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

APRIL 2014

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
BRS	behavioral response study
C	Celsius
CI	confidence interval
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 micro Pascal measured at one meter from center of acoustic source
dB re 1 µPa^2-sec	decibels relative to one micro Pascal squared per second
DoI	Department of the Interior
DPS	distinct population segment
ECS	East China Sea
EEZ	exclusive economic zone
EIS	environmental impact statement
EO	Executive Order
EOG	Executive Oversight Group
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
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
MPA	marine protected area
NDAA	National Defense Authorization Act
NMFS	National Marine Fisheries Service
nmi	nautical mile(s)
NP	North Pacific
OAWRS	Ocean Acoustic Waveguide Remote Sensing
OBIA(s)	offshore biologically important area(s)
OEIS/EIS	Overseas Environmental Impact Statement and Environmental Impact Statement
OIC	officer in charge
Pa	Pascal

ACRONYMS AND ABBREVIATIONS

PTS	permanent threshold shift
RL	received level
rms	root mean squared
SAG	Scientific Advisory Group
SAR	Stock Assessment Report
SE	standard error
sec	second(s)
SEIS	supplemental environmental impact statement
SEL	sound exposure level
SL	source level
SOCAL	Southern California
SOEIS	supplemental overseas environmental impact statement
SOJ	Sea of Japan
Sonar	SOund Navigation And Ranging
SPE	single ping equivalent
SPL	sound pressure level
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
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

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 DESCRIPTION OF THE PROPOSED ACTIVITY

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 may be harassed incidentally due to the underwater noise generated 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 incidental taking of marine mammals by Level A (no lethal taking) and Level B harassment during the employment of SURTASS LFA sonar systems onboard the United States Naval Ship (USNS) ABLE (Tactical-Auxiliary General Ocean Surveillance [T-AGOS] 20), USNS EFFECTIVE (T-AGOS 21), USNS IMPECCABLE (T-AGOS 23), and USNS VICTORIOUS (T-AGOS 19) for the annual period from 15 August 2014 through 14 August 2015 for no more than 20 total at-sea missions. The four SURTASS LFA sonar vessels will operate in the same eleven mission areas in the western and central North Pacific Ocean currently authorized under the 2013 to 2014 LOAs (NOAA, 2013).

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, each of seven days duration, 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 operations is training Navy crews that man the vessels as well as testing and operating the SURTASS and LFA sonar system 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, training, and military operations. Furthermore, SURTASS LFA operations constitute a military readiness activity as that term is defined in Public Law 107-314 (16 U.S.C. § 703 note), and these 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

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.

mitigation protocols delineated in the 2012 Navy SEIS/SOEIS, the Navy's Record of Decision (DoD, 2012), the NMFS' MMPA Final Rule (NOAA, 2012), annual LOAs, as issued (NOAA, 2013), the 2012 to 2017 biological opinion (BO) (NMFS, 2012), and annual BO/Incidental Take Statements (ITSs) (NMFS, 2013).

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 kilometers per hour (kph) (3 knots [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) composed of up to 18 source projectors that is 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 @ 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 the duration of 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 eleven-year period spanning 2002 through 2013 (i.e., through the end of the August 2013 LOA reporting period) involved 156 completed missions conducted over 480 days during which LFA sonar was transmitted for 930 hr (or about 39 days of a possible 4,015 days) in total. During those missions, only 10 marine mammals or sea turtles were visually observed, eight marine animals were detected passive-acoustically, and 149 marine mammals/animals were detected active-acoustically by the high frequency marine mammal monitoring (HF/M3) sonar system. These combined detections of marine animals led to 160[2] suspensions/delays of LFA sonar transmissions, per the mitigation protocol for the operation of SURTASS LFA sonar.

The mitigation program required for the use of SURTASS LFA sonar has successfully and effectively prevented harm to protected marine species and has affected the least practicable adverse impacts on marine mammal species or stocks. Throughout 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 reported or associated with the use of LFA sonar. Such results demonstrate the efficacy of SURTASS LFA sonar's mitigation program, which includes geographic restrictions (e.g., coastal exclusion zones, offshore biologically important areas [OBIAs], and polar waters) as well as a tripartite system of acoustic and visual mitigation and monitoring measures.

The acoustic (passive and active [HF/M3]) and visual mitigation and monitoring measures have been employed aboard four SURTASS LFA sonar vessels/systems that have operated in the western North Pacific Ocean during the annual LOA and ITS reporting period from August 2012 through August 2013 and the most recent period commencing 15 August 2013. For the 2012 through 2013 annual reporting

2 Because some of the passive and active acoustic detections were of the same animal, the sum of visual, passive acoustic, and active acoustic detections exceeds the number of shutdowns.

period, 47.3 hr of LFA sonar were transmitted during 12 missions over 24.4 mission days (Table 1). During this annual reporting period, in accordance with the mitigation monitoring protocol, LFA sonar was suspended 13 times due to three passive and 10 active acoustic detections of marine mammals (Table 1). No dead or injured marine species were observed during the 2012 to 2013 annual reporting period. The LOAs for SURTASS LFA permit up to 432 hr of LFA sonar transmissions per SURTASS LFA vessel annually for a combined total of 1,728 hr of LFA sonar transmissions in the western and central North Pacific Ocean. However, in the 2012 to 2013 LOA reporting period, all four SURTASS LFA vessels only transmitted a grand total of 47.3 hr of LFA sonar or 2.7% of the permitted sonar transmit time (Table 1).

During the first two quarters of the current LOA reporting period (15 August 2013 through 14 February 2014), two missions have been completed over four days, during which LFA sonar was transmitted for 9.75 hr with no visual, passive acoustic, or active acoustic detections of marine animals having been made and no reports of dead or injured marine animals (Table 2). Half way through the current LOAs reporting period, far less transmit time, only 9.75 hr for all vessels or 0.6% of the permitted total sonar transmissions, have been conducted thus far (Table 2).

In accordance with the terms and conditions of the annual LOAs and associated ITS for the operation of SURTASS LFA sonar, the Navy has submitted quarterly reports and an annual summary report that detailed SURTASS LFA sonar operations, including the locations of all vessels/sonar operation and any detections of marine mammals, over the associated reporting period. The annual report, which summarized all quarterly reports for the August 15, 2012 through August 14, 2013 LOA reporting period, was submitted to NMFS on 11 October 2013 (DoN, 2013). Also in accordance with Condition 9a(i) of the current LOAs, one training in October 2013 of the civilian lookouts and officers aboard the USNS VICTORIOUS was conducted.

Table 1. Summary of SURTASS LFA sonar operations and preventative measures during the annual LOAs and ITS reporting period from 15 August 2012 through 14 August 2013.

SURTASS LFA Vessel	Annual SURTASS LFA Sonar Operations							
	Missions	Mission Duration (Days)	LFA Sonar Transmissions (Hours)	Visual Detections	Passive Acoustic Detections	HF/M3-Active Acoustic Detections	LFA Sonar Suspensions Due to Detections	Total Suspensions of LFA Sonar[3]
USNS ABLE (T-AGOS 20)	3	2.5	5.4	0	0	0	0	0
USNS EFFECTIVE (T-AGOS 21)	4	12.5	22.5	0	3	9	12	16
USNS IMPECCABLE (T-AGOS 23)	2	2.5	5.2	0	0	0	0	12
USNS VICTORIOUS (T-AGOS 19)	3	6.9	14.2	0	0	1	1	1
Totals	**12**	**24.4**	**47.3**	**0**	**3**	**10**	**13**	**29**

3 In addition to LFA sonar suspensions due to visual, passive acoustic, or active acoustic/HF/M3 detections, suspensions of LFA sonar transmissions are also due to loss of the passive acoustic system, HF/M3 system faults, HF/M3 system artifacts, or impedance checks.

