1993) reported that bottlenose dolphins were caught in the Korea Strait and off Goto Island in the East China Sea. Miyashita (1993) reported that reproductive differences suggest that animals from the Sea of Japan and East China Sea are a separate, inshore Archipelago stock from animals in the western North Pacific. Kishiro and Kasuya (1993) cited Miyashita (1986) as estimating the abundance of the stock in the East China Sea as 35,046. Since these data represent only about one-third of the habitat of bottlenose dolphins in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (105,138 animals). No density estimates were available for this stock; therefore, a density estimate of 0.0008 animals/km^2 was derived from LGL (2011). This is appropriate since bottlenose dolphins were sighted in the East China Sea survey effort (Miyashita, 1993). This density estimate is lower than that of Mobley et al. (2000) estimate around Hawaii (0.0103 animals/km^2) but is more comparable to that derived by Barlow (2006) (0.0013 animals/km^2).

H. **Cuvier's beaked whale:** No density or stock estimate data are available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best data

available are a density estimate 0.0003 animals/km^2) and an abundance estimate of 90,725 animals (Ferguson and Barlow, 2001, 2003).

I. **False killer whale**: Miyashita (1993) suggested that animals summering in the Sea of Japan are probably from a separate, inshore Archipelago stock than animals offshore in the western North Pacific, by analogy from Pacific white-sided dolphins. Kishiro and Kasuya (1993) cited Miyashita (1986) as estimating the population wintering in the East China Sea at 3,259. Since these data represent only about one-third of the habitat of false killer whales in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (9,777 animals). There are no data on density estimates for the East China Sea. The best available density estimate (0.0011 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is an order of magnitude larger than the density estimate (0.0001 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and comparable to nearshore Hawaii waters (0.0017 animals/km^2) during the spring, summer, and fall (Mobley et al., 2000).

J. **Fraser's dolphin:** Kishiro and Kasuya (1993) reported catches off the Pacific coast of Japan in drive fisheries. Without any data on stock or density estimates for the western North Pacific, the population estimates (220,789 animals) from the ETP (Ferguson and Barlow, 2001, 2003) are most appropriate for application to this area. Barlow's (2006) density estimate of 0.0042 animals/km^2 derived for the Hawaiian EEZ is most appropriate for this mission area.

K. **Ginkgo-toothed beaked whale:** Miyazaki et al. (1987) reported no strandings of *M. ginkgodens* in the East China Sea. This is probably a separate population from that of the offshore western North Pacific, but no data are available. Since no data on density or stock estimates are available for this species, it was roughly estimated that the density (0.0005 animals/km^2) and abundance estimates (22,799 animals) for *Mesoplodon* spp. at the same latitude in the eastern Pacific (Ferguson and Barlow, 2001, 2003) are appropriate. This density estimate is comparable to that for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

L. **Killer whale**: Killer whales are considered rare with limited sightings reported (Carretta et al., 2013). The best available density estimate (0.0001 animals/km^2) is estimated from LGL (2011) while the best abundance estimate (12,256 animals) are calculated from the eastern North Pacific by Fergusona nd Barlow (2001, 2003). Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nmi of the Main Hawaiian Islands, nor did the Fulling et al. (2011) surveys around the Marianas Islands.

M. ***Kogia* spp.:** No density or abundance estimates are available. Summing the abundances of *Kogia breviceps, Kogia sima, and Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals is computed in the ETP. At the latitude of this site, *Kogia breviceps* and *Kogia sima* are both expected to occur. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N (Ferguson and Barlow, 2001, 2003), a density estimate of 0.0017 animals/km^2 was modeled. This is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2 (CV=1.12) and dwarf sperm whale (0.00714 animals/km^2 (CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

N. **Longman's beaked whale:** Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings were south of 25ºN. There was no density estimate for Longman's beaked whales available from the Mariana Islands (Fulling et al., 2011), therefore, a density estimate of 0.0003 animals/km^2 was derived from LGL (2011) and an abundance estimate of 1,007 animals were derived from the Hawaii offshore area (Barlow, 2006).

O. **Melon-headed whale:** The first record of melon-headed whales in Korean waters occurred in January 2009 with the stranding of an adult male on the southeast corner of the country (Kim et al.,

2010). Melon-headed whales are rare except in the Philippine Sea are probably uncommon in the colder waters of the East China Sea. The best available density estimate (0.0043 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.0012 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and in nearshore Hawaii waters (0.0021 animals/km^2) during the spring, summer and fall (Mobley et al., 2000). An abundance estimate in the eastern North Pacific (36,770 animals) (Ferguson and Barlow, 2001, 2003) was used.

P. **Pacific white-sided dolphin:** Recent research on genetic differentiation suggests that animals found in coastal Japanese waters and the Sea of Japan belong to a separate, inshore Archipelago stock than animals found in offshore North Pacific waters (Miyashita, 1993; Hayano et al., 2004). Sighting surveys in the North Pacific were analyzed to estimate the abundance of Pacific white-sided dolphins as 931,000 individuals (Buckland et al., 1993). This estimate is over an order of magnitude larger than the abundance estimate in the eastern North Pacific (Ferguson and Barlow, 2001, 2003). Without any data for the inshore Archipelago population, it is roughly estimated that the abundance estimate from the western North Pacific (931,000 animals) and the density estimate (0.0028 animals/km^2) from the ETP (Ferguson and Barlow, 2001, 2003) are appropriate. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Barlow, 2006; Mobley et al., 2000).

Q. **Pantropical spotted dolphin:** Gilpatrick et al. (1987) reported some animals from along the chain of the Ryukyu Islands. Miyashita (1993) summarized data from 34 sighting cruises conducted as part of the Japanese drive fishery. There was no discontinuity in sightings to suggest different stocks, though based on data from the ETP, it is possible that multiple populations exist in the western North Pacific (Miyashita, 1993). Total population size was 438,064 animals (CV=0.174); density estimate for western North Pacific was 0.0137 animals/km^2. One-half the abundance of the western North Pacific stock (219,032 individuals) was estimated with the same density estimate of 0.0137/km^2. This is comparable to those observed in the Hawaii EEZ (0.00366/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000).

R. **Pygmy killer whale**: There was no mention of pygmy killer whale sightings in Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or stock estimates off Japan or Taiwan have been reported (Miyashita, 1993). The best available density estimate (0.0001 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.00039 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). No pygmy killer whales were seen in nearshore aerial during the spring, summer and fall (Mobley et al., 2000). An abundance of 30,214 animals was estimated from Ferguson and Barlow's (2001, 2003) eastern North Pacific data.

S. **Risso's dolphin:** Kishiro and Kasuya (1993) reported that Risso's dolphin inhabit the East China Sea. Miyashita (1993) reported sightings in the East China Sea during June and September surveys (no effort during other months) and suggested, by analogy to bottlenose dolphins and Pacific white-sided dolphins, that animals summering in Sea of Japan are a separate, inshore Archipelago stock from the western North Pacific stock. However, there are no separate data reported for the Sea of Japan or East China Sea. Consequently, data from the western North Pacific for stock estimate (83,289 animals, CV=0.179) and density estimate (0.0106 animals/km^2) derived for the southeast Pacific coast of Japan/east of Taiwan (Miyashita, 1993) were used. For comparison, no density estimates were available from Mobley et al. (Mobley et al., 2000) and Fulling et al. (2011), and an estimate of 0.0010 animals/km^2 was reported in the offshore waters of Hawaii (Barlow, 2006).

T. **Rough-toothed dolphin:** There are no data on stock or density estimates for the western North Pacific; therefore, a density estimate from the Hawaii EEZ (0.0036 animals/km^2; Barlow, 2006) was most appropriate. An abundance of 145,729 animals was estimated from Ferguson and Barlow's (2001, 2003) ETP data. The density is comparable to nearshore Hawaii waters (0.0017 animals/km^2;

Mobley et al., 2000) and an order of magnitude larger than that observed around Guam and the Mariana Islands (0.00029 animals/km^2; Fulling et al., 2011).

U. **Short-beaked common dolphin**: Common dolphin have been caught off Goto Island in the East China Sea (Kishiro and Kasuya, 1993). Common dolphins have not been sighted by Barlow (2006) or Mobley et al. (2000) in Hawaii surveys or by the Fulling et al. (2011) during surveys around Guam and the Mariana Islands. There are no data on density or stock estimates (Miyashita, 1993). Without any data on stock or density estimates for the central or western North Pacific, the abundance, 3,286,163 animals, and density, 0.0461 animals/km^2 from the same latitude in the ETP (Ferguson and Barlow, 2001, 2003) are appropriate.

V. **Short-finned pilot whale:** Kishiro and Kasuya (1993) reported that short-finned pilot whales are uncommon in the East China Sea, and that insufficient information exists from which to determine whether the southern or northern form occurs in this region. Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 animals, CV=0.224). Kasuya et al. (1988) suggested that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). However, the northern form has not been harvested by Japanese drive fisheries (Kishiro and Kasuya, 1993); and therefore, it was not included in the above analyses (Miyashita, 1993). The best available density estimate (0.0016 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.0036 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and an order of magnitude less than in nearshore Hawaii waters (0.0237 animals/km^2) during the spring, summer and fall (Mobley et al., 2000).

W. **Sperm whale**: Stock structure of sperm whales in the North Pacific Ocean remains unclear except in U.S. EEZ waters (Allen and Angliss, 2013), and all sperm whales occurring in the North Pacific are currently classified as one stock, the North Pacific stock. De Boer (2000) sighted sperm whales in the South China Sea and suggested that whales seen west of the Balabac Strait might be migrating between the South China and Sulu Seas. Based on such movements, sperm whales might also be found in the East China Sea, where habitat characteristics suggest that conditions are conducive for sperm whale occurrence. The best available abundance estimate for the sperm whales potentially occurring in the East China Sea mission area is that of the North Pacific population of sperm whales, 102,112 individuals (CV=0.155), which was derived by Kato and Miyashita (1998). The most appropriate density estimate (0.00123 animals/km^2) is derived from recent survey data collected in the southern Mariana Islands (Fulling et al., 2011). This density estimate is considered comparable to Mobley's Hawaii estimate (0.0010 animals/km^2), where sperm whales were generally seen in the outer 5% of survey effort (Mobley et al., 2000).

X. **Spinner dolphin**: Gilpatrick et al. (1987) reported a high density of sightings in the Korea Strait and adjacent waters to the north but no spinner dolphin sightings were reported from the East China Sea. This species is not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and there are no data on density or stock estimates (Miyashita, 1993). The best available density estimate (0.0008 animals/km^2) is calculated from the Hawaii EEZ (Barlow, 2006), which is an order of magnitude less than that observed in nearshore waters of Hawaii (0.0443 animals/km^2; Mobley et al., 2000). The best data available abundance estimate for spinner dolphins is (1,015,059 animals) from the ETP (Ferguson and Barlow, 2001, 2003).

Y. **Striped dolphin**: Two concentrations of striped dolphins exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for three distinct populations (one in the area south of 30°N, one inshore north of 30°N, and one offshore north of

30°N, east of 145°E). The boundaries between these populations, however, have not yet been resolved and it is possible that the inshore population is connected to the Sea of Japan/East China Sea as an inshore Archipelago stock, as analogy from bottlenose dolphins (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate (570,038 animals, CV=0.186). LGL's (2011) density of 0.0058 animals/km^2 is most appropriate this region. This density is comparable to the Hawaii EEZ (0.00536 animals/km^2; Barlow, 2006), from nearshore Hawaii (0.0016 animals/km^2; Mobley et al., 2000), and from Guam and the Mariana Islands (0.00616 animals/km^2; Fulling et al., 2011).

7. MISSION AREA #7—SOUTH CHINA SEA

A. **Bryde's whale:** Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia stock (mainly Philippine waters and the Gulf of Thailand), East China Sea, and offshore western North Pacific. Animals found in this area are considered part of the southeast Asia stock of Bryde's whales, which includes waters of the Philippine Sea and Gulf of Thailand (Yoshida and Kato, 1999) and which is separate from both the East China Sea and western North Pacific populations. Animals in this region are the offshore form of *Balaenoptera edeni*. De Boer (2000) sighted Bryde's whales during his cruise. No data specific to this stock were reported. The Ohsumi (1977) western North Pacific density estimate is most appropriate; comparable to DoN (2007) (0.00041 animals/km^2), Barlow (2006) (0.00019 animals/km^2) and Ferguson and Barlow (2001, 2003) for the ETP. The IWC provides the best available population estimate, 20,501 whales, for the western North Pacific Bryde's whale stock (IWC, 2009).

B. **Common minke whale**: As a cosmopolitan species, minke whales are expected to be present in the South China Sea, though De Boer (2000) did not observe them during his recent cruise through the area and Smith et al. (1997) did not document them during their cruises or from historical "whale temples." Whaling data from the East China Sea suggest that animals do not migrate through the Taiwan Strait, though other studies (Butterworth et al., 1996; Gong, 1988) indicate that individuals might be from the J-stock, migrating into the region in the winter. In either case, there are limited data on density and stock estimates. Therefore, estimated encounter rates and stock estimate similar to the favored whaling grounds of the western North Pacific were used (Buckland et al., 1992), for an abundance of the O stock as 25,049 animals and a density of 0.0033 animals/km^2. These estimates are an order of magnitude higher than any calculated in the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

C. **Fin whale**: De Boer (2000) conducted a research cruise in the Indian Ocean Sanctuary and the South China Sea from 29 March to 17 April, 1999, during which fin whales and a sperm whale were sighted west of the Balabac Strait, suggesting a possible migration route of these species between the South China Sea and the Sulu Sea. De Boer's cruise is the first record of fin whales in the South China Sea (De Boer, 2000). The East China Sea population is thought to be resident and may represent a distinct population (Evans, 1987). Without any data on stock or density estimates for the South China Sea, it is roughly estimated that the data from the western North Pacific stock are appropriate for this mission area (Mizroch et al., 2009). Density and stock estimates were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977). These data are comparable to density estimates in other areas of the ETP (Ferguson and Barlow, 2001, 2003) and around Hawaii (Barlow, 2006).

D. **North Pacific right whale**: During limited survey effort in the South China Sea, no observations of right whales have ever been reported in the area (Clapham et al., 2004). In addition, right whales migrate further north to feed during summer, and are thus not expected in this mission at that time of year. Right whales are likely to occur in the South China Sea primarily during winter but also may be found in these waters as they migrate north and south in spring and fall. Due to the lack of population level data for the North Pacific right whale in this region, an abundance estimate of 922 animals

derived from Japanese sighting cruises in the Okhotsk Sea (Best et al., 2001) was used. Although no density estimates are available for this very rare marine mammal species, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis to reflect the very low probability of occurrence in this region.