Table 2. Summary of SURTASS LFA sonar operations and preventative measures during the first two quarters (August through February) of the annual LOAs and ITS reporting period from 15 August 2013 through 14 August 2014.

SURTASS LFA Vessel	Annual SURTASS LFA Sonar Operations To Date							
	Missions	Mission Duration (Days)	LFA Sonar Transmissions (Hours)	Visual Detections	Passive Acoustic Detections	HF/M3-Active Acoustic Detections	LFA Sonar Suspensions Due to Detections	Total Suspensions of LFA Sonar
USNS ABLE (T-AGOS 20)	0	0	0	0	0	0	0	0
USNS EFFECTIVE (T-AGOS 21)	2	4.0	9.75	0	0	0	0	0
USNS IMPECCABLE (T-AGOS 23)	0	0	0	0	0	0	0	0
USNS VICTORIOUS (T-AGOS 19)	0	0	0	0	0	0	0	0
Totals	**2**	**4.0**	**9.75**	**0**	**0**	**0**	**0**	**0**

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

2 DURATION AND LOCATION OF SURTASS LFA SONAR USE

2.1 ACTIVITY 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 has been developed that is based on actual LFA operations conducted since January 2003 and projected Navy requirements. The SURTASS LFA sonar vessels typically operate independently but may also 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 spent performing active at-sea operations (Table 3). Between missions, an estimated total of 71 days per year would be spent in port for upkeep and repair and to exchange crew members. Although the actual number and length of 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. For estimation purposes in this application, individual SURTASS LFA missions are based on a 7-day duration. 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 to/from mission areas	54	In-port upkeep	40
Active sonar operations (432 hours of permitted sonar 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 actually conducted by the Navy has historically been far fewer than the number used in planning and modeling; likewise, the number of actual LFA sonar transmit time has been far, far less than that permitted by NMFS. For instance, during the last full annual LOA reporting period (i.e., August 2012 through August 2013; Table 1), 12 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 47.3 hr over 24.4 mission days. The Navy only transmitted LFA sonar for a total of 47.3 hr of the permitted 1,728 hr. In the first six months of the current LOAs reporting period (15 August 2013 through 14 August 2014), two missions have been conducted over four missions days with a total of only 9.75 hr of LFA sonar transmissions (Table 2).

2.2 POTENTIAL GEOGRAPHIC REGIONS—SURTASS LFA SONAR MISSION AREAS

The ocean area locations requested for SURTASS LFA sonar deployment and transmission during the August 2014 to August 2015 LOAs reporting period are 11 mission areas in the western and central North Pacific (Table 4); these areas are the same mission areas in which SURTASS LFA sonar is currently authorized to operate. Nine mission areas are requested in the western North Pacific Ocean and two mission areas are requested in the central North Pacific Ocean. No seasonal limitations are associated with any of the areas requested for sonar use. Further, SURTASS LFA sonar will not employed in coastal areas such that the sonar-generated sound field generated by LFA sonar will be below received levels of 180 dB re 1 µPa (rms) within 22 kilometers (km) (12 nautical miles [nmi]) from any coastline, including islands, (hereafter known as the coastal standoff distance or coastal exclusion zone).

Specifically, the Navy requests permission to deploy and transmit SURTASS LFA sonar in the entire Sea of Japan, East China Sea, and South China Sea; the western and northern Philippine Sea; and other ocean areas east and offshore of Japan and Guam that lie between 40°N (with Japan as the western terminus), 180°E, and 10°N (with the Philippine Islands as the western terminus). Additionally, the Navy requests permission to employ SURTASS LFA sonar anywhere within the Navy's Hawaii Range Complex (mission areas Hawaii North and South), located in the central North Pacific Ocean approximately between 16°N to 43°N and 150°W to 179°W. 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 2014 through 14 August 2015 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

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

3 MARINE MAMMALS

As many as 35 marine mammal species may occur at least seasonally in the LFA mission areas of the western and central North Pacific Ocean that are requested for use of SURTASS LFA sonar (Table 5). These species include nine mysticetes (baleen whales), 25 odontocetes (toothed whales/dolphins/porpoises), and one pinniped (seals, sea lions, and walruses). Several of these species only occur seasonally while others occur year-round in the potential SURTASS LFA sonar mission areas. Some species, such as the *Mesoplodon* beaked whales and *Kogia* species, are not only difficult to differentiate at sea, but often, little occurrence information is known about these species in some geographic 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, eight species are listed as endangered under the Endangered Species Act (ESA). 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 includes 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 the coastal exclusion zone, where the sonar-generated sound field cannot exceed 180 dB re 1 µPa (rms) (sound pressure level [SPL]) within 22 km (12 nmi) of any coastline. The critical habitat boundaries for the Hawaiian monk seal lie within this coastal exclusion zone. 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 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 and to also to assess the percentage of each stock affected annually as mandated in the MMPA Final Rule and annual LOAs for SURTASS LFA sonar. Consequently, density and abundance estimates for marine mammal stocks were derived for the proposed 2014 to 2015 SURTASS LFA mission areas (Table 6). These population data were derived using the best available source information and data (Appendix A), including the NMFS Stock Assessment Reports (SARs) for Alaska and the United States (U.S.) Pacific (Allen and Angliss, 2013; Carretta et al., 2013, respectively). Stock delineations for insular stocks follow those outlined by NMFS SARs.

When density estimates were not available for a species/stock in a mission area, 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. 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. When possible, densities by season 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
Omura's whale (*Balaenoptera omurai)*		
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[4]—Endangered	Depleted
Fraser's dolphin (*Lagenodelphis hosei*)		
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens)*		
Hubbs beaked whale (*Mesoplodon carhubbsi)*		
Killer whale (*Orca orcinus*)[5]		
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

4 DPS=Distinct population segment

5 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 in each of the proposed SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km²)[7] Winter	Spring	Summer	Fall	Density Reference(s)
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"	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[8]			
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

6 NP=North Pacific; WNP=Western North Pacific; CNP=Central North Pacific; ECS=East China Sea; SOJ=Sea of Japan; IA=Inshore Archipelago; NMI=Northern Mariana Islands

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

8 A density value of 0.0001 with no reference citation indicates that no density was available for this species, but because a density was necessary to compute takes, the lowest value possible was assigned to the data sparse species for the purpose of impact estimation.

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
Pantropical spotted dolphin	WNP	438,064	9			0.0259	0.0259	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	0.0097	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"	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			
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
Cuvier's beaked whale	WNP	90,725	10, 11	0.0054	0.0054	0.0054	0.0054	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	0.0031	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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
Mission Area #3: West 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"	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
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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

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

MARINE MAMMAL SPECIES NAME	STOCK NAME[6]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)	DENSITY (ANIMALS PER KM^2)[7]				DENSITY REFERENCE(S)
				WINTER	SPRING	SUMMER	FALL	
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-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"	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	WNP	1,107	20	0.0009	0.0009		0.0009	19, 21
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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	10,226	14	0.0042	0.0042	0.0042	0.0042	14

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
Melon-headed whale	NMI	2,450	16	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"	25,049	3	0.0004	0.0004	0.0004	0.0004	10, 11
	WNP "J"	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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
Western North Pacific gray whale	WNP	121	1	0.0001	0.0001	0.0001	0.0001	
Baird's beaked whale	WNP	8,000	8	0.0003	0.0003	0.0003	0.0003	8
Common bottlenose dolphin	IA	105,138	9, 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	9, 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	9, 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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
Common minke whale	WNP "O"	25,049	3	0.0044	0.0044	0.0044	0.0044	3
	WNP "J"	893	22	0.0018	0.0018	0.0018	0.0018	3
Fin whale	ECS	500	4, 5, 32	0.0002	0.0002	0.0002	0.0002	5
North Pacific right whale	WNP	922	6	0.0001	0.0001			
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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	9, 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	9, 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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km²)[7]				Density reference(s)
				Winter	Spring	Summer	Fall	
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	9, 13	0.0028	0.0028			10, 11
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-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	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	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"	25,049	3	0.0033	0.0033	0.0033	0.0033	3
	WNP "J"	893	22	0.0018	0.0018	0.0018	0.0018	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			

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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
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

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

MARINE MAMMAL SPECIES NAME	STOCK NAME[6]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)	DENSITY (ANIMALS PER KM^2)[7]				DENSITY REFERENCE(S)
				WINTER	SPRING	SUMMER	FALL	
Sperm whale	NP	102,112	15	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	IA	570,038	9	0.0058	0.0058	0.0058	0.0058	12
MISSION AREA #8: OFFSHORE JAPAN/PACIFIC (25° to 40°N)								
Bryde's whale	WNP	20,501	1	0.0004	0.0004	0.0004	0.0004	16
Common minke whale	WNP "O"	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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
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			
Omura's whale	WNP	1,800	29	0.0001	0.0001	0.0001	0.0001	28
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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km²)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
Sei whale	Hawaiian	77	17, 24	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
	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
Dwarf sperm whale	Hawaiian	17,519	14, 17	0.0029	0.0029	0.0029	0.0029	14
False killer whale	Hawaii Pelagic	1,503	17, 26	0.0006	0.0006	0.0006	0.0006	26
	Main Hawaiian Islands Insular	151	17	0.0012	0.0012	0.0012	0.0012	27
	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

Table 6. Marine mammal species, abundances, and densities of the stocks affected in each of the proposed SURTASS LFA mission areas in the central and western North Pacific Ocean (references at end of table).								
MARINE MAMMAL SPECIES NAME	STOCK NAME[6]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)	DENSITY (ANIMALS PER KM^2)[7]				DENSITY REFERENCE(S)
				WINTER	SPRING	SUMMER	FALL	
Longman's beaked whale	Hawaiian	1,007	14	0.0004	0.0004	0.0004	0.0004	14
Melon-headed whale	Hawaiian	2,950	14, 17	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
Pygmy sperm whale	Hawaiian	7,138	14, 17	0.0071	0.0071	0.0071	0.0071	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 Pelagic	3,351	14	0.0008	0.0008	0.0008	0.0008	14
	Kauai/Niihau	601	17	0.0070	0.0070	0.0070	0.0070	14
	Kure/Midway Atoll	260	17	0.0070	0.0070	0.0070	0.0070	14
	Pearl and Hermes Reef	300	30, 31	0.0070	0.0070	0.0070	0.0070	14
Striped dolphin	Hawaiian	13,143	14, 17	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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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, 24	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
	Oahu	594	17, 25	0.0013	0.0013	0.0013	0.0013	14
	4-Islands Region	153	17, 25	0.0013	0.0013	0.0013	0.0013	14
	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
Dwarf sperm whale	Hawaiian	17,519	17	0.0029	0.0029	0.0029	0.0029	14
False killer whale	Hawaii Pelagic	1,503	17, 26	0.0006	0.0006	0.0006	0.0006	26
	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
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

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

Marine Mammal Species Name	Stock Name[6]	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km^2)[7]				Density Reference(s)
				Winter	Spring	Summer	Fall	
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
Pygmy sperm whale	Hawaiian	7,138	14, 17	0.0070	0.0070	0.0070	0.0070	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 Pelagic	3,351	14	0.0008	0.0008	0.0008	0.0008	14
	Oahu/4-Islands	355	17	0.0070	0.0070	0.0070	0.0070	14
	Hawaii Island	790	17	0.0070	0.0070	0.0070	0.0070	14
Striped dolphin	Hawaiian	13,143	14, 17	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

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18. Stafford et al., 2001
19. LGL, 2008
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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
28. DoN, 2013a
29. Ohsumi, 1980
30. Hoos, 2013
31. Andrews et al., 2006
32. Evans, 1987

<u>Requirement 4</u>: Description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals likely to be affected by such activities.

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

In the 2011, 2012, and 2013 applications for Rulemaking and annual LOAs, the Navy included summaries of the 34 marine mammal species and stocks most likely to be harassed incidental to SURTASS LFA sonar operations (DoN, 2011, 2012a, 2013b). The information on the 34 marine mammal species presented in those documents has not changed, and this 2014 to 2015 LOAs application incorporates the information on status and distribution, including seasonality and stock definition, of those potentially affected species or stocks of marine mammals by reference. In addition to the information incorporated by reference, presented herein is a summary and description of an additional potentially affected species, the Omura's whale (*Balaenoptera omurai*).

4.1 OMURA'S WHALE (*BALAEONOPTERA OMURAI*)

Omura's whale was described only relatively recently (Wada et al., 2003) and was formerly considered to be a pygmy form of the Bryde's whale, although it has now been shown to be genetically distinct and not closely related to the Bryde's whale. This species is not listed as threatened or endangered under the ESA nor is it categorized as depleted under the MMPA. The International Whaling Commission recognizes the Omura's whale but has not yet defined stocks or estimated its population, and no global abundance of Omura's whales exists. The only abundance estimate that relates to the Omura's whale is that derived by Ohsumi (1980) for what he characterized at the time as unusually small Bryde's whales in the Solomon Islands. At least part of the whales Ohsumi (1980) identified as small Bryde's whales in the Solomon Islands have now been shown through genetic analysis to have been Omura's whales (Wada et al., 2003; Sasaki et al., 2006). Thus, while not ideal, given the paucity of data currently available for this species, Ohsumi's (1980) estimate of 1,800 individuals is the only available estimate for Omura's whales in the western Pacific Ocean.

The geographic range of the Omura's whale is not well established since so few specimens and sightings have been confirmed. The putative range of the Omura's whale is in tropical and subtropical waters of the eastern Indian Ocean and western Pacific Ocean from the Sea of Japan south to Southern Australian and New Caledonia from about 90° to 160°E, including the Solomon Sea, Java Sea, Andaman Sea, Gulf of Thailand, South China Sea, East China Sea, Sea of Japan, and parts of the Philippine Sea (Yamada, 2009). This whale occurs in inshore to oceanic waters (Reilly et al., 2008). Omura's whales are known from sightings, when they have been observed alone or in pairs, and single strandings. Nothing is known about the behavior of this whale (Yamada, 2009), and no information has been recorded on the seasonality, movement patterns, or swimming or diving behaviors of this baleen whale. Due to their tropical to subtropical distribution, it is suspected that the Omura's whale does not have a well-defined breeding season (Jefferson et al., 2008).

Hearing has not been measured in the Omura's whale and no data are available on sound production. Like other mysticetes, they are classified as low-frequency hearing specialists, capable of hearing sound within the range of 7 Hz to 22 kiloHertz (kHz) (Southall et al., 2007). Vocalizations are likely to be produced in the range of 10 Hz to 20 kHz with a SL of 129 to 195 dB re 1 µPa @ 1 m (Richardson et al., 1995).

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.*

5 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

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 authorizing the unintentional taking (Levels A and B) of marine mammals incidental to Navy routine training, testing, and military operation of SURTASS LFA sonar onboard the USNS ABLE (T-AGOS 20), USNS EFFECTIVE (T-AGOS 21), USNS IMPECCABLE (T-AGOS 23), and USNS VICTORIOUS (T-AGOS 19) for the 12-month period commencing 15 August 2014. This renewal request document has been prepared in accordance with applicable regulations and the MMPA, as amended by the National Defense Authorization Act (NDAA)[9] for Fiscal Year 2004.