E. **Western North Pacific gray whale**: Gray whales found in the western and eastern North Pacific are genetically and distributionally distinct (LeDuc et al., 2002). Gray whales are expected to occur principally in this mission area during the winter season, they may also occur in these waters as they migrate north and south during spring and fall. Exact wintering grounds of this species are not known but are believed to be located in the South China Sea, in the vicinity of Korea and China (Evans, 1987; Omura, 1988). Presumably gray whales maintain a shallow water/nearshore affinity throughout this southern portion of their range. The exact migration route of gray whales is not known, but they are believed to migrate directly across the East China Sea, which is one of the few times that they leave their shallow, nearshore habitat (Omura ,1988). During this time, they may be found up to 741 km (400 nmi) offshore (Weller et al., 2002). Currently, IWC reports an abundance estimate of 121 animals for the western Pacific stock (IWC, 2009), which includes gray whales potentially occurring in this mission area. With no density estimate for this rare species available, a minimal density of 0.0001 animals/km^2 was used in risk computation for this stipulation area to reflect the extremely low potential for this species occurring.

F. **Blainville's beaked whale:** Miyazaki et al. (1987) did not report any strandings of *M. densirostris* from the South China Sea. De Boer (2000) and Miyashita et al. (1996) did not observe any *M. densirostris* during their research cruises. Without any data on stock or density estimates for the western North Pacific, the data from the ETP (Ferguson and Barlow, 2001, 2003) are most appropriate for this region. The *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate is 8,032 animals and the *Mesoplodon* spp. density estimate, 0.0005 animals/km^2, are best for use at this area (Ferguson and Barlow, 2001, 2003). This density estimate can be compared to that for Blainville's beaked whales in the Hawaii EEZ (0.00117 animals/km^2; Barlow 2006), in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

G. **Common bottlenose dolphin:** Smith et al. (1997) reported that bottlenose dolphins are found in "whale temples" in South China Sea nations. Miyashita (1993) reported that reproductive differences suggest that animals from the Sea of Japan and East China Sea are a separate, inshore Archipelago stock than animals in the western North Pacific. Kishiro and Kasuya (1993) cite Miyashita (1986) as estimating the abundance of the stock in the East China Sea as 35,046. Since these data represent only about one-third of the habitat of bottlenose dolphins in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (105,138 animals). It is assumed that animals found in the Sea of Japan, East China Sea, and South China Sea are of the same stock. No density estimates are available for this stock; therefore, a density estimate was derived 0.0008 animals/km^2 estimated by LGL (2011) was most appropriate. This is within the range of densities estimated in the eastern North Pacific (Ferguson and Barlow, 2001, 2003) and higher than those around Hawaii, 0.0103 animals/km^2 (Mobley et al. 2000), 0.0013 animals/km^2 (Barlow, 2006), and around Guam and the Mariana Islands, 0.00021 animals/km^2 (Fulling et al., 2011).

H. **Cuvier's beaked whale**: De Boer (2000) sighted Cuvier's beaked whales during his cruise through the South China Sea. No density or stock estimate data are available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best available data are a density estimate from the same latitude in the eastern Pacific (0.0003 animals/km^2) and an abundance estimate of 90,725 animals (Ferguson and Barlow, 2001, 2003). This is comparable to

that estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

I. **False killer whale:** Miyashita (1993) suggested that animals summering in the Sea of Japan are probably from a separate, inshore Archipelago stock, by analogy of Pacific white-sided dolphins, than animals from the western North Pacific stock. Kishiro and Kasuya (1993) cited Miyashita (1986) as estimating the population wintering in the East China Sea at 3,259 animals. Since these data represent only about one-third of the habitat of false killer whales in the South China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (9,777 individuals). False killer whales are sighted infrequently in the South China Sea (De Boer, 2000; Miyashita et al., 1996; Smith et al., 1997). There are no data on density estimates for the South China Sea. The best available density estimate (0.0011 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is an order of magnitude larger than the density estimate (0.0001 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and comparable to nearshore Hawaii waters (0.0017 animals/km^2) during the spring, summer, and fall (Mobley et al., 2000).

J. **Fraser's dolphin**: Kishiro and Kasuya (1993) report catches off the Pacific coast of Japan in drive fisheries. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the abundance estimate of 220,789 animals from the ETP (Ferguson and Barlow, 2001, 2003) and the density estimate of 0.0042 animals/km^2 the Hawaii EEZ (Barlow, 2006) are appropriate.

K. **Ginkgo-toothed beaked whale:** Miyazaki et al. (1987) report no strandings of *M. ginkgodens* from the South China Sea. De Boer (2000) and Miyashita et al. (1996) did not observe *M. ginkgodens* during their research cruises. Since no data on density or stock estimates are available for this species, it was roughly estimated that the density (0.0005 animals/km^2) and abundance estimates (22,799 animals) for *Mesoplodon* spp. at the same latitude in the eastern Pacific (Ferguson and Barlow, 2001, 2003) are appropriate. This density estimate is comparable to that for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

L. **Killer whale**: Killer whales are considered rare with limited sightings reported (Carretta et al., 2013). The best available density estimate (0.0001 animals/km^2) derived by LGL (2011) and abundance estimate (12,256 animals) calculated from Ferguson and Barlow (2001, 2003). Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nm of the Main Hawaiian Islands, nor did the DoN (2007) surveys around the Mariana Islands.

M. ***Kogia* spp.**: Smith et al. (1997) reported that *Kogia* were found in “whale temples” in nations surrounding the South China Sea. No density or abundance estimates are available. No sightings of *Kogia* spp. were made by De Boer (2000). Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals is computed in the ETP. Both *Kogia breviceps* and *Kogia sima* potentially may occur in this region. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N (Ferguson and Barlow, 2003), a density estimate of 0.0017 animals/km^{2}was modeled. This is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2 CV=1.12) and dwarf sperm whale (0.00714 animals/km^2 CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

N. **Longman’s beaked whale:** Ferguson and Barlow (2001) reported that all Longman’s beaked whale sightings were south of 25ºN. There was no density estimate for Longman’s beaked whales available from the Mariana Islands (Fulling et al., 2011), therefore, a density estimate of 0.0003 animals/km^2 derived by LGL (2011) and an abundance estimate of 1,007 animals were derived from the Hawaii offshore area (Barlow, 2006).

O. **Melon-headed whale:** Leatherwood and Reeves (1983) stated that melon-headed whales are rare except in the Philippine Sea. Distributed in tropical and subtropical waters, preferring equatorial water masses, they have been observed in the South China Sea (De Boer, 2000) and in "whale temples" on islands surrounding the South China Sea (Smith et al., 1997). However, they were not observed by Miyashita et al. (1996). The best available density estimate (0.0043 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.0012 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and in nearshore Hawaii waters (0.0021 animals/km^2) during the spring, summer and fall (Mobley et al., 2000). An abundance estimate in the eastern North Pacific (36,770) (Ferguson and Barlow, 2001, 2003) was used.

P. **Pantropical spotted dolphin**: These animals have been reported during the De Boer (2000) research cruise, observed in winter (Jan-Feb) in South China Sea (Miyashita et al., 1996), and reported from historical "whale temples" (Smith et al., 1997). Gilpatrick et al. (1987) summarized one report from west of Taiwan in the northern portion of the South China Sea. Miyashita (1993) summarized data from 34 sighting cruises conducted as part of the Japanese drive fishery. There is no discontinuity in sightings to suggest different stocks, though based on data from the ETP, it is possible that multiple populations exist in the western North Pacific (Miyashita, 1993). In the western North Pacific, total population size was 438,064 animals (CV=0.174); density estimate was 0.0137 animals/km^2. Based on Miyashita's (1993) data, the population in South China Sea was one-half the abundance of the western North Pacific stock (219,032 animals) with the same density estimate of 0.0137 animals/km^2. This is comparable to those observed in the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000).

Q. **Pygmy killer whale:** Pygmy killer whales were seen by De Boer (2000) during his research cruise through the South China Sea, known from historical "whale temples" (Smith et al., 1997), but not seen by Miyashita et al. (1996). No mention of these animals exists in Japanese whaling records (Kishiro and Kasuya, 1993). There are no data on density or stock estimates off Japan or Taiwan (Miyashita, 1993), or nearshore Hawaii (Mobley et al., 2000). The best available density estimate (0.0001 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.00039 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). An abundance estimate (30,214 animals) from the eastern Pacific (Ferguson and Barlow, 2001, 2003) was used.

R. **Risso's dolphin**: Smith et al. (1997) reported that Risso's dolphin bones were found in "whale temples" in nations along the South China Sea, but this species was not seen by Miyashita et al. (1996) or De Boer (2000) during their surveys. Miyashita (1993) suggested by analogy to bottlenose dolphins and Pacific white-sided dolphins that animals summering in Sea of Japan are a separate, inshore Archipelago stock from the western North Pacific stock. There have been no separate data reported for the Sea of Japan, East China Sea, or South China Sea, though. Therefore, the western North Pacific stock estimate (83,289 animals, CV=0.179) and the density estimate (0.0106 animals/km^2 derived for southeast Pacific coast of Japan/east of Taiwan; Miyashita, 1993) were used. This is within the range of densities estimated in the eastern North Pacific (Ferguson and Barlow, 2001, 2003) and higher than those around Hawaii (not observed by Mobley et al. (2000) or DoN (2007); 0.0010 animals/km^2 Barlow, 2006).

S. **Rough-toothed dolphin:** Rough-toothed dolphins have been found in "whale temples" in South China Sea nations (Smith et al., 1997). The best available data are a density (0.0036 animals/km^2) estimated from the Hawaiian EEZ (Barlow, 2006) and an abundance estimate of 145,729 animals from eastern Pacific (Ferguson and Barlow, 2001, 2003). This is comparable to those observed in the Hawaii EEZ (0.00355 animals/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000) and an order of magnitude larger than that observed around Guam and the Mariana Islands (0.00029 animals/km^2; Fulling et al., 2011).

T. **Short-finned pilot whale**: Smith et al. (1997) reported that short-finned pilot whales are found in "whale temples" on islands surrounding the South China Sea. De Boer (2000) did not observe pilot whales during his research cruise, but Miyashita et al. (1996) did observe them in the western North Pacific. With limited data for this particular region, data from the Pacific coast of Japan were used. Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 individuals, CV=0.224). Kasuya et al. (1988) suggest that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). However, the northern form has not been harvested by Japanese drive fisheries (Kishiro and Kasuya, 1993), and therefore, it was not included in the above analyses (Miyashita, 1993). The best available density estimate (0.0016 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to the density estimate (0.0036 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006) and an order of magnitude less than in nearshore Hawaii waters (0.0237 animals/km^2) during the spring, summer and fall (Mobley et al., 2000).

U. **Sperm whale**: The population structure of sperm whales throughout the North Pacific Ocean remains largely unresolved. De Boer (2000) sighted sperm whales in the South China Sea (March through April) and suggested that animals seen west of the Balabac Strait might be migrating between the South China and Sulu Seas. Miyashita et al. (1996) also observed sperm whales in the winter in the South China Sea, very close to the Philippines. No data on density or stock estimates were derived from either the De Boer (2000) or Miyashita et al. (1996) studies. The only available abundance estimate for the western North Pacific population of sperm whales is 102,112 animals (CV=0.155) (Kato and Miyashita, 1998). The best available density estimate, 0.00123 animals/km^2, for use in this region was derived from recent survey in waters of Guam and the Mariana Islands (Fulling et al., 2011). This density is comparable to the sperm whale density, 0.0010 animals/km^2, derived from Hawaiian surveys, where sperm whales were generally seen in the outer 5% of the survey effort (Mobley et al., 2000).

V. **Spinner dolphin:** Gilpatrick et al. (1987) reported a high density of sightings in the Korea Strait and adjacent waters to the north, but none were reported from the South China Sea or Philippine Sea. Spinner dolphins were not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), reported during the De Boer (2000) research cruise, or encountered in historical "whale temples" (Smith et al., 1997). There are no data on density or stock estimates (Miyashita, 1993). The best available density estimate (0.0008 animals/km^2) is calculated from the Hawaii EEZ (Barlow, 2006). This density is orders of magnitude less than that observed in nearshore waters of Hawaii (0.0443 animals/km^2; Mobley et al., 2000). The best available abundance estimate is for spinner dolphins (1,015,059 animals) from the ETP (Ferguson and Barlow, 2001, 003).

W. **Striped dolphin:** These animals were not reported during the De Boer (2000) research cruise in March-April, but were seen by Miyashita et al. (1996) in the South China Sea during their Jan-Feb cruise. No data on density or abundance estimates for the South China Sea are available. Two concentrations of striped dolphin are recognized in the western North Pacific: one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for three populations in the area: one south of 30°N, one inshore north of 30°N, one offshore north of 30°N, east of 145°E though the boundaries between these populations have not been resolved and it is possible that the inshore population is connected to the Sea of Japan/East China Sea/South China Sea as an inshore Archipelago stock, as analogy from bottlenose dolphins (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate 570,038 animals (CV=0.186). LGL's (2011) density of 0.0058 animals/km^2 was considered best for this species in this region. This is an order of magnitude greater than the density estimates from the Hawaii EEZ (0.00536 animals/km^2; Barlow, 2006), from

nearshore Hawaii (0.0016 animals/km^2; Mobley et al., 2000), and from Guam and the Mariana Islands (0.00616 animals/km^2; Fulling et al., 2011).

8. MISSION AREA #8—OFFSHORE JAPAN/WESTERN NORTH PACIFIC 25º TO 40ºN

A. **Bryde's whale**: Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific. Ohizumi et al. (2002) conducted winter sighting surveys, observing Bryde's whales at about 20°N, which is the southern limit of their summer range. The best available density estimate (0.0004 animals/km^2) is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This is comparable to density estimates from offshore areas of the ETP (0.00003 animals/km^2; Ferguson and Barlow, 2001, 2003) and the Hawaii EEZ (0.00019 animals/km^2; Barlow, 2006). The IWC provides the best available population estimate, 20,501 whales, for the western North Pacific Bryde's whale stock (IWC, 2009).

B. **Common minke whale:** The south coast of Honshu and Shikoku were whaling grounds for this species (Ohsumi, 1978). Animals are migratory from the offshore western North Pacific waters. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk. Density estimates were derived from encounter rates and effective search widths for the offshore population for a density of 0.0003 animals/km^2, SE = 0.17) (Buckland et al., 1992). Ferguson and Barlow (2001; 2003) computed density estimates in offshore areas of the ETP that were of the same magnitude. Minke whales were heard but not seen during a recent survey around Guam and the Mariana Islands (Fulling et al., 2011). An abundance of 25,049 animals is most appropriate (Buckland et al., 1992).

C. **Fin whale**: Fin whales have been reported migrating south in the winter to about 20°N (Mizroch et al., 2009) and have been observed in summer from near Japan north to the Chukchi Sea and Aleutian Islands and may occur in the waters of this mission area seasonally (Evans, 1987). Density and stock estimates for the western North Pacific stock of fin whales, which include fin whales occurring in mission #8, were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977). These data are comparable to density estimates in offshore areas of the ETP (Ferguson and Barlow, 2001, 2003).

D. **Sei whale**: Sei whales are present throughout the temperate North Pacific Ocean but have been observed as far south as 20°N (Horwood, 1987). The IWC recognizes one stock of sei whales in the North Pacific (Donovan, 1991), although some evidence exists for several populations (Carretta et al., 2010). Very few sightings of sei whales have occurred in any region of the North Pacific, and adding to the difficulty, sei whales are extremely difficult to differentiate from Bryde's whales at sea. Therefore, the best available estimate for the entire North Pacific stock, of which sei whales found in the waters of mission area #8 belong, is 8,600 animals based on very old whaling data (Tillman, 1977). With no specific densities derived for these waters, the best available density estimate (0.00029 animals/km^2 CV=48.7) for the sei whales in this mission area is calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011).

E. **Baird's beaked whale**: Kasuya (1986) reported the presence of Baird's beaked whales off the east coast of Japan, as did Leatherwood and Reeves (1983). Miyazaki et al. (1987) did not report any Baird's beaked whale strandings along the Pacific coast of Japan. Ohizumi et al. (2003) examined the stomach content of Baird's whales caught off the east coast of Japan, and reported that the observed prey species were demersal fish that were identical to those caught in bottom-trawl nets at depths greater than 1000 m. Kasuya (1986) collected aerial survey sighting records over 25 years and shipboard sightings in 1984 off the Pacific coast of Japan; based on his encounter rate and effective search width, a density estimate of 0.0001 animals/km^2 was derived. Kasuya's (1986) abundance estimate of 4,220 animals (CV=0.295) covered the region from about 32-40°N and seaward of the

Pacific Japanese coast out to about 150°E. Since Kasuya's (1986) surveys did not include habitat further north or east, the stock estimate is increased to 8,000 to account for unsurveyed areas, and the density estimate (0.0001 animals/km^2) was reduced to reflect less occupation of areas further offshore. The density estimate is comparable to the most western strata density estimates in the eastern Pacific (Ferguson and Barlow, 2003).

F. **Blainville's beaked whale**: Lacking data on population estimates for the Blainville's beaked whale in the western North Pacific, the data derived for this species in waters of the ETP (Ferguson and Barlow, 2001, 2003) are deemed most appropriate to represent the species in the Western North Pacific stock. Ferguson and Barlow's (2001, 2003) abundance derived for *Mesoplodon densirostris* added to one-fifth of the *Mesoplodon* spp. abundance provides an estimate of 8,032 animals to represent this stock. The density estimate of 0.0007 animals/km^2 is most appropriate (LGL, 2011). This density estimate is lower than that derived for Blainville's beaked whales in the Hawaii EEZ (0.00117 animals/km^2; Barlow, 2006) and in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), but is comparable to the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

G. **Common bottlenose dolphin:** Miyashita (1993) reports an abundance estimate of 168,791 animals (CV=0.261) while LGL (2011) derived a density estimate of 0.0008 animals/km^2. This is comparable to the density estimate around Guam and the Mariana Islands (0.00021 animals/km^2; Fulling et al., 2011).

H. **Cuvier's beaked whale:** No density or stock estimate data are available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best abundance available of 90,725 animals are the long-term time series from the ETP (Ferguson and Barlow, 2001, 2003) and the best density estimate (0.0037 animals/km^2) is that derived by LGL (2011). This is comparable to that estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

I. **Dwarf sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution; they are not believed to be concentrated anywhere. Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals is computed in the ETP. At this northern latitude, only *Kogia breviceps* is expected. LGL's (2011) density estimate of 0.0043 animals/km^2 is the best for this species in this region. This density is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2 CV=1.12) and dwarf sperm whale (0.00714 animals/km^2 CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

J. **False killer whale**: Miyashita (1993) estimated abundance of false killer whales from 34 sighting cruises associated with the Japanese drive fishery (16,668 animals CV=0.263) and also derived adensity estimate of 0.0036 animals/km^2. This density is within the range of average densities estimated in the eastern North Pacific (0.0027 animals/km^2; Ferguson and Barlow, 2001, 2003).

K. **Hubbs' beaked whale**: All known occurrences to date of Hubb's beaked whales in the western North Pacific Ocean having been strandings along Japan's shore (MacLeod et al., 2006). Miyazaki et al. (1987) reported five strandings of Hubbs' beaked whales along the Pacific coast of northern Honshu. Since no data on density or stock estimates are available for the Hubb's beaked whale in the waters of this mission area, *Mesoplodon* spp. data from the ETP (Ferguson and Barlow, 2001 and 2003) are considered to be the most appropriate population estimates available from which to extrapolate population estimates for this mission area. Using the northernmost strata from Ferguson and Barlow's (2001, 2003) data, a density of 0.0005 animals/km^2 and an abundance of 22,799 animals are estimated for the North Pacific stock of Hubb's beaked whales. Ferguson and Barlow's (2001, 2003) density is comparable to that estimated for unidentified beaked whales in the Hawaii EEZ (0.00015

animals/km^2; Barlow, 2006) and the mean predicted density estimated for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

24. **Killer whale**: Killer whales have been observed off the southeast coast of Honshu, Japan, but no killer whales were taken in Japanese drive fisheries (Miyashita, 1993). Without any population or occurrence data on killer whales for the western North Pacific, the best available abundance estimate of 12,256 animals is from Ferguson and Barlow's (2001, 2003) long time series in the ETP while the best available density estimate of 0.0001 animals/km^2 is from LGL (2011) compilation of data for the Marianas area. LGL's (2011) density is very close to the density estimate of killer whales derived in waters of the Hawaii EEZ of 0.00014 animals/km^2 (Barlow, 2006).

L. **Longman's beaked whale:** Considering the lack of occurrence or population data for the Western North Pacific stock of Longman's beaked whales, the abundance of 1,007 animals estimated for Longman's beaked whales in offshore Hawaiian waters (Barlow, 2006) and the density of 0.0003 animals per km^2 (LGL, 2011) derived from the Marianas regions are considered most appropriate to represent the Western North Pacific stock.

M. **Melon-headed whale:** Leatherwood and Reeves (1983) stated that melon-headed whales are rare except in the Philippine Sea. Distributed in tropical and subtropical waters, preferring equatorial water masses, they are probably uncommon outside of the warm waters of the Kuroshio Current. With these limited data, a density estimate of 0.0027 animals/km^2 from LGL (2011) was considered most appropriate while comparable to Mobley et al.'s (2000) density estimate for Hawaii waters of 0.0021 animals/km^2 and the Guam/Marianas estimate of 0.00428 animals/km^2 (Fulling et al., 2011). An abundance estimate of 36,770 (Ferguson and Barlow, 2001, 2003) was used.

N. ***Mesoplodon* spp:** Miyazaki et al. (1987) reported five strandings of *M. ginkgodens* from the east coast of Japan. Of the 15 known strandings of *M. ginkgodens,* Palacios (1996) reported eight off Taiwan and Japan. Since no data on density or stock estimates are available for this species, it is roughly estimated that the data on *Mesoplodon* spp. from the ETP (Ferguson and Barlow, 2001, 2003) are appropriate; using the northernmost strata, the density estimate is 0.0005 animals/km^2 and the abundance estimate is 22,799 animals. This density estimate is comparable to that for unidentified beaked whales in the Hawaii EEZ (0.00015 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

O. **Pacific white-sided dolphin:** No data on density or stock estimates are available (Miyashita 1993). Density (0.0048 animals/km^2) estimated from eastern Pacific waters were used for this species in this area (Ferguson and Barlow, 2001, 2003). Buckland et al. (1993) abundance of 931,000 animals is most appropriate for this region. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Mobley et al., 2000; Barlow, 2006).

P. **Pantropical spotted dolphin:** Miyashita (1993) reports an abundance estimate (438,064 animals CV=0.174) while LGL (2011) derived a density estimate of 0.0113 animals/km^2. This density is an order of magnitude higher than that derived for the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006), and nearshore Hawaii waters (0.0407 animals/km^2; Mobley et al., 2000).

Q. **Pygmy killer whale:** Kishiro and Kasuya (1993) reviewed the historical catches of Japanese drive fisheries. No pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan), but Leatherwood and Reeves (1983) reported that they were seen relatively frequently in the tropical Pacific off Japan. The best available density estimate (0.0001 animals/km^2) is calculated from LGL (2011) data. This is comparable to the density estimate (0.00039 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). No pygmy killer whales were seen in nearshore aerial during the spring, summer, and fall (Mobley et al., 2000). An abundance estimate (30,214) was used from the eastern Pacific (Ferguson and Barlow, 2001, 2003).

R. **Pygmy sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution; they are not believed to be concentrated anywhere. Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals is computed in the ETP. At this northern latitude, only *Kogia breviceps* is expected. LGL (2011) calculated a density estimate of 0.0018/km^2 for the pygmy sperm whale. This is comparable to the density estimates for pygmy sperm whale (0.00291 animals/km^2 CV=1.12) observed within the Hawaii EEZ (Barlow, 2006).

S. **Risso's dolphin:** Miyashita (1993) reports a western North Pacific stock estimate of 83,289 animals (CV=0.179) while LGL (2011) derived a density estimate of 0.0005 animals/km^2.

T. **Rough-toothed dolphin:** The best available density estimate of 0.0019 animals/km^2 is calculated by LGL (2011). This is comparable to that observed in the Hawaii EEZ (0.00355/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000). The best available abundance (145,729) estimate is from eastern Pacific waters (Ferguson and Barlow, 2001, 2003).

U. **Short-beaked common dolphin:** There are no data on density or stock estimates in the western Pacific (Miyashita, 1993). Without any data on stock or density estimates for the western North Pacific, the data from the ETP, with a derive density estimate of 0.0863 animals/km^2 and an abundance of 3,286,163 animals (Ferguson and Barlow, 2001, 2003) are appropriate for use at this site.

V. **Short-finned pilot whale:** Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 animals CV=0.224). Kasuya et al. (1988) suggested that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). Miyashita (1993) questioned whether the entire range consisted of a single stock or population, but had no way of delineating the data. The most appropriate density estimate, 0.0021 animals/km^2 for this offshore site is derived from LGL (2011) data.

W. **Sperm whale**: Stock structure of sperm whales in the North Pacific is not well resolved. Sightings collected by Kasuya and Miyashita (1988) suggest that in the summer, the density of sperm whales is high south of the Kuroshio Current System (south of approximately 35°N) but extremely low north of 35°N. These data suggest two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands (~50°N) and winter off Hokkaido and Sanriku (~40°N) and the southwestern North Pacific stock with females that summer off Hokkaido and Sanriku (~40°N) and winter around the Bonin Islands (~25°N) (Kasuya and Miyashita, 1988). The males of these two stocks are found north of the range of the corresponding females, i.e., in the Bering Sea (~55°N) and off Hokkaido and Sanriku (~40°N), respectively, during the summer (Kasuya and Miyashita, 1988). Potentially sperm whales of the North Pacific stock, numbering 102,112 individuals (Kato and Miyashita, 1998), may occur year-round in the waters of this mission area. The best density estimated for sperm whales in mission area #8 is 0.0022 animals/km^2, derived by LGL (2011). This density is higher but in the same order of magnitude as the Mobley et al. (2000) estimate (0.0010 animals/km^2) where sperm whales were generally seen in the outer 5% of the survey effort or than the Fulling et al. (2011) density estimate (0.00123 animals/km^2) calculated from the winter/spring survey around Guam and Mariana Islands.

X. **Spinner dolphin:** Gilpatrick et al. (1987) did not report any sightings from the Pacific coast of Japan. This species is not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or stock estimates are available (Miyashita, 1993). Without any data on stock or density estimates for the western North Pacific, LGL's (2011) estimate of 0.0019 animals/km^2 is most

appropriate for this species in this region. An abundance of 1,015,059 spinner dolphins was estimated from the ETP (Ferguson and Barlow, 2001, 2003) at a similar latitude.

Y. **Striped dolphin:** Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for three populations in the area: one south of 30°N, one inshore north of 30°N, and one offshore north of 30°N, east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate of 570,038 animals CV=0.186). LGL (2011) derived a density estimate of 0.0019 animals/km^2. This is comparable to the density estimates from the Hawaii EEZ (0.00536 animals/km^2; Barlow, 2006), from nearshore Hawaii (0.0016 animals/km^2; Mobley et al., 2000), and from Guam and the Mariana Islands (0.00616 animals/km^2; Fulling et al., 2011).

Z. **Hawaiian monk seal**: Monk seals are known to haul out on Kure Atoll, the westernmost atoll in the NWHI (Carretta et al., 2013). Monk seals from Kure Atoll may forage on the Hancock Banks, NW of Kure Atoll. Parrish et al. (2002) reported on a monk seal diving study and referenced a study by Abernathy (1999), who reported that monk seals may travel up to 400 km (216 nmi) to forage. The Hancock Banks are approximately 300 km (162 nmi) NW of Kure Atoll and are characterized by a single pinnacle that is shallower than 450 m (1,476 ft); this single pinnacle is within the known range of movements of monk seals. However, it appears unlikely that many, if any, seals would travel a distance near their maximum-recorded distance and dive to a depth near their maximum recorded depth to access a small potential foraging area. However, to account for the possibility that monk seals may forage such distances from known foraging areas, monk seals were included in this mission area. The abundance for the Hawaiian stock of Hawaiian monk seals is estimated at 1,212 animals (Carretta et al., 2013). Although no density for the very rare Hawaiian monk seal is available, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis for this species to reflect the very low probability of occurrence in this region.

9. MISSION AREA #9—OFFSHORE JAPAN/WESTERN NORTH PACIFIC 10º TO 25ºN

A. **Blue whale**: Few data are available on blue whale occurrence in the North Pacific Ocean and the stock structure in the North Pacific remains uncertain[15]. Stafford et al. (2001) studied the geographic variation of blue whale calls in the North Pacific, and although there was no hydrophone coverage in the mid-latitudes off Japan, there was some coverage near the Kamchatka peninsula and along the western Aleutian Islands chain. All calls recorded on these hydrophones were northwest Pacific blue whale calls (Stafford et al., 2001). Based on Stafford et al. (2001) data and the lack of population data on blue whales in this region, the most appropriate abundance data would be those from fin whales derived from sighting surveys associated with Japanese whaling (Tillman, 1977; Carretta et al., 2013). The best density for blue whales in this mission area is 0.0001 whales/km^2, which was estimated for the winter, spring, and fall seasons from (Tillman, 1977, Ferguson and Barlow, 2003; LGL, 2008).