The employment of SURTASS LFA sonar onboard four vessels has the potential for incidental harassment of marine mammals due to the underwater noise generated during at-sea training, testing, and military operations. As a result, the Navy is requesting annual LOAs under the MMPA for each of the four SURTASS LFA sonar vessels to take marine mammals by Level A (no lethal taking) and Level B harassment incidental to the employment of SURTASS LFA sonar systems. No lethal taking or serious injury is likely due to the suite of monitoring and mitigation measures employed during use of LFA sonar onboard all vessels, the sonar's operational parameters, and the geographic restrictions governing where SURTASS LFA sonar can be operated within the western and central North Pacific Ocean. Throughout the more than 10 years of the Navy's use of SURTASS LFA sonar, no injury or mortality has ever been known or shown to have occurred as a result of LFA sonar transmissions.

9 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.''

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.*

6 INCIDENTAL TAKES

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 onboard four SURTASS LFA vessels will be deployed in the North Pacific Ocean.
- USNS ABLE (T-AGOS 20), USNS EFFECTIVE (T-AGOS 21), USNS IMPECCABLE (T-AGOS 23), 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 11-year operation period from 2002 through 2013, LFA sonar was transmitted for 930 hr for all operational vessels or an average of 85 hr total per year for up to four vessels.
- 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 hr).

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 impacts**: Non-auditory impacts 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. These types of impacts have the potential for resonance of the lungs/organs, tissue damage, and mortality.
- **Auditory impacts**: Auditory impacts include permanent threshold shift (PTS), which is a severe situation that 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. PTS constitutes Level A “harassment” under the MMPA. Temporary threshold shift (TTS) is a lesser hearing impact caused by underwater sounds of sufficient loudness that cause a transient condition in which an animal's hearing is impaired for a

period of time. Since hearing is not permanently or irrevocably damaged, 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. Albeit not injurious, for the purposes of the SURTASS LFA sonar analyses presented herein, TTS is considered a component of Level A harassment, in that 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.

- **Behavioral change**: Behavioral responses to intense sounds in a marine animal's environment 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.
- **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, prey, or reproductively active mates. During auditory masking, an animal may, thus, not be able to escape predacious attack, locate food, or find a reproductive partner.

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.

For the purposes of the SURTASS LFA sonar analyses presented here, all marine mammals exposed to underwater sound at ≥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 throughout the environmental compliance process for SURTASS LFA sonar.

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[10] 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 nitrogen concentrations for breath-holding marine mammals (e.g., elephant seals, Weddell seals, and beaked whales). Fahlman et al. (2009) suggested that repeated dives might result in tissue and blood levels of nitrogen sufficient to cause symptomatic bubble formation.

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

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 underlying reasoning for beaked whale strandings predicated by gas bubble formation 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). Since 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 AUDITORY EFFECTS OF SOUND ON MARINE MAMMALS

Marine mammals exposed to natural or man-made sound may experience physical and psychological auditory 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 (Southall et al., 2007); 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 at a certain frequency 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.

Southall et al. (2007) defined 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).

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 auditory evoked potential (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).

6.1.2.1 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. 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).

In relation to SURTASS LFA sonar, NMFS does not consider TTS to constitute injury (NOAA, 2002, 2007, 2012). 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 sound exposure levels (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.

6.1.2.2 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 SURTASS LFA Sonar MMPA Final Rules (NOAA, 2002, 2007, and 2012), NMFS did not consider TTS to be 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.

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 decibels relative to one micro Pascal squared per second (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. Harbor porpoises do not occur in any of the SURTASS LFA sonar mission areas proposed for use during 2014 to 2015. 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.

These scientific conclusions supports the assumptions and findings of the SURTASS LFA documents (DoN, 2001, 2007, 2012) that the likelihood that SURTASS LFA sonar may cause TTS at a SPL of 180 dB RL in marine mammals is negligible and very few animals are likely at all to be affected by TTS. Further, mitigation measures, such as defined mitigation zones and sonar shutdown protocols (NOAA, 2007 and 2012), are employed such that there is little potential for a marine mammal to incur TTS or PTS.

6.1.3 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 Miller et al. (2000) and Fristrup et al*.* (2003) 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.

A recent study by Risch et al. (2012) documented reduction in humpback whale vocalization concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) system, at distances of 200 km from the source. OAWRS is a low-frequency sensor designed to monitor fish populations and marine life over shelf-scale areas. The recorded OAWRS signal consisted of three one-second long frequency modulated upsweeps, with 0.5 seconds between each pulse in the signal. The pulses had a bandwidth of about 50 Hz and were centered on 415, 735, and 950 Hz. The interval between pulse trains was apparently variable. Signal received levels in the study region ranged from 88 to 110 dB RL (Risch et al., 2012). The OAWRS source appears to have affected more whales than the Phase III of the LFS SRP, even though OAWRS had a lower received level than the LFA signal. This strongly suggests that other acoustic characteristics may be responsible for the difference in observed behavioral responses. For example, Risch et al. (2012) note that (1) the duration and frequency range of the OAWRS signals are similar to those of natural humpback whale song components, (2) the duty cycle of the OAWRS signal was, at times, much greater and more variable that that of the LFS SRP. It may be that the greater predictability of the LFA signal mitigated the response, just as bowhead whales had a lesser response to predictable vessels (Richardson et al., 1985); (3) the bandwidth of the OAWRS signal was much greater than that of the LFS SRP. In summary, the OAWRS experiment appeared to produce a greater response with a lower sound source level. However those experimental signals, in duration and frequency, were more similar to biological sound, more varied in their production rate, and greater in bandwidth. Risch et al. (2012) stated that due to differences in behavioral context, location, and proximity to the source, it is difficult to compare their findings directly to the Phase III of the LFS SRP. These observations are consistent with the importance of considering context in predicting and observing the level and type of behavioral response to anthropogenic signals (Ellison et al., 2011).

Studies similar to those of the LFS SRP have also researched the potential effects of mid-frequency sonar on marine mammal species (Tyack et al., 2011; Southall et al., 2012). Two Cuvier's beaked whale were shown to demonstrate behavioral responses to a 30-min playback (one 1.6-sec simulated MFA sonar signal repeated every 25 sec) at received levels of 89-127 dB (DeRuiter et al., 2013). Distant sonar signals with received levels of exercises 78-106 dB did not elicit similar responses, suggesting that reactions may be context dependent (Ellison et al., 2012). Context was shown to be a significant factor in determining whether blue whales responded to mid-frequency sonar (Goldbogen et al., 2013). Animals were classified as deep-diving foragers, shallow-diving foragers, or non-foraging, with shallow-diving foragers showing no response to controlled exposure experimental conditions. Goldbogen et al. (2013) suggest that a combination of behavioral state and received sound level may influence behavioral response. It is clear that more research is needed to understand the complex interactions that may result in behavioral responses.

6.1.4 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 the 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. (2006) 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.

6.1.4.1 Marine Mammal Behavioral Responses to Masking Sounds

Parks et al. (2007, 2010) 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 studies indicated that right whales might shift the frequency band of their calls to compensate for increased in-band background noise (Parks et al., 2007) and increase the amplitude of their calls with increased background noise (Parks et al., 2010). 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).

6.1.4.2 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 ≤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/yr. 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., 2006; 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.

6.1.5 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.

6.1.6 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, nor does any evidence exist to indicate 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 (DoN, 2012). The use of SURTASS LFA sonar was not associated with any of the 11 known mass strandings that occurred from 2013 through the present, as only two strandings, and one of those of a single marine mammal even occurred over the last year in the potential mission areas for SURTASS LFA; in January 2013, one young humpback whale stranded in Hawaii due to a fishing gear entanglement, and in March 2014, 24 *Kogia* spp. stranded in Surigao del Norte, Philippines after dynamite fishing occurred in the area, with at least two of the animals dying.

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 and other anthropogenic factors that can result in marine mammal mortality or live strandings, the high occurrence of marine mammal strandings, and the more than 12 years of LFA sonar operations without any 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 use from 2002 through the present, neither LFA sonar nor operation of T-AGOS vessels have been associated with any mass or individual strandings of marine mammals.