B. **Bryde's whale:** Yoshida and Kato (1999) identified three stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific. Ohizumi et al. (2002) conducted winter sighting surveys, observing Bryde's whales at about 20°N, which is the southern limit of their summer range. The IWC provides the best available population estimate, 20,501 whales, for the western North Pacific Bryde's whale stock (IWC, 2009). The best available density estimate, 0.0003 animals/km^2, is calculated by LGL (2011). This is comparable to density estimates from offshore areas of the ETP (0.00003/km^2; Ferguson and Barlow, 2001, 2003) and the Hawaii EEZ (0.00019 animals/km^2; Barlow, 2006).

C. **Fin whale**: Fin whales have been reported migrating south in the winter to about 20°N (Mizroch et al., 2009), and are found in the summer from a line near Japan north to the Chukchi Sea and Aleutian Islands (Evans, 1987). Population data for the fin whale are sparse in this area of the North Pacific, but an abundance for the Western North Pacific stock, which occurs in this mission area, numbering 9,250 animals was derived from whaling data (Tillman, 1977) and occurrence information Mizroch et al. (2009). Although no density information are available for the fin whale in the waters of mission area #9, a density estimate is needed to compute potential acoustic impacts. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis for this species to reflect the very low probability of occurrence in this region.

D. **Sei whale**: Sei whales are present throughout the temperate North Pacific Ocean but have been observed as far south as 20°N (Horwood, 1987). The IWC recognizes one stock of sei whales in the North Pacific (Donovan, 1991), although some evidence exists for several populations (Carretta et al., 2013). Very few sightings of sei whales have occurred in any region of the North Pacific, and adding to the difficulty, sei whales are extremely difficult to differentiate from Bryde's whales at sea. Therefore, the best available estimate for the entire North Pacific stock, of which sei whales found in the waters of mission area #9 belong, is 8,600 animals based on very old whaling data (Tillman, 1977). A density estimate of 0.0001 animals/km^2 was derived from LGL (2011) data and information.

E. **Blainville's beaked whale**: Lacking data on population estimates for the Blainville's beaked whale in the western North Pacific, the abundance data derived for this species in waters of the ETP (Ferguson and Barlow, 2001, 2003) are deemed most appropriate to represent the species in the Western North Pacific stock. Ferguson and Barlow's (2001, 2003) abundance derived for *Mesoplodon densirostris* added to one-fifth of the *Mesoplodon* spp. abundance provides an estimate of 8,032 animals to represent this stock. The density estimate derived by LGL (2011), 0.0007 animals/km^2; is most appropriate. This density estimate is lower than that derived for Blainville's beaked whales in the Hawaii EEZ (0.00117 animals/km^2; Barlow, 2006) and in the main Hawaiian Islands (0.0012 animals/km^2; Mobley et al., 2001), but is comparable to the mean predicted density estimate for the ETP *Mesoplodon* spp. (0.000296 animals/km^2; Ferguson et al., 2006).

F. **Common bottlenose dolphin:** Miyashita (1993) reports an abundance estimate (168,791 animals CV=0.261) while 0.0008 animals/km^2 was derived by North Pacific waters for this species by LGL (2011). This is comparable to the density estimate around Guam and the Mariana Islands (0.00021 animals/km^2; Fulling et al., 2011).

G. **Cuvier's beaked whale:** No density or stock estimate data are available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best abundance of 90,725 animals available is the long-term time series from the ETP (Ferguson and Barlow, 2001, 2003). The best density for this species in this region is LGL's (2011) estimate of 0.0037 animals/km^2. This is comparable to that estimated for the Hawaii EEZ (0.00621 animals/km^2; Barlow, 2006) and the mean predicted density estimate for the ETP (0.00455 animals/km^2; Ferguson et al., 2006).

H. **Dwarf sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution; they are not believed to be concentrated anywhere. Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001), an overall abundance of 350,553 animals is computed in the ETP. At the latitude of this site, only *Kogia breviceps* is expected. LGL's density estimate of 0.0043 animals/km^2 best represents this species in this region. This is comparable to the density estimates for pygmy sperm whale (0.00291/km^2 (CV=1.12) and dwarf sperm whale (0.00714 animals/km^2 CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

I. **False killer whale:** Miyashita (1993) estimated abundance of false killer whales from 34 sighting cruises associated with the Japanese drive fishery (16,668 individuals CV=0.263). LGL's (2011) density of 0.0006 animals/km^2 is most representative of this species. This is much lower than the

average densities estimated in the eastern North Pacific (0.0045 animals/km^2; Ferguson and Barlow, 2001, 2003).

J. **Fraser's dolphin**: Without data on abundance or density estimates for the western North Pacific, Ferguson and Barlow's (2001, 2003) abundance estimate of 220,789 animals is extrapolated to represent the Western North Pacific stock of Fraser's dolphins. However, the density estimate derived by LGL (2011), 0.0025 animals/km^2, is most appropriate.

25. **Killer whale**: Without any population or occurrence data on killer whales for the western North Pacific, the best available abundance estimate of 12,256 animals is from Ferguson and Barlow's (2001, 2003) long time series in the ETP while the best available density estimate of 0.0001 animals/km^2 is from LGL (2011) compilation of data for the Marianas area. LGL's (2011) density is very close to the density estimate of killer whales derived in waters of the Hawaii EEZ of 0.00014 animals/km^2 (Barlow, 2006).

AA. **Longman's beaked whale:** Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings in their ETP surveys were south of 25ºN. Considering the lack of occurrence or population data for the Western North Pacific stock of Longman's beaked whales, the abundance of 1,007 animals estimated for Longman's beaked whales in offshore Hawaiian waters (Barlow, 2006) and the density of 0.0003 animals per km^2 (LGL, 2011) derived from the Marianas regions are considered most appropriate to represent the Western North Pacific stock.

K. **Melon-headed whale:** Leatherwood and Reeves (1983) stated that melon-headed whales are rare except in the Philippine Sea. With these limited data, a density estimate derived by LGL (2011) of 0.0027 animals/km^2. This is very comparable to Mobley et al.'s (2000) density estimate for Hawaii waters of 0.0021 animals/km^2 and the Guam/Marianas estimate of 0.00428 animals/km^2 (Fulling et al., 2011). An abundance estimate of 36,770 (Ferguson and Barlow, 2001, 2003) was used.

L. **Pantropical spotted dolphin:** Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Japan. Miyashita (1993) reports an abundance estimate (438,064 animals CV=0.174). The best available density estimate of 0.0113 animals/km^2 is calculated by LGL (2011). This is comparable to that observed in the Hawaii EEZ (0.00366 animals/km^2; Barlow, 2006) and an order of magnitude less than that observed in nearshore waters of Hawaii (0.0407 animals/km^2; (Mobley et al., 2000).

M. **Pygmy killer whale:** Kishiro and Kasuya (1993) reviewed the historical catches of Japanese drive fisheries. No pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan), but Leatherwood and Reeves (1983) reported that they were seen relatively frequently in the tropical Pacific off Japan. The best available density estimate (0.0001 animals/km^2) is calculated by LGL (2011). This is comparable to the density estimate (0.00039 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). No pygmy killer whales were seen in nearshore aerial during the spring, summer, and fall (Mobley et al., 2000). An abundance estimate of 30,214 was used from the eastern Pacific (Ferguson and Barlow, 2001, 2003).

N. **Pygmy sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution; they are not believed to be concentrated anywhere. Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001, 2003), an overall abundance of 350,553 animals is computed in the ETP. At the latitude of this site, only *Kogia breviceps* is expected but both *Kogia* species are included to be conservative. A density of 0.0018 animals/km^2 was derived by LGL (2011). This is comparable to the density estimates for pygmy sperm whale (0.00291/km^2 (CV=1.12) and dwarf sperm whale (0.00714 animals/km^2 CV=0.74) observed within the Hawaii EEZ (Barlow, 2006).

O. **Risso's dolphin:** Miyashita (1993) reports a western North Pacific stock estimate of 83,289 animals (CV=0.179). LGLs (2011) density estimate of 0.0005 animals/km^2 best represents this species in this region. This density is lower than the density estimate off Hawaii (0.0010 animals/km^2; Barlow, 2006).

P. **Rough-toothed dolphin:** The best available density estimate, 0.0019 animals/km^2, is calculated by LGL (2011). This is comparable to those estimated in the Hawaii EEZ (0.00355 animals/km^2; Barlow, 2006) and in nearshore Hawaii waters (0.0017 animals/km^2; Mobley et al., 2000). The best available abundance estimate (145,729 animals) is from eastern Pacific waters (Ferguson and Barlow, 2001, 2003).

Q. **Short-finned pilot whale:** Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 animals CV=0.224). Kasuya et al. (1988) suggested that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). Miyashita (1993) questioned whether the entire range consisted of a single stock or population, but had no way of delineating the data. The most appropriate density estimate, 0.0021 animals/km^2, for this offshore site is derived by LGL (2011).

R. **Sperm whale**: Uncertainty regarding the stock structure of sperm whales in the North Pacific Ocean, except in the U.S. EEZ waters results in Kasuya and Miyashita's (1988) stock estimate of 102,112 animals being used to represent the North Pacific stock in this mission area. Sightings collected by Kasuya and Miyashita (1988) suggest that in the summer, the density of sperm whales is high south of the Kuroshio Current System (south of approximately 35°N) but extremely low north of 35°N. Kasuya and Miyashita's (1988) data suggest that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands (~50°N) and winter off Hokkaido and Sanriku (~40°N), and the southwestern North Pacific stock with females that summer off Hokkaido and Sanriku (~40°N) and winter around the Bonin Islands (~25°N). Male sperm whales of these two stocks are found north of the range of the corresponding females. Based on this information, sperm whales may occur throughout the year in this mission area. A density estimate of 0.0022 animals/km^2 was derived from LGL data (2011). This density is higher than the Mobley et al. (2000) estimate (0.0010 animals/km^2) and the density estimate (0.00123 animals/km^2) calculated from the winter/spring survey around Guam and Mariana Islands (Fulling et al., 2011), but is very close to the density calculated from the summer/fall survey off Hawaii in 2002 (0.00282 animals/km^2) (Barlow, 2006).

S. **Spinner dolphin:** This species is not mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or stock estimates are available (Miyashita, 1993). The best available density estimate (0.0019 animals/km^2) is calculated by LGL (2011). This is comparable to that observed in the Hawaii EEZ (0.00137 animals/km^2; Barlow, 2006) and an order of magnitude less than that observed in nearshore waters of Hawaii (0.0443 animals/km^2; Mobley et al., 2000). The best available abundance estimate is for spinner dolphins (1,015,059 animals) from the ETP (Ferguson and Barlow, 2001, 2003).

T. **Striped dolphin:** Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for one population in the area: one south of 30°N. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate of 570,038 animals (CV=0.186). The density of 0.0058 animals/km^2 was derived by LGL (2011) and is comparable to the density estimates from nearshore Hawaii (0.0016/km^2; Mobley et al., 2000), and the Hawaii EEZ (0.00536/km^2; Barlow, 2006) and Guam and the Mariana Islands (0.00616/km^2; Fulling et al., 2011).

10. MISSION AREA #10—HAWAII NORTH

The waters around the MHI have been systematically surveyed as part of the Acoustic Thermometry of Ocean Climate Marine Mammal Research Program (ATOC MMRP) during the peak humpback season (mid-Feb through mid-April) (Mobley, 2006). The aerial surveys were designed to assess the distribution and abundance of marine mammals and sea turtles within approximately 46 km (25 nmi) of the MHI to assess the potential effects of the ATOC transmissions. The first systematic shipboard survey of the Hawaii EEZ was conducted from August to November 2002 (Barlow, 2006). Due to the spatial and temporal characteristics of these surveys, the knowledge of marine mammals around the Hawaiian Islands is growing but still is relatively limited, particularly for mysticete whales that migrate seasonally to offshore waters. Much more extensive survey work has been conducted in the ETP (Ferguson and Barlow, 2001, 2003; Ferguson et al., 2006), but it is not known whether these ETP marine mammals are part of the same population that occurs around the Hawaiian Islands.

A. **Blue whale**: Due to the general lack of occurrence data for blue whales in the North Pacific Ocean, stock structure remains uncertain[15]. Blue whales occur rarely in the central North Pacific, with few sightings and acoustic detections having been made (Carretta et al., 2013). No recent sightings of blue whales have been made around Hawaii in recent years (Barlow, 2006; Mobley, 2006). Further evidence of their occurrence in the area exists in acoustic recordings. Stafford et al. (2001) reported that recordings made near Kaneohe, Hawaii from August 1992 through April 1993 consisted of approximately 30% of the northwest Pacific blue whale call type and 70% of northeast Pacific call type, with western North Pacific calls dominating during the winter and eastern North Pacific calls dominating during the summer. Since data are so limited for the blue whale occurrences around Hawaii and given the current uncertainty regarding the blue whale stock delineation in the North Pacific, blue whales in Hawaiian waters are considered part of the Central North Pacific stock, with a stock abundance estimated at 9,250 animals (Tillman, 1977; Stafford et al., 2001; Carretta et al., 2013). Since no density is available for blue whales in this region, the density estimate, 0.0002 animals/km^2, Ferguson and Barlow (2001, 2003) derived for blue whales in the ETP are considered appropriate for use with this stock.

B. **Bryde's whale:** The best available density (0.0002 animals/km^2) and abundance (469 animals, CV=0.45) estimates are those calculated for the summer/fall surveys in the Hawaii EEZ (Barlow, 2006).

C. **Common minke whale:** A Hawaii stock is recognized that occurs seasonally (November-March) in Hawaiian waters, though no estimate of abundance has been calculated (Carretta et al., 2013). Minke whales were observed and acoustically detected during the 2002 summer/fall survey of the Hawaiian EEZ (Barlow, 2006). A year-long analysis of acoustic recordings made at Station ALOHA (A Long-term Oligotrophic Habitat Assessment) 100 km north of Oahu detected "central" or "Hawaii" boings from 22 October 2007 to 21 May 2008 and not at all during the months of June to September, though this does not indicate that no minke whales were present (Oswald et al., 2011). The best estimate of abundance (25,049 animals) is from sighting surveys in July and August in the western North Pacific and Sea of Okhotsk (Buckland et al., 1992). The best density estimate (0.0002 animals/km^2) is from the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

D. **Fin whale**: There has been acoustic evidence for fin whale presence in fall and winter (Thompson and Friedl, 1982; Moore et al., 1998) and one sighting in nearshore waters (February) (Mobley et al., 1996). From the five sightings reported during the 2002 summer/fall survey (Barlow, 2003), an abundance estimate of 174 animals (CV=0.72) was calculated for the Hawaii stock of fin whales (Carretta et al., 2013). A density of 0.0001 animals/km^2 fin whales was also derived from Barlow, 2003 for these waters. This estimate is conservative because McDonald and Fox (1999) derived an average calling whale density estimate of 0.027 animals per 1000 km^2 (0.000027 animals/km^2) based on recordings made north of Oahu, Hawaii–a value an order of magnitude less than what was

modeled. The seasonal maximum calling whale density was about three times the average, or 0.000081 animals/km^2 (McDonald and Fox, 1999), still considerably less than the modeled density.