6.1.7 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 any stock of 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 indicate that any mortality or injury of marine mammals is reasonably expected occur as a result of SURTASS LFA sonar operations, and the potential to cause strandings of marine mammals is negligible.
- Potential non-injurious effects (TTS, masking, modification of biological important behavior) are predicted to be minimal or negligible.

- Cumulative effects are not a reasonably foreseeable adverse impact, as auditory masking potentially resulting from SURTASS LFA sonar's 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) and the small number of hours LFA sonar actually transmits.

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 the 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[11].

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 the potential for impacts from SURTASS LFA sonar and that have been documented in three EISs/SEISs (DoN, 2001, 2007, and 2012) and in the most recent MMPA rulemaking for SURTASS LFA sonar operations (NOAA, 2012) were used in the analysis for this LOAs request.

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 is 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 horizontally and dive vertically to 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

11 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.

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 2014 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 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 $\geq$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. In the analysis results (Tables 7 to 17), the total percent affected has been rounded up to two decimal places and fractional numbers of animals potentially affected have been rounded upwards to the next whole number.

The results of the Navy's analysis demonstrate that no exposures of marine mammals at sound levels $\geq$180 dB re 1 µPa (rms) are expected as 0.00% of any stock or 0 animals in any mission area would be affected; 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 2014 through 14 August 2015. At exposures of 120 to 180 dB re 1 µPa (rms) (MMPA Level B harassment), the overall percentages of potentially affected marine mammal stocks range from 0.00% to 8.98% at exposures of 120 to 180 dB re 1 µPa (rms) (single ping equivalent [SPE]) during operation of SURTASS LFA sonar for the proposed missions in 11 mission areas (Tables 7 to 17). 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 8.98% of the WNP stock of Longman's beaked whales, or 97 whales, during the proposed annual missions in western North Pacific mission areas (Appendix B, Table B21). The second highest percentage of any stock potentially affected at SURTASS LFA sonar exposures of 120 to 180 dB re 1 µPa (rms) is 8.54% of the WNP stock of humpback whales, or 98 humpbacks (Appendix B, Table B5).

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) of the East of Japan mission area throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Mission Area #1—East of Japan—1 Mission			
Marine Mammal Species	**Stock[12]**	**Summer**	
		Percent Affected 120 to 180 dB[13]	**Number Animals Affected 120 to 180 dB[14]**
Bryde's whale	WNP	0.03	7
Common minke whale	WNP "O"	0.10	26
Fin whale	WNP	0.05	5
North Pacific right whale	WNP	—[15]	—
Sei whale	NP	0.07	7
Baird's beaked whale	WNP	0.80	64
Common bottlenose dolphin	WNP	0.11	189
Cuvier's beaked whale	WNP	0.08	69
False killer whale	WNP Pelagic	0.50	84
Ginkgo-toothed beaked whale	NP	0.05	12
Hubbs' beaked whale	NP	0.05	12
Killer whale	WNP	0.01	2
Kogia spp.	WNP	0.02	65
Pacific white-sided dolphin	WNP	0.01	41
Pantropical spotted dolphin	WNP	0.02	90
Pygmy killer whale	WNP	0.16	49
Risso's dolphin	WNP	0.23	192
Rough-toothed dolphin	WNP	0.10	149
Short-beaked common dolphin	WNP	0.04	1,367
Short-finned pilot whale	WNP	0.28	151
Sperm whale	NP	0.02	24
Spinner dolphin	WNP	0.01	3
Striped dolphin	WNP	0.01	39

12 Stock names: WNP=Western North Pacific; NP= North Pacific; CNP=Central North Pacific; ECS=East China Sea, IA=Inshore Archipelago, NMI=Northern Mariana Islands

13 The total percent affected has been rounded up to two decimal places.

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

15 "—" 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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

North Philippine Sea—Mission Area #2—3 Missions, One per Season

Marine Mammal Species	Stock[12]	Winter		Spring		Summer		Total	
		Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Blue whale	CNP	0.00	1	0.00	1	—[15]	—	0.01	2
Bryde's whale	WNP	0.13	26	0.03	7	0.08	18	0.24	51
Common minke whale	WNP "O"	0.70	176	0.40	101	0.31	77	1.41	354
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
Omura's whale	WNP	0.13	3	0.00	1	0.08	2	0.21	6
Blainville's beaked whale	WNP	0.19	16	0.06	5	0.11	10	0.36	31
Common bottlenose dolphin	WNP	0.34	566	0.05	93	0.17	293	0.56	952
Cuvier's beaked whale	WNP	0.18	164	0.05	49	0.11	99	0.34	312
False killer whale	WNP Pelagic	0.68	113	0.21	36	0.30	50	1.19	199
Fraser's dolphin	WNP	0.07	162	0.04	95	0.03	74	0.14	331
Ginkgo-toothed beaked whale	NP	0.07	16	0.02	5	0.04	10	0.13	31
Killer whale	WNP	0.03	4	0.01	2	0.01	2	0.05	8
Kogia spp.	WNP	0.03	123	0.03	93	0.02	68	0.08	284
Longman's beaked whale	WNP	0.75	8	0.25	3	0.45	5	1.45	16

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 throughout 15 August 2014 to 14 August 2015; 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[12]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**
Melon-headed whale	WNP	0.45	167	0.14	53	0.20	74	0.79	294
Pacific white-sided dolphin	WNP	0.05	478	0.02	165	—	—	0.07	643
Pantropical spotted dolphin	WNP	0.13	559	0.04	188	0.05	237	0.22	984
Pygmy killer whale	WNP	0.27	82	0.08	26	0.12	36	0.47	144
Risso's dolphin	WNP	0.50	416	0.33	278	0.28	237	1.11	931
Rough-toothed dolphin	WNP	0.16	230	0.11	162	0.10	150	0.37	542
Short-beaked common dolphin	WNP	0.07	2,189	0.02	553	0.03	958	0.12	3,700
Short-finned pilot whale	WNP	1.02	549	0.51	276	0.47	253	2.00	1,078
Sperm whale	NP	0.05	48	0.02	20	0.02	22	0.09	90
Spinner dolphin	WNP	0.00	34	0.00	12	0.00	15	0.01	61
Striped dolphin	WNP	0.24	1,341	0.08	452	0.10	569	0.42	2,362

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

West Philippine Sea—Mission Area #3—3 Missions, One per Season									
Marine Mammal Species	**Stock[12]**	**Winter**		**Summer**		**Fall**		**Total**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**
Blue whale	CNP	0.00	1	—[15]	—	0.00	1	0.01	2
Bryde's whale	WNP	0.11	24	0.11	24	0.04	8	0.26	56
Common minke whale	WNP "O"	0.50	127	0.50	127	0.20	51	1.20	305
Fin whale	WNP	0.09	8	—	—	—	—	0.09	8
Humpback whale	WNP	0.55	7	—	—	0.92	11	1.47	18
Omura's whale	WNP	0.25	3	0.11	3	0.04	1	0.40	7
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	0.10	170	0.77	1,292
Cuvier's beaked whale	WNP	0.01	12	0.01	9	0.01	4	0.03	25
False killer whale	WNP Pelagic	0.70	118	0.68	113	0.20	33	1.58	264
Fraser's dolphin	WNP	0.07	158	0.08	168	0.03	57	0.18	383
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	0.01	2	0.07	10
Kogia spp.	WNP	0.02	68	0.02	68	0.01	30	0.05	166

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 throughout 15 August 2014 to 14 August 2015; 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[12]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Longman's beaked whale	WNP	0.92	10	0.74	8	0.37	4	2.03	22
Melon-headed whale	WNP	0.47	174	0.45	167	0.13	49	1.05	390
Pantropical spotted dolphin	WNP	0.12	526	0.12	518	0.03	146	0.27	1,190
Pygmy killer whale	WNP	0.28	85	0.27	82	0.08	24	0.63	191
Risso's dolphin	WNP	0.51	428	0.50	420	0.19	159	1.20	1,007
Rough-toothed dolphin	WNP	0.17	246	0.16	233	0.08	111	0.41	590
Short-finned pilot whale	WNP	0.55	295	0.56	301	0.23	124	1.34	720
Sperm whale	NP	0.05	49	0.04	44	0.01	15	0.10	108
Spinner dolphin	WNP	0.00	32	0.00	32	0.00	9	0.01	73
Striped dolphin	WNP	0.11	630	0.11	620	0.03	175	0.25	1,425