E. **Humpback whale**: The Central North Pacific stock of humpback whales is identified as individuals that migrate from summer/fall feeding grounds of northern British Columbia and southeast Alaska (Prince William Sound west to Kodiak), to winter/spring breeding and calving grounds of the Hawaiian Islands (Carretta et al., 2013). Some exchange between winter/spring areas has been documented, as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Calambokidis et al., 1997). Acoustic surveys suggest a northbound migration heading of approximately magnetic north (10° true), with a "migration corridor" of 150° to 160°W (Norris et al., 1999) and a winter presence in the Northwestern Hawaiian Islands (Lammers et al., 2010). Animals are cycling through the breeding grounds with an average residency of approximately 30 to 45 days. Based on the recent North Pacific humpback whale abundance updates from Calambokidis et al. (2008), the best available abundance estimate for the Central North Pacific stock of humpback whales is 10,103 individuals, which is a much higher estimate than former surveys and research provided. Humpback whales are not expected in this mission area during summer. A density estimate of 0.0009 animals animals/km^2 from LGL (2008) data was used for this mission area and stock.

F. **Sei whale**: Sei whales are present throughout the temperate North Pacific Ocean but have been observed as far south as 20°N (Horwood, 1987), with whaling effort distributed continuously across the North Pacific between 45°N and 55°N (Masaki, 1977). The IWC only considers one stock of sei whales in the North Pacific (Donovan, 1991), but NMFS recognizes three stocks, including a Hawaiian stock. The best estimate of abundance is from a 2002 summer/fall shipboard line-transect survey of the entire Hawaiian Islands EEZ that estimated 77 sei whales (Barlow, 2003), though the majority of sei whales would be expected to be distributed at a higher latitude during this time of year. No density estimate was derived from the 2002 line-transect survey, and considering their traditional temperate distribution, a nominal density estimate of 0.0001 animals/km^2 is used for take calculations.

G. **Blainville's beaked whale:** The best available density estimate (0.0012 animals/km^2) and abundance estimate (2,872 animals, CV=1.25) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0012 animals/km^2; Mobley et al., 2000).

H. **Common bottlenose dolphin**: Recent photo-id and genetic studies around the main Hawaiian Islands suggest limited movements among islands and offshore waters (Baird et al., 2009). Five Pacific Islands Region stocks are identified: (1) Kauai and Niihau; (2) Oahu; (3) the "4-Island Region" including Molokai, Lanai, Maui, and Kahoolawe; (4) Hawaii Island; and (5) Hawaii pelagic stock (Carretta et al., 2013). The boundary between the insular stocks and the pelagic stock is the 1,000-m (3,281-ft) isobath.

Hawaii pelagic stock The best available density estimate (0.0013 animals/km^2) and abundance estimate (3,178 animals) for the pelagic stock are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006; Baird et al., 2009; Carretta et al., 2013). The density estimate is the same as that for the nearshore Hawaiian waters (0.0103 animals/km^2; Mobley et al., 2000).

Kauai/Niihau stock: Because of the offshore location of this modeling site, only the more northerly insular stock of Kauai/Niihau is potentially affected. The best available density estimate (0.00131 animals/km^2) is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The best available abundance estimate (147 animals, CV=0.11) for the Kauai/Niihau stock is calculated from photo-id studies around Kauai and Niihau (Baird et al., 2009; Carretta et al. 2013). The density estimate is the same as that calculated from nearshore Hawaiian waters (0.0013 animals/km^2; Mobley et al., 2000).

I. **Cuvier's beaked whale:** The best available density estimate (0.00621 animals/km^2) and abundance estimate (15,242 individuals, CV=1.43) are calculated from the summer/fall survey in the Hawaii EEZ

(Barlow, 2006; Carretta et al., 2013). The density estimate is an order of magnitude larger than the density estimate in nearshore Hawaiian waters (0.0008 animals/km^2; Mobley et al., 2000).

J. **False killer whale**: Five Pacific Islands Region management stocks of false killer whales are currently recognized (Carretta et al., 2013): the main Hawaiian Islands insular stock (which includes false killer whales occurring within 140 km [approximately 75 nmi] of the main Hawaiian Islands; the Northwestern Hawaiian Islands (NWHI) stock (which includes false killer whales inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai); the Hawaii pelagic stock (including false killer whales occurring in waters further than 44 km [approximately 22 nmi] of the main Hawaiian Islands; the Palmyra Atoll stock (which includes false killer whales within the U.S. EEZ of Palmyra Atoll); and the American Samoa stock (including animals within the U.S. EEZ of American Samoa). Overlap of the stock's ranges occurs between the main Hawaiian Islands insular, Northwestern Hawaiian Islands, and pelagic stocks of the false killer whale; the ranges of the insular and pelagic populations overlap in the area between about 42 km and 112 km from shore of the main Hawaiian Islands while overlap in the ranges of insular and Northwestern Hawaiian Islands stocks occurs in water within 40 km of Kauai and Niihau (Forney et al., 2010; Carretta et al., 2013). False killer whales occur year-round in Hawaiian waters. Only the Main Hawaiian Islands, Northwestern Hawaiian Islands, and Pelagic stocks of false killer whales potentially occur in the Hawaii-North mission area.

MHI insular stock: The best available abundance estimate (151 animals, CV=0.20) for the MHI insular stock is derived from the 2006 to 2009 recent sighting histories and open population models presented in unpublished assessments for the status review of Hawaiian false killer whales (Caretta et al., 2013). A density estimate of 0.0012 animals/km^2 is the best available estimate of the insular stock (Oleson et al., 2010).

Hawaii pelagic stock: The abundance of the Hawaii pelagic stock of false killer whales is estimated as 1,503 individuals CV=0.66) from 2010 visual line-transect data; this estimate, however, has not been yet corrected for shipboard attraction (Bradford et al., 2012). As indicated by behavioral observations and assessment of the detection function, false killer whales are attracted to the survey vessel, so that the abundance estimated is an overestimate. The best available density estimate for the Hawaii pelagic stock, 0.0006 individuals/km^2, was also estimated from the 2010 dedicated survey of Hawiian EEZ waters (Bradford et al., 2012).

Northwestern Hawaiian Islands stock: This stock was defined only recently, and the abundance of this stock estimated from 2010 visual line-transect survey data is 552 whales (CV = 1.09) this estimate, however, has not been yet corrected for shipboard attraction (Bradford et al., 2012). As indicated by behavioral observations and assessment of the detection function, false killer whales are attracted to the survey vessel, so that the abundance estimated is an overestimate. The most current density estimated for the Northwestern Hawaiian Island stock is 0.0013 individuals/km^2 (CV = 1.09) (Bradford et al., 2012).

K. **Fraser's dolphin**: Fraser's dolphin were first documented in Hawaii waters during a recent summer/fall survey (Barlow, 2006), resulting in the best available density estimate (0.0042 animals/km^2) and abundance estimate (10,226 animals, CV=1.16).

L. **Killer whale:** Killer whales are considered rare in Hawaii waters with limited sightings being reported (Carretta et al., 2013). The best available density estimate (0.0001 animals/km^2) and abundance estimate (349 animals, CV=0.98) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nm of the Main Hawaiian Islands.

M. ***Kogia* spp.**: Hawaii stocks of pygmy and dwarf sperm whales are recognized (Carretta et al., 2013). Mobley et al. (2000) saw 2 pods for a total of 5 individuals during his 1993-1998 survey efforts. No density or abundance estimates were derived. The best available estimates are combined pygmy and

dwarf sperm whale density (0.0101 animals/km^2) and abundance (24,657 animals; CV=1.86), calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006).

N. **Longman's beaked whale:** Longman's beaked whale has only recently been identified to species (Dalebout et al., 2003; Pitman et al.,1999). It is considered one of the rarest and least known cetacean species. The best available density estimate (0.0004 animals/km^2) and abundance estimate (1,007 animals, CV=1.26) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). No other density estimates exist for this species around Hawaii (Mobley et al., 2000).

O. **Melon-headed whale:** Additional studies are beginning to reveal evidence for island-associated stock structure in melon-headed whales in the main Hawaiian Islands. It is suggested that a Kohala Resident Stock should be recognized, consisting of animals within the 2,500 m (8,202.5 ft) isobath around the west and northwest sides of Hawaii Island (Oleson et al., 2013). The remainder of melon-headed whales found within the Hawaii EEZ would consist of a Hawaiian Islands Stock that is not restricted to nearshore waters. However, at this point, NMFS recognizes one stock of melon-headed whales within the Hawaii EEZ, the Hawaiian stock. The best available density estimate (0.0012 animals/km^2) and abundance estimate (2950 whales, CV=1.17) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0021 animals/km^2; Mobley et al., 2000). Recent studies of photo-identification data using mark-recapture techniques suggests there are two populations, a localized resident population around the northwest corner of the island of Hawaii and a larger population (5,794 animals CV = 0.20) distributed throughout the Main Hawaiian Islands (Baird et al., 2010; Aschettino, 2012).

P. **Pantropical spotted dolphin:** Genetic analyses support the recognition of three island-associated stocks: a Hawaii Island Stock that extends 65 km from shore, a 4-Islands Region Stock that extends 20 km from shore, and an Oahu Stock that extends 20 km from shore (Oleson et al., 2013), in addition to a Hawaii Pelagic Stock that consists of all other pantropical spotted dolphins within the Hawaii EEZ. However, at this point, NMFS recognizes one stock of pantropical spotted dolphins within the Hawaii EEZ, the Hawaiian stock. The best available density estimate (0.0037 animals/km^2) and abundance estimate (8,978 animals, CV=0.48) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0407 animals/km^2; Mobley et al., 2000).

Q. **Pygmy killer whale:** Very little information exists about this species in the Hawaii region. Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nmi of the Main Hawaiian Islands. Two sightings were reported during the summer/fall survey in the Hawaii EEZ, resulting in the best available density estimate (0.0004 animals/km^2) and abundance estimate (956 animals, CV=0.83) (Barlow, 2006).

R. **Risso's dolphin:** The best available density estimate (0.0010 animals/km^2) and abundance estimate (2,372 animals, CV=0.65) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). There were not enough sightings to derive density or abundance estimates in nearshore waters (Mobley et al., 2000). A Hawaii stock is recognized, though they appear to be rare in the area (Carretta et al., 2013). "Based on the locations of interactions with the Hawaiian longline fishery, it is likely that Risso's dolphins primarily occur in pelagic waters tens to hundreds of miles from the main Hawaiian Islands and are only occasionally found nearshore" (Carretta et al., 2013).

S. **Rough-toothed dolphin:** The best available density estimate (0.00355 animals/km^2) and abundance estimate (8,709 animals, CV=0.45) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0017 animals/km^2; Mobley et al., 2000).

T. **Short-finned pilot whale:** The best available density estimate (0.0036 animals/km^2) and abundance estimate (8,870 animals, CV=1.13) are calculated from the summer/fall survey in the Hawaii EEZ

(Barlow, 2006). The density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0237 animals/km^2; Mobley et al., 2000).

U. **Sperm whale**: Sperm whales occurring in the deep waters of the Hawaiian Islands are considered to be part of the Hawaiian stock, which numbers 6,919 animals (CV=0.81) (Barlow, 2006). The best available density (0.00282 animals/km^2) estimated for sperm whales in this mission area was calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is slightly higher but comparable to near-shore Hawaiian waters (0.0010 animals/km^2; Mobley et al., 2000).

V. **Spinner dolphin:** Based on analyses of genetic data, movement patterns of dolphins, and the geographic distances among the Hawaiian Islands, five separate island-associated stocks are recognized in the central North Pacific: Hawaii Island, Oahu/4-Islands Region, Kauai/Niihau, Pearl and Hermes Reef, and Midway Atoll/Kure (Hill et al., 2010; Carretta et al., 2013). The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010).

   Hawaii Pelagic stock: Spinner dolphins beyond 18.5 km (10 nmi) from shore or around other islands within the Hawai'i EEZ belong to the Hawaii Pelagic Stock. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,351 spinner dolphins (Barlow, 2006). However, this study assumed a single Hawaiian Islands stock and occurred over eight years old. A 2010 shipboard line-transect study within the Hawaiian EEZ did not record any sightings of pelagic spinner dolphins. Given the need for a density and abundance estimate for take calculations, the best available density estimate (0.0014 animals/km^2) and abundance estimate (3,351 animals, CV=0.74) are calculated from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006) The density estimate is an order of magnitude less than nearshore Hawaiian waters (0.0443 animals/km^2; Mobley et al., 2000).

   Kauai/Niihau stock: The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010). Spinner dolphins beyond 18.5 km (10 nmi) from shore or around other islands within the Hawai'i EEZ belong to the Hawaii Pelagic Stock. The best estimate of abundance for the Kauai/Niihau Stock is from a photo-identification study conducted October to November 2005 on the leeward coast of Kauai, which resulted in an estimate of 601 animals (CV=0.20), though it is recognized that this is likely an underestimate because of its limited spatial scope (Carretta et al., 2013). The best available density estimate (0.0014 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

W. **Striped dolphin:** The best available density estimate (0.0054 animals/km^2) and abundance estimate (13,143 individuals; CV=0.46) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0016 animals/km^2; Mobley et al., 2000).

X. **Hawaiian monk seal**: Monk seals primarily occur in the NWHI, though a respectable population is beginning to establish itself on Niihau and Kauai, with 21 distinct individuals documented on Kauai (Farry, 2003) and 83 individuals observed throughout the MHI in 2006 (Carretta et al., 2013). Small numbers of interaction occur between the monk seal subpopulations, and foraging behavior suggests offshore movement patterns (Parrish et al., 2000; Parrish et al., 2002). The current abundance estimated for the stock of Hawaiian monk seals is 1,212 animals (Carretta et al., 2013). Although no density for the very rare Hawaiian monk seal is available, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis for this species to reflect the very low probability of occurrence in this region.

11. MISSION AREA #11—HAWAII SOUTH

A. **Blue whale**: Although there is uncertainty about the structure of blue whale stocks in the North Pacific, blue whales occurring in Hawaiian waters are considered part of the Central North Pacific stock (Carretta et al., 2013). Blue whales occur rarely in the central North Pacific, with few sightings and acoustic detections having been made (Carretta et al., 2013). There have been no recent sightings of blue whales around Hawaii in recent years (Barlow, 2006; Mobley, 2006). Evidence of blue whale occurrence in this mission area exists in acoustic recordings. Stafford et al. (2001) showed that recordings made near Kaneohe, Hawaii from August 1992 through April 1993 consisted of approximately 30% of the northwest Pacific blue whale call type and 70% of northeast Pacific call type, with western North Pacific calls dominating during the winter and eastern North Pacific calls dominating during the summer. Since data are so limited for the blue whale occurrences around Hawaii and given the current uncertainty in blue whale stock delineation in the North Pacific, the abundance estimated for the Central North Pacific stock is derived from whaling and acoustic occurrence data (Tillman, 1977; Stafford et al., 2001; Carretta et al., 2011). Since no density estimate is available for blue whales in mission area #11, the density of 0.0002 animals/km^2, derived from offshore ETP waters by Ferguson and Barlow (2001, 2003) was considered appropriate to apply to this mission area.

B. **Bryde's whale:** The best available density (0.0002 animals/km^2) and abundance (469, animals CV=0.45) estimates are those calculated for the summer/fall surveys in the Hawaii EEZ (Barlow, 2006).

C. **Common minke whale:** A Hawaii stock is recognized that occurs seasonally (November-March) in Hawaiian waters, though no estimate of abundance has been calculated (Carretta et al., 2013). Minke whales were observed and acoustically detected during the 2002 summer/fall survey of the Hawaiian EEZ (Barlow, 2006). A year-long analysis of acoustic recordings made at Station ALOHA (A Long-term Oligotrophic Habitat Assessment) 100 km north of Oahu detected "central" or "Hawaii" boings from 22 October 2007 to 21 May 2008 and not at all during the months of June to September, though this does not indicate that no minke whales were present (Oswald et al., 2011). The best estimate of abundance (25,049 animals) is from sighting surveys in July and August in the western North Pacific and Sea of Okhotsk (Buckland et al., 1992). The best density estimate (0.0002 animals/km^2) is from the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

D. **Fin whale**: There has been acoustic evidence for fin whale presence in fall and winter in Hawaiian waters (Thompson and Friedl, 1982; Moore et al., 1998) and one sighting in nearshore waters (February) (Mobley et al., 1996). From the five sightings reported during the 2002 summer/fall survey (Barlow, 2003), an abundance estimate of 174 animals (CV=0.72) was calculated for the Hawaii stock of fin whales (Carretta et al., 2013). A density of 0.0001 animals/km^2 fin whales was also derived from Barlow, 2003 for these waters. This estimate is conservative because McDonald and Fox (1999) derived an average calling whale density estimate of 0.027 animals per 1000 km^2 (0.000027 animals/km^2) based on recordings made north of Oahu, Hawaii–a value an order of magnitude less than what was modeled. The seasonal maximum calling whale density was about three times the average, or 0.000081 animals/km^2 (McDonald and Fox, 1999), still considerably less than the modeled density.

E. **Humpback whale**: The Central North Pacific stock of humpback whales is identified as individuals that migrate from summer/fall feeding grounds of northern British Columbia and southeast Alaska (Prince William Sound west to Kodiak), to winter/spring breeding and calving grounds of the Hawaiian Islands (Carretta et al., 2013). Some exchange between winter/spring areas has been documented, as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Calambokidis et al., 1997). Acoustic surveys suggest a northbound migration heading of approximately magnetic north (10° true), with a "migration corridor" of 150° to 160°W (Norris et al.,

1999) and a winter presence in the Northwestern Hawaiian Islands (Lammers et al., 2010). Animals are cycling through the breeding grounds with an average residency of approximately 30 to 45 days. Based on the recent North Pacific humpback whale abundance updates from Calambokidis et al. (2008), the best available abundance estimate for the Central North Pacific stock of humpback whales is 10,103 individuals, which is a much higher estimate than former surveys and research provided. Humpback whales are not expected in this mission area during summer. A density estimate of 0.0009 animals animals/km^2 from LGL (2008) data was used for this mission area and stock.

F. **Sei whale**: Sei whales are present throughout the temperate North Pacific Ocean but have been observed as far south as 20°N (Horwood, 1987), with whaling effort distributed continuously across the North Pacific between 45°N and 55°N (Masaki, 1977). The IWC only considers one stock of sei whales in the North Pacific (Donovan, 1991), but NMFS recognizes three stocks, including a Hawaiian stock. The best estimate of abundance is from a 2002 summer/fall shipboard line-transect survey of the entire Hawaiian Islands EEZ that estimated 77 sei whales (Barlow, 2003), though the majority of sei whales would be expected to be distributed at a higher latitude during this time of year. No density estimate was derived from the 2002 line-transect survey, and considering their traditional temperate distribution, a nominal density estimate of 0.0001 animals/km^2 is used for take calculations.

G. **Blainville's beaked whale:** The best available density estimate (0.00117 animals/km^2) and abundance estimate (2,872 animals, CV=1.25) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0012 animals/km^2; Mobley et al., 2000).

H. **Common bottlenose dolphin:** Recent photo-id and genetic studies around the main Hawaiian Islands suggest limited movements among islands and offshore waters (Baird et al., 2009). Five Pacific Islands Region stocks are identified: (1) Kauai and Niihau; (2) Oahu; (3) the "4-Island Region" including Molokai, Lanai, Maui, and Kahoolawe; (4) Hawaii Island; and (5) Hawaii pelagic stock (Carretta et al., 2013). The boundary between the insular stocks and the pelagic stock is the 1,000-m (3,281-ft) isobath. Because of the offshore location of this modeling site, only the more southerly insular stocks of Oahu, 4-Islands Region, and Hawaii Island are potentially affected.

Hawaii pelagic stock: The best available density estimate (0.0013 animals/km^2) and abundance estimate (3178 animals) for the pelagic stock are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006; Baird et al., 2009; Carretta et al., 2013). The density estimate is an order of magnitude less than nearshore Hawaiian waters (0.0103 animals/km^2; Mobley et al., 2000).

Oahu stock: The best available density estimate (0.0013 animals/km^2) is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The best available abundance estimate (594 animals, CV=0.54) for the Oahu stock is calculated from photo-id studies (Baird et al., 2009; Carretta et al., 2013). The density estimate is an order of magnitude less than that calculated from nearshore Hawaiian waters (0.0013 animals/km^2; Mobley et al., 2000).

4-Islands Region stock: Because of the offshore location of this modeling site, only the more southerly insular stocks of Oahu, 4-Islands Region, and Hawaii Island are potentially affected. The best available density estimate (0.0013 animals/km^2) is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The best available abundance estimate (153 animals, CV=0.24) for the 4-Islands Region stock is calculated from photo-id studies (Baird et al., 2009; Carretta et al. 2013). The density estimate is an order of magnitude less than that calculated from nearshore Hawaiian waters (0.0013 animals/km^2; Mobley et al., 2000).

Hawaii Island stock: Because of the offshore location of this modeling site, only the more southerly insular stocks of Oahu, 4-Islands Region, and Hawaii Island are potentially affected. The best available density estimate (0.0013 animals/km^2) is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The best available abundance estimate (102 animals, CV=0.13) for the Hawaii Island stock is calculated from photo-id studies (Baird et al., 2009; Carretta et al., 2013). The

density estimate is an order of magnitude less than that calculated from nearshore Hawaiian waters (0.0013 animals/km^2; Mobley et al., 2000).

I. **Cuvier's beaked whale:** The best available density estimate (0.0062 animals/km^2) and abundance estimate (15,242 individuals, CV=1.43) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006; Carretta et al., 2013). The density estimate is an order of magnitude larger than the density estimate in nearshore Hawaiian waters (0.0008 animals/km^2; Mobley et al., 2000).

J. **False killer whale**: Five Pacific Islands Region management stocks of false killer whales are currently recognized (Carretta et al., 2013): the main Hawaiian Islands insular stock (which includes false killer whales occurring within 140 km [approximately 75 nmi] of the main Hawaiian Islands; the Northwestern Hawaiian Islands (NWHI) stock (which includes false killer whales inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai); the Hawaii pelagic stock (including false killer whales occurring in waters further than 44 km [approximately 22 nmi] of the main Hawaiian Islands; the Palmyra Atoll stock (which includes false killer whales within the U.S. EEZ of Palmyra Atoll); and the American Samoa stock (including animals within the U.S. EEZ of American Samoa). Overlap of the stock's ranges occurs between the main Hawaiian Islands insular, Northwestern Hawaiian Islands, and pelagic stocks of the false killer whale; the ranges of the insular and pelagic populations overlap in the area between about 42 km and 112 km from shore of the main Hawaiian Islands while overlap in the ranges of insular and Northwestern Hawaiian Islands stocks occurs in water within 40 km of Kauai and Niihau (Forney et al., 2010; Carretta et al., 2013). False killer whales occur year-round in Hawaiian waters. Only the Main Hawaiian Islands and Pelagic stocks of false killer whales potentially occur in the Hawaii-South mission area.

MHI insular stock: The best available abundance estimate (151 animals, CV=0.20) for the MHI insular stock is derived from the 2006 to 2009 recent sighting histories and open population models presented in unpublished assessments for the status review of Hawaiian false killer whales (Caretta et al., 2013). A density estimate of 0.0012 animals/km^2 is the best available estimate of the insular stock (Oleson et al., 2010).

Hawaii pelagic stock: The abundance of the Hawaii pelagic stock of false killer whales is estimated as 1,503 individuals CV=0.66) from 2010 visual line-transect data; this estimate, however, has not been yet corrected for shipboard attraction (Bradford et al., 2012). As indicated by behavioral observations and assessment of the detection function, false killer whales are attracted to the survey vessel, so that the abundance estimated is an overestimate. The best available density estimate for the Hawaii pelagic stock, 0.0006 individuals/km^2, was also estimated from the 2010 dedicated survey of Hawiian EEZ waters (Bradford et al., 2012).

K. **Fraser's dolphin:** Fraser's dolphin were first documented in Hawaii waters during a recent summer/fall survey (Barlow, 2006), resulting in the best available density estimate (0.0042 animals/km^2) and abundance estimate (10,226 animals, CV=1.16).

L. **Killer whale:** Killer whales are considered rare in Hawaii waters with limited sightings being reported (Carretta et al., 2013). The best available density estimate (0.0001 animals/km^2) and abundance estimate (349 animals, CV=0.98) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nm of the Main Hawaiian Islands.

M. ***Kogia* spp.**: Hawaii stocks of pygmy and dwarf sperm whales are recognized (Carretta et al., 2013). Mobley et al. (2000) saw 2 pods for a total of 5 individuals during his 1993-1998 survey efforts. No density or abundance estimates were derived. The best available estimates are combined pygmy and dwarf sperm whale density (0.0101 animals/km^2) and abundance (24,657 animals; CV=1.86), calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006).

N. **Longman's beaked whale:** Longman's beaked whale has only recently been identified to species (Dalebout et al., 2003; Pitman et al.,1999). It is considered one of the rarest and least known cetacean species. The best available density estimate (0.0004 animals/km^2) and abundance estimate (1,007 animals, CV=1.26) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). No other density estimates exist for this species around Hawaii (Mobley et al., 2000).

O. **Melon-headed whale:** Additional studies are beginning to reveal evidence for island-associated stock structure in melon-headed whales in the main Hawaiian Islands. It is suggested that a Kohala Resident Stock should be recognized, consisting of animals within the 2,500 m (8,202.5 ft) isobath around the west and northwest sides of Hawaii Island (Oleson et al., 2013). The remainder of melon-headed whales found within the Hawaii EEZ would consist of a Hawaiian Islands Stock that is not restricted to nearshore waters. However, at this point, NMFS recognizes one stock of melon-headed whales within the Hawaii EEZ, the Hawaiian stock. The best available density estimate (0.0012 animals/km^2) and abundance estimate (2,950 whales, CV=1.17) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0021 animals/km^2; Mobley et al., 2000). Recent studies of photo-identification data using mark-recapture techniques suggests there are two populations, a localized resident population around the northwest corner of the island of Hawaii and a larger population (5,794 animals CV = 0.20) distributed throughout the Main Hawaiian Islands (Aschettino, 2010; Baird et al., 2010).

P. **Pantropical spotted dolphin:** Genetic analyses support the recognition of three island-associated stocks: a Hawaii Island Stock that extends 65 km from shore, a 4-Islands Region Stock that extends 20 km from shore, and an Oahu Stock that extends 20 km from shore (Oleson et al., 2013), in addition to a Hawaii Pelagic Stock that consists of all other pantropical spotted dolphins within the Hawaii EEZ. However, at this point, NMFS recognizes one stock of pantropical spotted dolphins within the Hawaii EEZ, the Hawaiian stock. The best available density estimate (0.0037 animals/km^2) and abundance estimate (8,978 animals, CV=0.48) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0407 animals/km^2; Mobley et al., 2000).

Q. **Pygmy killer whale**: Very little information exists about this species in the Hawaii region. Mobley et al. (2000) did not report any sightings in their surveys of waters within 25 nmi of the Main Hawaiian Islands. Two sightings were reported during the summer/fall survey in the Hawaii EEZ, resulting in the best available density estimate (0.0004 animals/km^2) and abundance estimate (956 animals, CV=0.83) (Barlow, 2006).

R. **Risso's dolphin:** The best available density estimate (0.0010 animals/km^2) and abundance estimate (2,372 animals, CV=0.65) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). There were not enough sightings to derive density or abundance estimates in nearshore waters (Mobley et al., 2000). A Hawaii stock is recognized, though they appear to be rare in the area (Carretta et al., 2013). "Based on the locations of interactions with the Hawaiian longline fishery, it is likely that Risso's dolphins primarily occur in pelagic waters tens to hundreds of miles from the main Hawaiian Islands and are only occasionally found nearshore" (Carretta et al., 2013).

S. **Rough-toothed dolphin:** The best available density estimate (0.0036 animals/km^2) and abundance estimate (8,709 animals, CV=0.45) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is comparable to nearshore Hawaiian waters (0.0017 animals/km^2; Mobley et al., 2000).

T. **Short-finned pilot whale:** The best available density estimate (0.0036 animals/km^2) and abundance estimate (8,870 animals, CV=1.13) are calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0237 animals/km^2; Mobley et al., 2000).