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Offshore Guam—Mission Area #4—3 Missions, One per Season									
Marine Mammal Species	**Stock[12]**	**Winter**		**Spring**		**Summer**		**Total**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**
Blue whale	CNP	0.00	1	0.00	1	—[15]	—	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	WNP	0.09	1	0.09	1	—	—	0.18	2
Omura's whale	WNP	0.14	2	0.14	2	0.02	1	0.30	5
Sei whale	NP	0.10	9	0.10	9	—	—	0.20	18
Blainville's beaked whale	WNP	0.44	36	0.44	36	0.17	14	1.05	86
Common bottlenose dolphin	WNP	0.02	42	0.02	42	0.01	14	0.05	98
Cuvier's beaked whale	WNP	0.21	188	0.21	188	0.08	71	0.50	447
Dwarf sperm whale	WNP	0.06	223	0.06	223	0.02	85	0.14	531
False killer whale	WNP Pelagic	0.19	33	0.19	33	0.07	12	0.46	78
Fraser's dolphin	WNP	1.27	130	1.27	130	0.43	44	2.97	304
Ginkgo-toothed beaked whale	NP	0.12	29	0.12	29	0.05	11	0.29	69

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Offshore Guam—Mission Area #4—3 Missions, One per Season

Marine Mammal Species	Stock[12]	Winter		Spring		Summer		Total	
		Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Killer whale	WNP	0.03	5	0.03	5	0.01	2	0.07	12
Longman's beaked whale	WNP	1.23	13	1.23	13	0.46	5	2.92	31
Melon-headed whale	NMI	1.79	45	1.79	45	1.79	45	5.37	135
Pantropical spotted dolphin	WNP	0.17	731	0.17	731	0.05	204	0.39	1,666
Pygmy killer whale	WNP	0.01	5	0.01	5	0.01	2	0.03	12
Pygmy sperm whale	WNP	0.03	91	0.03	91	0.01	35	0.07	217
Risso's dolphin	WNP	0.04	31	0.04	31	0.02	13	0.10	75
Rough-toothed dolphin	WNP	0.07	102	0.07	102	0.03	50	0.17	254
Short-finned pilot whale	WNP	0.24	127	0.24	127	0.07	39	0.55	293
Sperm whale	NP	0.04	41	0.04	41	0.01	16	0.09	98
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	56	0.07	454

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Sea of Japan—Mission Area #5—2 Missions, One per Season							
Marine Mammal Species	**Stock[12]**	**Winter**		**Fall**		**Total**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**	**Percent Affected 120-180 dB[13]**	**Number Animals Affected 120-180 dB[14]**
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
	WNP "J"	0.74	7	0.36	4	1.10	11
Fin whale	WNP	0.36	34	0.41	39	0.77	73
North Pacific right whale	WNP	0.05	1	—[15]	—	0.05	1
Omura's whale	WNP	0.02	1	0.01	1	0.03	2
Western North Pacific gray whale	WNP	0.06	1	0.04	1	0.10	2
Baird's beaked whale	WNP	0.11	9	0.25	21	0.36	30
Common bottlenose dolphin	IA	0.03	31	0.02	19	0.05	50
Cuvier's beaked whale	WNP	0.10	91	0.22	199	0.32	290
Dall's porpoise	SOJ	2.60	1,993	0.84	644	3.44	2,637
False killer whale	IA	0.93	92	0.19	19	1.12	111
Killer whale	WNP	0.03	4	0.03	4	0.06	8
Kogia spp.	WNP	0.02	60	0.02	77	0.04	137
Pacific white-sided dolphin	IA	0.01	119	—	—	0.01	119
Risso's dolphin	IA	0.29	244	0.38	314	0.67	558
Rough-toothed dolphin	WNP	0.08	116	0.13	187	0.21	303

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB (with mitigation measures applied).

Sea of Japan—Mission Area #5—2 Missions, One per Season							
Marine Mammal Species	**Stock**[12]	**Winter**		**Fall**		**Total**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB**[14]	**Percent Affected 120-180 dB**[13]	**Number Animals Affected 120-180 dB**[14]	**Percent Affected 120-180 dB**[13]	**Number Animals Affected 120-180 dB**[14]
Short-beaked common dolphin	WNP	0.10	3,417	0.08	2,618	0.18	6,035
Short-finned pilot whale	WNP	0.10	54	0.07	36	0.17	90
Sperm whale	NP	0.04	38	0.08	82	0.12	120
Spinner dolphin	WNP	—	—	0.01	9	0.01	9
Stejneger's beaked whale	WNP	0.18	15	0.40	33	0.58	48
Striped dolphin	IA	0.04	229	0.01	60	0.05	289

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected >180 dB (with mitigation measures applied).

East China Sea—Mission Area #6—1 Mission			
Marine Mammal Species	**Stock**[12]	**Summer**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB**[14]
Bryde's whale	WNP	0.10	21
Common minke whale	WNP "O"	0.61	154
	WNP "J"	2.64	24
Fin whale	ECS	1.48	8
North Pacific right whale	WNP	—[15]	—
Omura's whale	WNP	0.10	3
Western North Pacific gray whale	WNP	—	—
Blainville's beaked whale	WNP	0.16	13
Common bottlenose dolphin	IA	0.02	26
Cuvier's beaked whale	WNP	0.01	8
False killer whale	IA	0.32	32
Fraser's dolphin	WNP	0.06	139
Ginkgo-toothed beaked whale	NP	0.06	13
Killer whale	WNP	0.03	4
Kogia spp.	WNP	0.02	61
Longman's beaked whale	WNP	0.63	7
Melon-headed whale	WNP	0.33	122
Pacific white-sided dolphin	IA	—	—
Pantropical spotted dolphin	IA	0.18	400
Pygmy killer whale	WNP	0.01	4
Risso's dolphin	IA	0.43	356
Rough-toothed dolphin	WNP	0.08	117
Short-beaked common dolphin	WNP	0.05	1,503
Short-finned pilot whale	WNP	0.10	53
Sperm whale	NP	0.03	30
Spinner dolphin	WNP	0.01	25
Striped dolphin	IA	0.03	170

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 throughout 15 August 2014 to 14 August 2015; 0.00% affected/0 animals affected ≥180 dB.

South China Sea—Mission Area #7—1 Mission			
Marine Mammal Species	**Stock[12]**	**Spring**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB[14]**
Bryde's whale	WNP	0.04	9
Common minke whale	WNP "O"	0.17	43
	WNP "J"	2.62	24
Fin whale	WNP	0.04	4
North Pacific right whale	WNP	0.04	1
Omura's whale	WNP	0.06	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 throughout 15 August 2014 to 14 August 2015; 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[12]	Summer	
		Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Bryde's whale	WNP	0.04	9
Common minke whale	WNP "O"	0.04	10
Fin whale	WNP	0.05	6
Sei whale	NP	0.07	6
Baird's beaked whale	WNP	0.04	3
Blainville's beaked whale	WNP	0.07	16
Common bottlenose dolphin	WNP	0.01	18
Cuvier's beaked whale	WNP	0.09	86
Dwarf sperm whale	WNP	0.05	192
False killer whale	WNP	0.20	34
Hubbs' beaked whale	NP	0.05	12
Killer whale	WNP	0.03	5
Longman's beaked whale	WNP	0.56	6
Melon-headed whale	WNP	0.07	26
Mesoplodon spp.	WNP	0.05	12
Pacific white-sided dolphin	WNP	0.01	91
Pantropical spotted dolphin	WNP	0.04	175
Pygmy killer whale	WNP	0.01	1
Pygmy sperm whale	WNP	0.02	79
Risso's dolphin	WNP	0.02	19
Rough-toothed dolphin	WNP	0.06	88
Short-beaked common dolphin	WNP	0.10	3,365
Short-finned pilot whale	WNP	0.14	75
Sperm whale	NP	0.05	49

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 throughout 15 August 2014 to 14 August 2015; 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**[12]	**Summer**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB**[14]
Spinner dolphin	WNP	0.01	29
Striped dolphin	WNP	0.02	90
Hawaiian monk seal	Hawaiian	0.04	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 throughout 15 August 2014 to 14 August 2015; 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**[12]	**Winter**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB**[14]
Blue whale	CNP	0.01	1
Bryde's whale	WNP	0.05	10
Fin whale	WNP	0.01	1
Omura's whale	WNP	0.06	2
Sei whale	NP	0.05	5
Blainville's beaked whale	WNP	0.06	14
Common bottlenose dolphin	WNP	0.01	24
Cuvier's beaked whale	WNP	0.08	72
Dwarf sperm whale	WNP	0.03	119
False killer whale	WNP	0.11	18
Fraser's dolphin	WNP	0.03	66
Killer whale	WNP	0.02	3
Longman's beaked whale	WNP	0.47	5
Melon-headed whale	WNP	0.23	84
Pantropical spotted dolphin	WNP	0.08	346
Pygmy killer whale	WNP	0.01	2
Pygmy sperm whale	WNP	0.01	49
Risso's dolphin	WNP	0.01	12
Rough-toothed dolphin	WNP	0.03	44
Short-finned pilot whale	WNP	0.12	63
Sperm whale	NP	0.04	42
Spinner dolphin	WNP	0.01	58
Striped dolphin	WNP	0.03	179

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 throughout 15 August 2014 to 14 August 2015; 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**[12]	**Winter**		**Summer**		**Total**	
		Percent Affected 120-180 dB[13]	**Number Animals Affected 120-180 dB**[14]	**Percent Affected 120-180 dB**[13]	**Number Animals Affected 120-180 dB**[14]	**Percent Affected 120-180 dB**[13]	**Number Animals Affected 120-180 dB**[14]
Blue whale	CNP	0.14	14	—[15]	—	0.14	14
Bryde's whale	Hawaiian	2.62	13	0.94	5	3.56	18
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	0.75	22	3.70	107
Common bottlenose dolphin	Hawaii Pelagic	0.11	4	0.82	27	0.93	31
	Kauai/Niihau	2.70	4	0.01	1	2.71	5
Cuvier's beaked whale	Hawaiian	2.95	451	0.75	115	3.70	566
Dwarf sperm whale	Hawaiian	2.53	443	1.06	185	3.59	628
False killer whale	Hawaii Pelagic	2.75	42	0.69	11	3.44	53
	Main Hawaiian Islands Insular	0.19	1	0.03	1	0.22	2
	Northwestern Hawaiian Islands	0.01	1	0.01	1	0.02	2
Fraser's dolphin	Hawaiian	2.58	264	0.87	89	3.45	353
Killer whale	Hawaiian	1.81	7	0.80	3	2.61	10
Longman's beaked whale	Hawaiian	2.88	30	0.73	8	3.61	38

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 throughout 15 August 2014 to 14 August 2015; 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[12]	Winter		Summer		Total	
		Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Melon-headed whale	Hawaiian	2.81	83	0.72	22	3.53	105
Pantropical spotted dolphin	Hawaiian	2.71	244	0.76	68	3.47	312
Pygmy killer whale	Hawaiian	2.89	28	0.72	7	3.61	35
Pygmy sperm whale	Hawaiian	2.53	181	1.06	76	3.59	257
Risso's dolphin	Hawaiian	2.63	63	1.11	27	3.74	90
Rough-toothed dolphin	Hawaiian	2.62	229	1.05	92	3.67	321
Short-finned pilot whale	Hawaiian	2.76	245	0.90	81	3.66	326
Sperm whale	Hawaiian	2.47	171	0.76	53	3.23	224
Spinner dolphin	Hawaii Pelagic	0.44	15	0.44	15	0.88	30
	Kauai/Niihau	0.01	1	0.01	1	0.02	2
	Kure/Midway	0.01	1	0.01	1	0.02	2
	Pearl and Hermes Reef	0.01	1	0.01	1	0.02	2
Striped dolphin	Hawaiian	2.71	357	0.76	100	3.47	457
Hawaiian monk seal	Hawaiian	0.59	7	0.21	3	0.80	10

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 throughout 15 August 2014 to 14 August 2015; 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[12]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Blue whale	CNP	0.02	2	0.06	7	0.08	9
Bryde's whale	Hawaiian	0.55	3	0.81	4	1.36	7
Common minke whale	Hawaiian	0.01	2	0.02	5	0.03	7
Fin whale	Hawaiian	0.75	2	1.50	3	2.25	5
Humpback whale	CNP	0.01	1	0.10	11	0.11	12
Sei whale	Hawaiian	0.44	1	0.25	1	0.69	2
Blainville's beaked whale	Hawaiian	0.40	12	0.79	23	1.19	35
Common bottlenose dolphin	Hawaii Pelagic	0.19	7	0.77	25	0.96	32
	Oahu	0.01	1	0.02	1	0.03	2
	4-Islands	0.07	1	0.05	1	0.12	2
	Hawaii Island	0.58	1	0.02	1	0.60	2
Cuvier's beaked whale	Hawaiian	0.40	61	0.79	120	1.19	181
Dwarf sperm whale	Hawaiian	0.52	92	1.09	191	1.61	283
False killer whale	Hawaii Pelagic	0.45	7	0.53	9	0.98	16
	Main Hawaiian Islands Insular	0.47	1	0.15	1	0.62	2
Fraser's dolphin	Hawaiian	0.40	42	0.83	86	1.23	128
Killer whale	Hawaiian	0.38	2	0.78	3	1.16	5
Longman's beaked whale	Hawaiian	0.39	4	0.77	8	1.16	12

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 throughout 15 August 2014 to 14 August 2015; 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[12]	Spring		Fall		Total	
		Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]	Percent Affected 120-180 dB[13]	Number Animals Affected 120-180 dB[14]
Melon-headed whale	Hawaiian	0.46	14	0.55	17	1.01	31
Pantropical spotted dolphin	Hawaiian	0.29	27	0.52	47	0.81	74
Pygmy killer whale	Hawaiian	0.47	5	0.56	6	1.03	11
Pygmy sperm whale	Hawaiian	0.52	38	1.09	78	1.61	116
Risso's dolphin	Hawaiian	0.48	12	0.97	23	1.45	35
Rough-toothed dolphin	Hawaiian	0.49	43	1.08	94	1.57	137
Short-finned pilot whale	Hawaiian	0.35	32	0.76	68	1.11	100
Sperm whale	Hawaiian	0.34	24	0.72	50	1.06	74
Spinner dolphin	Hawaii Pelagic	0.31	11	0.31	11	0.62	22
	Oahu/4-Islands	0.03	1	0.03	1	0.06	2
	Hawaii Island	0.01	1	0.01	1	0.02	2
Striped dolphin	Hawaiian	0.29	39	0.52	69	0.81	108
Hawaiian monk seal	Hawaiian	0.10	2	0.18	3	0.28	5

Per Condition 8J of the annual LOAs authorizing 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 2014 to 2015 annual LOA reporting period is estimated as 8.98%. 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 current LOAs, as issued (NOAA, 2013).

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

7 IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

MMPA Level A harassment can result from auditorialIly or non-auditorially induced injury. Auditory injury or PTS has been defined for 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, 2007, 2012). 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 2014 through 14 August 2015 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 in 2002. 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 2013.