U. **Sperm whale**: Sperm whales occurring in the deep waters of the Hawaiian Islands are considered to be part of the Hawaiian stock, which numbers 6,919 animals (CV=0.81) (Barlow, 2006). The best available density (0.00282 animals/km^2) estimated for sperm whales in this mission area was calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is slightly higher but comparable to near-shore Hawaiian waters (0.0010 animals/km^2; Mobley et al., 2000).

V. **Spinner dolphin:** Based on analyses of genetic data, movement patterns of dolphins, and the geographic distances among the Hawaiian Islands, five separate island-associated stocks are recognized in the central North Pacific: Hawaii Island, Oahu/4-Islands Region, Kauai/Niihau, Pearl and Hermes Reef, and Midway Atoll/Kure (Hill et al., 2010; Carretta et al., 2013). The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010).

W. Hawaii Pelagic stock: Spinner dolphins beyond 18.5 km (10 nmi) from shore or around other islands within the Hawai'i EEZ belong to the Hawaii Pelagic Stock. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 3,351 spinner dolphins (Barlow, 2006). However, this study assumed a single Hawaiian Islands stock and occurred over eight years old. A 2010 shipboard line-transect study within the Hawaiian EEZ did not record any sightings of pelagic spinner dolphins. Given the need for a density and abundance estimate for take calculations, the best available density estimate (0.0014 animals/km^2) and abundance estimate (3351 animals, CV=0.74) are calculated from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006). The density estimate is an order of magnitude less than nearshore Hawaiian waters (0.0443 animals/km^2; Mobley et al., 2000).

Oahu/4 Islands stock: Based on analyses of genetic data, movement patterns of dolphins, and the geographic distances among the Hawaiian Islands, five separate island-associated stocks are recognized in the central North Pacific: Hawaii Island, Oahu/4-Islands Region, Kauai/Niihau, Pearl and Hermes Reef, and Midway Atoll/Kure (Hill et al., 2010; Carretta et al., 2013). The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010). Spinner dolphins beyond 18.5 km (10 nmi) from shore or around other islands within the Hawai'i EEZ belong to the Hawaii Pelagic Stock. The best estimate of abundance for the Oahu/4-Islands Region Stock is from a photo-identification study conducted July to September 2007 on the leeward coast of Oahu, which resulted in an estimate of 355 animals (CV=0.09), though it is recognized that this is likely an underestimate because of its limited spatial scope (Carretta et al., 2013). The best available density estimate (0.0014 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

Hawaii Island: Based on analyses of genetic data, movement patterns of dolphins, and the geographic distances among the Hawaiian Islands, five separate island-associated stocks are recognized in the central North Pacific: Hawaii Island, Oahu/4-Islands Region, Kauai/Niihau, Pearl and Hermes Reef, and Midway Atoll/Kure (Hill et al., 2010; Carretta et al., 2013). The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010). Spinner dolphins beyond 18.5 km (10 nmi) from shore or around other islands within the Hawai'i EEZ belong to the Hawaii Pelagic Stock. The best estimate of abundance for the Hawaii Island Stock is from a photo-identification study conducted May to July 2003 on the leeward coast of Hawaii Island, which resulted in an estimate of 790 animals (CV=0.17), though it is recognized that this is likely an underestimate because of its limited spatial scope (Carretta et al., 2013). The best available density estimate (0.0014 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

X. **Hawaiian monk seal**: Monk seals primarily occur in the NWHI, though a respectable population is beginning to establish itself on Niihau and Kauai, with 21 distinct individuals documented on Kauai

(Farry, 2003) and 83 individuals observed throughout the MHI in 2006 (Carretta et al., 2013). Small numbers of interaction occur between the monk seal subpopulations, and foraging behavior suggests offshore movement patterns (Parrish et al., 2000; Parrish et al., 2002). The current abundance estimated for the stock of Hawaiian monk seals is 1,212 animals (Carretta et al., 2013). Although no density for the very rare Hawaiian monk seal is available, a density estimate is necessary to compute the potential risk to this species. Thus, a density estimate of 0.0001 animals/km^2 was used in the risk analysis for this species to reflect the very low probability of occurrence in this region.

APPENDIX B: POTENTIALLY AFFECTED MARINE MAMMAL SPECIES BY STOCK IN THE WESTERN AND CENTRAL NORTH PACIFIC OCEAN

Table B1. Number of blue whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 blue whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	CNP	9,250	0.01	2
3	West Philippine Sea	3	CNP	9,250	0.01	2
4	Offshore Guam	3	CNP	9,250	0.01	2
9	Offshore Japan (10° to 25°N)	1	CNP	9,250	0.01	2
10	Hawaii-North	2	CNP	9,250	0.14	14
11	Hawaii-South	2	CNP	9,250	0.04	4
Totals		**14**			**0.22**	**26**

16 Stock names: CNP=Central North Pacific; WNP=Western North Pacific; ECS=East China Sea; NP=North Pacific; SOJ=Sea of Japan; IA=Inshore Archipelago

17 Percent (%) stock has been rounded up to two decimal places.

18 Fractional animals potentially affected have been rounded up to the next whole number.

Table B2. Number of Bryde's whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Byrde's whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	20,501	0.03	6
2	North Philippine Sea	3	WNP	20,501	0.29	60
3	West Philippine Sea	3	WNP	20,501	0.29	62
4	Offshore Guam	3	WNP	20,501	0.14	31
5	Sea of Japan	2	WNP	20,501	0.03	8
6	East China Sea	1	WNP	20,501	0.04	8
7	South China Sea	1	WNP	20,501	0.04	9
8	Offshore Japan (25° to 40°N)	1	WNP	20,501	0.10	21
9	Offshore Japan (10° to 25°N)	1	WNP	20,501	0.06	13
10	Hawaii-North	2	Hawaiian	469	3.81	19
11	Hawaii-South	2	Hawaiian	469	1.11	6
			Total WNP		***1.02***	***218***
			Total Hawaiian		***4.92***	***25***
Totals		**20**				**243**

Table B3. Number of common minke whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 common minke whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP "O"	25,049	0.06	15
2	North Philippine Sea	3	WNP "O"	25,049	1.82	457
3	West Philippine Sea	3	WNP "O"	25,049	1.20	302
4	Offshore Guam	3	WNP "O"	25,049	0.08	20
5	Sea of Japan	2	WNP "O"	25,049	0.10	25
5	Sea of Japan	2	WNP "J"	893	1.07	10
6	East China Sea	1	WNP "O"	25,049	0.23	58
6	East China Sea	1	WNP "J"	893	2.62	24
7	South China Sea	1	WNP "O"	25,049	0.17	43
8	Offshore Japan (25° to 40°N)	1	WNP "O"	25,049	0.05	12
10	Hawaii-North	2	Hawaiian	25,049	0.05	13
11	Hawaii-South	2	Hawaiian	25,049	0.02	4
			Total WNP "O"		***3.71***	***932***
			Total WNP "J"		***3.69***	***34***
			Total Hawaiian		***0.07***	***17***
Totals		**22**				**983**

Table B4. Number of fin whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 fin whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	9,250	0.02	3
2	North Philippine Sea	3	WNP	9,250	0.18	18
z3	West Philippine Sea	3	WNP	9,250	0.09	8
4	Offshore Guam	3	WNP	9,250	0.01	2
5	Sea of Japan	2	WNP	9,250	0.60	56
6	East China Sea	1	ECS	500	0.62	4
7	South China Sea	1	WNP	9,250	0.04	4
8	Offshore Japan (25° to 40°N)	1	WNP	9,250	0.05	5
9	Offshore Japan (10° to 25°N)	1	WNP	9,250	0.00	1
10	Hawaii-North	2	Hawaiian	174	3.59	7
11	Hawaii-South	2	Hawaiian	174	1.51	4
			Total ECS		***0.62***	***4***
			Total WNP		***0.99***	***97***
			Total Hawaiian		***5.10***	***11***
Totals		**20**				**112**

Table B5. Number of humpback whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 humpback whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	WNP	1,107	6.89	78
3	West Philippine Sea	3	WNP	1,107	1.10	14
4	Offshore Guam	3	CNP	10,103	0.18	18
10	Hawaii North	2	CNP	10,103	0.09	10
11	Hawaii South	2	CNP	10,103	0.01	2
			Total WNP		***7.99***	***92***
			Total CNP		***0.28***	***30***
Totals		**13**				**122**

Table B6. Number of North Pacific right whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 North Pacific right whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	922	—[19]	—
2	North Philippine Sea	3	WNP	922	0.06	2
5	Sea of Japan	2	WNP	922	0.05	1
6	East China Sea	1	WNP	922	—	—
7	South China Sea	1	WNP	922	0.04	1
Totals		**8**			**0.15**	**4**

19 "—" indicates that an animal is not expected in the mission area during that season.

Table B7. Number of sei whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 sei whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	NP	8,600	0.07	6
4	Offshore Guam	3	NP	8,600	0.21	18
8	Offshore Japan (25° to 40°N)	1	NP	8,600	0.17	15
9	Offshore Japan (10° to 25°N)	1	NP	8,600	0.06	6
10	Hawaii-North	2	Hawaiian	77	0.11	1
11	Hawaii-South	2	Hawaiian	77	0.88	2
			Total NP		***0.51***	***45***
			Total Hawaiian		***0.99***	***3***
Totals		**10**				**48**

Table B8. Number of Western Pacific gray whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Western Pacific gray whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
5	Sea of Japan	2	WNP	121	0.07	2
6	East China Sea	1	WNP	121	—[19]	—
7	South China Sea	1	WNP	121	0.31	1
Totals		**4**			**0.38**	**3**

Table B9. Number of Baird's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Baird's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	8,000	0.26	21
5	Sea of Japan	2	WNP	8,000	0.22	18
8	Offshore Japan (25° to 40°N)	1	WNP	8,000	0.03	3
Totals		**4**			**0.51**	**42**

Table B10. Number of Blainville's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Blainville's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	WNP	8,032	0.46	38
3	West Philippine Sea	3	WNP	8,032	0.50	41
4	Offshore Guam	3	WNP	8,032	1.03	84
6	East China Sea	1	WNP	8,032	0.07	6
7	South China Sea	1	WNP	8,032	0.08	7
8	Offshore Japan (25° to 40°N)	1	WNP	8,032	0.20	17
9	Offshore Japan (10° to 25°N)	1	WNP	8,032	0.11	10
10	Hawaii North	2	Hawaiian	2,872	3.62	105
11	Hawaii South	2	Hawaiian	2,872	0.80	24
			Total WNP		***2.45***	***203***
			Total Hawaiian		***4.42***	***129***
Totals		**17**				**332**

Table B11. Number of common bottlenose dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 common bottlenose dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	168,791	0.08	139
2	North Philippine Sea	3	WNP	168,791	0.73	1,241
3	West Philippine Sea	3	WNP	168,791	0.76	1,279
4	Offshore Guam	3	WNP	168,791	0.06	98
5	Sea of Japan	2	IA	105,138	0.04	44
6	East China Sea	1	IA	105,138	0.01	6
7	South China Sea	1	IA	105,138	0.01	5
8	Offshore Japan (25° to 40°N)	1	WNP	168,791	0.01	23
9	Offshore Japan (10° to 25°N)	1	WNP	168,791	0.02	32
10	Hawaii North	2	Hawaii Pelagic	3,178	3.14	101
10	Hawaii North	2	Kauaii/ Niihau	147	2.74	5
11	Hawaii South	2	Hawaii Pelagic	3,178	0.38	14
11	Hawaii South	2	Oahu	594	0.02	2
11	Hawaii South	2	4-Islands Region	153	0.14	2
11	Hawaii South	2	Hawaii Island	102	1.16	2
			Total WNP		***1.66***	***2,812***
			Total IA		***0.06***	***55***
			Total Hawaii Pelagic		***3.52***	***115***
			Total Kauaii/ Niihau		***2.74***	***5***
			Total Oahu		***0.02***	***2***
			Total 4-Islands Region		***0.14***	***2***
			Total Hawaii Island		***1.16***	***2***
Totals		**28**				**2,993**

Table B12. Number of Cuvier's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Cuvier's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	90,725	0.02	23
2	North Philippine Sea	3	WNP	90,725	0.43	395
3	West Philippine Sea	3	WNP	90,725	0.03	25
4	Offshore Guam	3	WNP	90,725	0.49	439
5	Sea of Japan	2	WNP	90,725	0.20	180
6	East China Sea	1	WNP	90,725	0.01	4
7	South China Sea	1	WNP	90,725	0.01	4
8	Offshore Japan (25° to 40°N)	1	WNP	90,725	0.09	85
9	Offshore Japan (10° to 25°N)	1	WNP	90,725	0.15	138
10	Hawaii North	2	Hawaiian	15,242	3.62	554
11	Hawaii South	2	Hawaiian	15,242	0.80	122
			Total WNP		***1.43***	***1,293***
			Total Hawaiian		***4.42***	***676***
Totals		**20**				**1,969**

Table B13. Number of Dall's porpoises potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Dall's porpoises affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
5	Sea of Japan	2	SOJ	76,720	3.52	2,701
Totals		**2**			**3.52**	**2,701**

Table B14. Number of false killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 false killer whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	16,668	0.19	32
2	North Philippine Sea	3	WNP	16,668	1.62	272
3	West Philippine Sea	3	WNP	16,668	1.64	275
4	Offshore Guam	3	WNP	16,668	0.46	78
5	Sea of Japan	2	IA	9,777	1.75	173
6	East China Sea	1	IA	9,777	0.17	17
7	South China Sea	1	IA	9,777	0.19	19
8	Offshore Japan (25° to 40°N)	1	WNP	16,668	0.70	117
9	Offshore Japan (10° to 25°N)	1	WNP	16,668	0.14	24
10	Hawaii-North	2	Hawaii Pelagic	1,503	5.51	84
10	Hawaii-North	2	Main Hawaiian Islands Insular	151	0.38	2
10	Hawaii-North	2	North-western Hawaiian Islands	552	0.02	2
11	Hawaii-South	2	Hawaii Pelagic	1,503	0.90	14
11	Hawaii-South	2	Main Hawaiian Islands Insular	151	0.94	2
Total WNP					***4.75***	***798***
Total IA					***2.11***	***209***
Total Hawaii Pelagic					***6.41***	***98***
Total Main Hawaiian Islands Insular					***1.32***	***4***
Total Northwestern Hawaiian Islands					***0.02***	***2***
Totals		**24**				**1,111**

Table B15. Number of Fraser's dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Fraser's dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	WNP	220,789	0.19	430
3	West Philippine Sea	3	WNP	220,789	0.18	392
4	Offshore Guam	3	WNP	220,789	0.14	303
6	East China Sea	1	WNP	220,789	0.03	58
7	South China Sea	1	WNP	220,789	0.03	60
9	Offshore Japan (10° to 25°N)	1	WNP	220,789	0.05	104
10	Hawaii North	2	Hawaiian	10,226	3.34	342
11	Hawaii South	2	Hawaiian	10,226	0.81	84
			Total WNP		***0.62***	***1,347***
			Total Hawaiian		***4.15***	***426***
Totals		**16**				**1,773**

Table B16. Number of ginkgo-toothed beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 ginkgo-toothed beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	NP	22,799	0.02	4
2	North Philippine Sea	3	NP	22,799	0.16	38
3	West Philippine Sea	3	NP	22,799	0.18	41
4	Offshore Guam	3	NP	22,799	0.29	68
6	East China Sea	1	NP	22,799	0.02	6
7	South China Sea	1	NP	22,799	0.03	7
Totals		**12**			**0.70**	**164**

Table B17. Number of Hubbs' beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Hubb's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	NP	22,799	0.02	4
8	Offshore Japan (25° to 40°N)	1	NP	22,799	0.03	8
Totals		**2**			**0.05**	**12**

Table B18. Number of killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 killer whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	12,256	0.01	2
2	North Philippine Sea	3	WNP	12,256	0.07	10
3	West Philippine Sea	3	WNP	12,256	0.09	12
4	Offshore Guam	3	WNP	12,256	0.08	12
5	Sea of Japan	2	WNP	12,256	0.06	8
6	East China Sea	1	WNP	12,256	0.03	4
7	South China Sea	1	WNP	12,256	0.03	4
8	Offshore Japan (25° to 40°N)	1	WNP	12,256	0.05	7
9	Offshore Japan (10° to 25°N)	1	WNP	12,256	0.03	4
10	Hawaii-North	2	Hawaiian	349	2.60	10
11	Hawaii-South	2	Hawaiian	349	0.76	4
			Total WNP		***0.45***	***63***
			Total Hawaiian		***3.36***	***14***
Totals		**20**				**77**

Table B19. Number of dwarf and pygmy sperm whales (*Kogia* spp.) potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 dwarf/pygmy sperm whales/*Kogia* spp. affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP *Kogia* spp.	350,553	0.01	28
2	North Philippine Sea	3	WNP *Kogia* spp.	350,553	0.10	347
3	West Philippine Sea	3	WNP *Kogia* spp.	350,553	0.05	171
4	Offshore Guam	3	WNP dwarf sperm whale	350,553	0.19	669
4	Offshore Guam	3	WNP pygmy sperm whale	350,553	0.06	220
5	Sea of Japan	2	WNP *Kogia* spp.	350,553	0.02	71
6	East China Sea	1	WNP *Kogia* spp.	350,553	0.01	11
7	South China Sea	1	WNP *Kogia* spp.	350,553	0.01	31
8	Offshore Japan (25° to 40°N)	1	WNP dwarf sperm whale	350,553	0.08	269
8	Offshore Japan (25° to 40°N)	1	WNP pygmy sperm whale	350,553	0.03	111
9	Offshore Japan (10° to 25°N)	1	WNP dwarf sperm whale	350,553	0.05	175
9	Offshore Japan (10° to 25°N)	1	WNP pygmy sperm whale	350,553	0.02	72
10	Hawaii-North	2	Hawaiian *Kogia* spp.	24,657	3.56	878
11	Hawaii-South	2	Hawaiian *Kogia* spp.	24,657	1.04	258
			Total WNP Kogia spp.		***0.20***	***659***
			Total WNP Dwarf Sperm Whale		***0.32***	***1,113***
			Total WNP Pygmy sperm whale		***0.11***	***403***
			Total Hawaiian Kogia spp.		***4.60***	***1,136***
Totals		**25**				**3,311**

Table B20. Number of Longman's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Longman's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	WNP	1,007	1.83	20
3	West Philippine Sea	3	WNP	1,007	1.92	21
4	Offshore Guam	3	WNP	1,007	2.88	31
6	East China Sea	1	WNP	1,007	0.25	3
7	South China Sea	1	WNP	1,007	0.92	10
8	Offshore Japan (25° to 40°N)	1	WNP	1,007	0.07	1
9	Offshore Japan (10° to 25°N)	1	WNP	1,007	0.04	1
10	Hawaii-North	2	Hawaiian	1,007	3.53	37
11	Hawaii-South	2	Hawaiian	1,007	0.78	8
			Total WNP		***7.91***	***87***
			Total Hawaiian		***4.31***	***45***
Totals		**17**				**132**

Table B21. Number of melon-headed whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 melon-headed whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
2	North Philippine Sea	3	WNP	36,770	1.09	401
3	West Philippine Sea	3	WNP	36,770	1.10	406
4	Offshore Guam	3	WNP	36,770	0.80	295
6	East China Sea	1	WNP	36,770	0.17	65
7	South China Sea	1	WNP	36,770	0.19	71
8	Offshore Japan (25° to 40°N)	1	WNP	36,770	0.24	87
9	Offshore Japan (10° to 25°N)	1	WNP	36,770	0.30	110
10	Hawaii-North	2	Hawaiian	2,950	3.67	109
11	Hawaii-South	2	Hawaiian	2,950	0.92	28
			Total WNP		***3.89***	***1,435***
			Total Hawaiian		***4.59***	***137***
Totals		**17**				**1,572**

Table B22. Number of *Mesoplodon* spp. potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 *Mesoplodon* spp. affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
8	Offshore Japan (25° to 40°N)	1	WNP	22,799	0.07	17
Totals		**1**			**0.07**	**17**

Table B23. Number of Pacific white-sided dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Pacific white-sided dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	931,000	0.01	65
2	North Philippine Sea	3	WNP	931,000	0.07	643
5	Sea of Japan	2	IA	931,000	0.01	119
6	East China Sea	1	IA	931,000	—[19]	—
8	Offshore Japan (25° to 40°N)	1	WNP	931,000	0.01	105
			Total WNP		***0.09***	***813***
			Total IA		***0.01***	***119***
Totals		**8**				**932**

Table B24. Number of pantropical spotted dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 pantropical spotted dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	438,064	0.02	79
2	North Philippine Sea	3	WNP	438,064	0.29	1,291
3	West Philippine Sea	3	WNP	438,064	0.26	1,145
4	Offshore Guam	3	WNP	438,064	0.38	1,657
6	East China Sea	1	IA	219,032	0.07	160
7	South China Sea	1	IA	219,032	0.06	142
8	Offshore Japan (25° to 40°N)	1	WNP	438,064	0.04	191
9	Offshore Japan (10° to 25°N)	1	WNP	438,064	0.11	474
10	Hawaii-North	2	Hawaiian	8,978	2.94	266
11	Hawaii-South	2	Hawaiian	8,978	0.59	54
			Total WNP		***1.10***	***4,837***
			Total IA		***0.13***	***302***
			Total Hawaiian		***3.53***	***320***
Totals		**18**				**5,459**

Table B26. Number of pygmy killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 pygmy killer whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	30,214	0.06	19
2	North Philippine Sea	3	WNP	30,214	0.65	197
3	West Philippine Sea	3	WNP	30,214	0.66	199
4	Offshore Guam	3	WNP	30,214	0.03	12
6	East China Sea	1	WNP	30,214	0.01	3
7	South China Sea	1	WNP	30,214	0.01	3
8	Offshore Japan (25° to 40°N)	1	WNP	30,214	0.01	2
9	Offshore Japan (10° to 25°N)	1	WNP	30,214	0.01	3
10	Hawaii-North	2	Hawaiian	956	3.78	37
11	Hawaii-South	2	Hawaiian	956	0.94	10
			Total WNP		***1.44***	***438***
			Total Hawaiian		***4.72***	***47***
Totals		**18**				**485**

Table B27. Number of Risso's dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Risso's dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	83,289	0.11	95
2	North Philippine Sea	3	WNP	83,289	1.37	1,145
3	West Philippine Sea	3	WNP	83,289	1.24	1,039
4	Offshore Guam	3	WNP	83,289	0.09	74
5	Sea of Japan	2	IA	83,289	0.50	421
6	East China Sea	1	IA	83,289	0.18	153
7	South China Sea	1	IA	83,289	0.21	173
8	Offshore Japan (25° to 40°N)	1	WNP	83,289	0.02	17
9	Offshore Japan (10° to 25°N)	1	WNP	83,289	0.02	19
10	Hawaii-North	2	Hawaiian	2,372	3.54	85
11	Hawaii-South	2	Hawaiian	2,372	0.96	24
			Total WNP		***2.85***	***2,389***
			Total IA		***0.89***	***747***
			Total Hawaiian		***4.50***	***109***
Totals		**20**				**3,245**

Table B28. Number of rough-toothed dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 rough-toothed dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	145,729	0.03	51
2	North Philippine Sea	3	WNP	145,729	0.44	645
3	West Philippine Sea	3	WNP	145,729	0.41	592
4	Offshore Guam	3	WNP	145,729	0.17	245
5	Sea of Japan	2	WNP	145,729	0.11	157
6	East China Sea	1	WNP	145,729	0.03	46
7	South China Sea	1	WNP	145,729	0.04	61
8	Offshore Japan (25° to 40°N)	1	WNP	145,729	0.05	71
9	Offshore Japan (10° to 25°N)	1	WNP	145,729	0.05	76
10	Hawaii-North	2	Hawaiian	8,709	3.56	311
11	Hawaii-South	2	Hawaiian	8,709	0.99	86
			Total WNP		***1.33***	***1,944***
			Total Hawaiian		***4.55***	***397***
Totals		**20**				**2,341**

Table B29. Number of short-beaked common dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 short-beaked common dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	3,286,163	0.02	696
2	North Philippine Sea	3	WNP	3,286,163	0.16	5,165
5	Sea of Japan	2	WNP	3,286,163	0.16	5,155
6	East China Sea	1	WNP	3,286,163	0.02	664
8	Offshore Japan (25° to 40°N)	1	WNP	3,286,163	0.11	3,746
Totals		**8**			**0.47**	**15,426**

Table B30. Number of short-finned pilot whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 short-finned pilot whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	53,608	0.22	117
2	North Philippine Sea	3	WNP	53,608	2.59	1,387
3	West Philippine Sea	3	WNP	53,608	1.25	669
4	Offshore Guam	3	WNP	53,608	0.56	297
5	Sea of Japan	2	WNP	53,608	0.13	71
6	East China Sea	1	WNP	53,608	0.05	27
7	South China Sea	1	WNP	53,608	0.04	23
8	Offshore Japan (25° to 40°N)	1	WNP	53,608	0.06	33
9	Offshore Japan (10° to 25°N)	1	WNP	53,608	0.17	92
10	Hawaii-North	2	Hawaiian	8,870	3.13	278
11	Hawaii-South	2	Hawaiian	8,870	0.71	64
			Total WNP		***5.07***	***2,716***
			Total Hawaiian		***3.84***	***342***
Totals		**20**				**3,058**

Table B31. Number of sperm whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 sperm whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	NP	102,112	0.01	8
2	North Philippine Sea	3	NP	102,112	0.12	117
3	West Philippine Sea	3	NP	102,112	0.10	107
4	Offshore Guam	3	NP	102,112	0.09	93
5	Sea of Japan	2	NP	102,112	0.07	71
6	East China Sea	1	NP	102,112	0.01	10
7	South China Sea	1	NP	102,112	0.01	13
8	Offshore Japan (25° to 40°N)	1	NP	102,112	0.04	41
9	Offshore Japan (10° to 25°N)	1	NP	102,112	0.09	88
10	Hawaii-North	2	Hawaiian	6,919	3.00	208
11	Hawaii-South	2	Hawaiian	6,919	0.68	48
			Total North Pacific		***0.54***	***548***
			Total Hawaiian		***3.68***	***256***
Totals		**20**				**804**

Table B33. Number of spinner dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 spinner dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	1,015,059	0.01	3
2	North Philippine Sea	3	WNP	1,015,059	0.01	79
3	West Philippine Sea	3	WNP	1,015,059	0.01	71
4	Offshore Guam	3	WNP	1,015,059	0.01	62
5	Sea of Japan	2	WNP	1,015,059	0.01	9
6	East China Sea	1	WNP	1,015,059	0.01	10
7	South China Sea	1	WNP	1,015,059	0.01	9
8	Offshore Japan (25° to 40°N)	1	WNP	1,015,059	0.01	32
9	Offshore Japan (10° to 25°N)	1	WNP	1,015,059	0.01	79
10	Hawaii North	2	Hawaii Pelagic	3,351	2.50	85
10	Hawaii North	2	Kauai/ Niihau	601	0.45	4
11	Hawaii South	2	Hawaii Pelagic	3,351	0.44	16
11	Hawaii South	2	Oahu/4-Islands	355	0.05	2
11	Hawaii South	2	Hawaii Island	790	0.10	2
			Total WNP		***0.09***	***354***
			Total Hawaii Pelagic		***2.94***	***101***
Totals		**20**				**455**

Table B34. Number of Stejneger's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Stejneger's beaked whales affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
5	Sea of Japan	2	WNP	8,000	0.36	30
Totals		**20**			**0.36**	**30**

Table B35. Number of striped dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 striped dolphins affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
1	East of Japan	1	WNP	570,038	0.01	34
2	North Philippine Sea	3	WNP	570,038	0.54	3,098
3	West Philippine Sea	3	WNP	570,038	0.24	1,371
4	Offshore Guam	3	WNP	570,038	0.08	452
5	Sea of Japan	2	IA	570,038	0.05	297
6	East China Sea	1	IA	570,038	0.01	68
7	South China Sea	1	IA	570,038	0.01	61
8	Offshore Japan (25° to 40°N)	1	WNP	570,038	0.02	99
9	Offshore Japan (10° to 25°N)	1	WNP	570,038	0.04	245
10	Hawaii North	2	Hawaiian	13,143	2.95	388
11	Hawaii South	2	Hawaiian	13,143	0.59	78
			Total WNP		***0.93***	***5,299***
			Total IA		***0.07***	***426***
			Total Hawaiian		***3.54***	***466***
Totals		**20**				**6,191**

Table B36. Number of Hawaiian monk seals potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2013 to 14 August 2014; 0.00% affected/0 Hawaiian monk seals affected ≥180 dB (with mitigation measures applied).

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[16]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[17]	Number Individuals Affected 120 to 180 dB[18]
Number	Name					
8	Offshore Japan (25° to 40°N)	1	Hawaiian	1,212	0.01	1
10	Hawaii-North	2	Hawaiian	1,212	0.73	9
11	Hawaii-South	2	Hawaiian	1,212	0.20	4
Totals		**5**			**0.94**	**14**