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 2014 to 2015 annual reporting period and the over 10 years of documented operational results presented in the National Environmental Policy Act 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 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 than this total per vessel.
- 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.

<u>Requirement 8</u>: Anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

8 IMPACT ON SUBSISTENCE USE

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.

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 IMPACT TO MARINE MAMMAL 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 (2010) found that blue whales increase their rate of social calling in the presence of seismic exploration sparkers (plasma sound sources), which presumably represented a compensatory behavior to elevated ambient noise levels from seismic surveys.

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 sonar 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 operating in the vast ocean area of the western and central North Pacific Ocean and considering that these systems will not necessarily transmit 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. Even though the eastern Steller sea lion DPS has been de-listed from the ESA, the eastern critical habitat established for that species has not been de-listed and remains valid (NOAA, 2013a). 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 MPAs, 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. The Penguin Bank portion of the Hawaiian Islands Humpback Whale National Marine Sanctuary has been designated as an OBIA for SURTASS LFA sonar. The Papahānaumokuākea Marine National Monument was set aside principally as a MPA to preserve habitat for the Hawaiian monk seal. Since the monk seal is not an LF hearing specialist, the monument did not qualify under the criteria for OBIA designation. Most of the waters of the monument lie within the 22 km (12 nmi) coastal standoff distance where LFA sonar will not be used. A small portion of the monument does lie outside the coastal exclusion distance, however. SURTASS LFA sonar has no exclusion for operating in the small portion of the monument located outside the 22-km exclusion zone. SURTASS LFA sonar will not be operated in the majority of the waters of either of the two MPAs that are in proximity to the proposed mission areas for the 2014 to 2015 reporting period.

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

10 IMPACTS TO MARINE MAMMALS FROM HABITAT LOSS OR MODIFICATION

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.

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.

11 MEANS OF EFFECTING LEAST PRACTICABLE ADVERSE IMPACTS—MITIGATION MEASURES

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	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
Penguin Bank, Hawaiian Islands Humpback Whale National Marine Sanctuary	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 National Marine Sanctuary 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)[16] 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

16 The previous MMPA rulemaking regulations for the operation of SURTASS LFA sonar 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 minutes after there are no further detections by the HF/M3 sonar or visual observations of the animal within the LFA mitigation-buffer zone.

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

12 MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USES

Pursuant to this application for renewal of LOAs for the operation of SURTASS LFA sonar, only areas in the western and central North Pacific Ocean 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.

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 MONITORING AND REPORTING

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 NMFS Office of Protected Resources 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 also submits an annual, unclassified report to the NMFS Office of Protected Resources. 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 LOAs 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 LOAs 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. Acoustic 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 enabled the detection of sperm whale clicks—the longest record to date of one sperm whale was 12 hr with 14 dives recorded. 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.

The Navy, NMFS Office of Protected Resources, and Marine Mammal Commission personnel participated in an Adaptive Management meeting for SURTASS LFA sonar on 10 June 2013. Possible areas for OBIA designation were a key topic of discussion, with at least seven ocean areas being reviewed and discussed. In addition to other important topics, the Navy also provided NMFS with updates on its SURTASS LFA sonar operations. While other areas were considered as potential OBIAs for SURTASS LFA sonar, as a result of discussion and review, information was insufficient to support designation. Information and data gathering regarding the areas discussed in addition to other potential areas is ongoing. Scheduling for an early summer 2014 Adaptive Management meeting for SURTASS LFA sonar is underway.

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.

14 RESEARCH

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, despite waning research budgets, continues to sponsor a high percentage of the research on the effects of human-generated underwater sound on marine mammals.

An important research effort that Navy and NOAA continue to fund is the national and international independent research on whale behavioral response studies (BRSs), whose purpose is to document the responses of marine mammals to sonar signals (Southall et al., 2012). A multi-year (2010 to 2015) BRS research effort has taken place with more experiments planned to occur later this year in the Navy's Southern California (SOCAL) Range Complex; these experiments are designed to contribute to the emerging understanding of marine mammal behavior and changes in behavior as a function of sound exposure. The SOCAL BRS program 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 waters.

14.1 MONITORING TO INCREASE KNOWLEDGE OF AFFECTED MARINE MAMMAL SPECIES

A requirement of the LOAs for the reporting period of 2013 through 2014 for SURTASS LFA sonar operations is that the Navy conducts 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 M3 Program was originated to assess the feasibility of detecting and tracking baleen whales using a Navy seafloor sensor system to collect data. The data and information collected by the Navy systems allows researchers to document undersea sound, including whale acoustic behavior patterns and whale vocalization sequences, which in turn can be used to estimate location and swimming speeds. These passive acoustic systems comprise a valuable tool to gauge underwater noise trends and marine mammal response to noise, both in the short and long term. Over 20 unclassified scientific papers and reports based on information from classified M3 Program data and other Navy passive acoustic assets have been published since 1993.

The Navy (OPNAV N2/N6F24) has continued to assess and analyze M3 data collected from their passive acoustic monitoring system and is working toward making some portion of that data, after appropriate review, available to scientists with appropriate clearances. The NMFS 2012 Final Rule and current LOAs for SURTASS LFA sonar in fact require the Navy to continue assess data from the M3 Program, including any portions of the analyses based on M3 data, and work toward making some portion of those data, after appropriate security reviews, available to scientists with appropriate clearances and ultimately to the public. 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.

14.1.2 BEAKED WHALE AND HARBOR PORPOISE MONITORING AND RESEARCH

The impetus for investigating the effect of SURTASS LFA sonar on beaked whales and the harbor porpoise is the result 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 LF sonar systems has arisen as an important monitoring and research need. This area of research is considered so important that NMFS made it a condition of the 2012 MMPA rulemaking and a condition of the current LOAs for SURTASS LFA sonar employment. Condition 13b of the 2013 to 2014 LOAs requires the Navy to continue investigating research efforts and to draft a plan of action outlining the strategy for implementing research recommendations on the effects of SURTASS LFA sonar on beaked whales and harbor porpoises.

The Navy convened an independent Scientific Advisory Group (SAG), whose purpose was to investigate and assess different types of research and monitoring methods that could increase the understanding of the potential effects to beaked whales and the harbor porpoise from exposure to SURTASS LFA sonar transmissions. The SAG was responsible for preparing and submitting a report, *Potential Effects of SURTASS LFA Sonar on Beaked Whales and Harbor Porpoises*, which described the SAG's monitoring and research recommendations. The SAG report was submitted to the Navy and the SURTASS LFA sonar Executive Oversight Group (EOG) in August 2013.

The SURTASS LFA sonar EOG met on 19 February 2014 to review and discuss the research recommendations put forth by the SAG. The EOG is comprised of representatives from the U.S. Navy Undersea Capabilities Branch of the Office of the Chief of Naval Operations (Chair), Office of the Deputy Assistant Secretary of the Navy for Environment, Office of Naval Research, Navy Living Marine Research Program, as well as two members of the NMFS Office of Protected Resources (Permits, Conservation, and Education Division). Two members of the Marine Mammal Commission also attended as observers.

In addition to the research and monitoring efforts recommended by the SAG, EOG members provided additional promising research/monitoring suggestions The EOG Chair summarized the Navy budgetary constraints for conducting any laboratory or field research studies, noting that research budgets have been reduced and that due to existing budgetary constraints, the earliest likely opportunity to submit a budgetary request for research funding support would be for fiscal year 2017. The EOG will meet again in late spring 2014 to agree on the best research or monitoring recommendations for each taxa and develop a plan of action recommending how the Navy carry out the research to maximize the reduced research funding. The EOG Chair will also coordinate with the Navy's Energy and Environmental Readiness Division to integrate and coordinate the recommended beaked whale and harbor porpoise research for the SURTASS LFA sonar program with other existing or planned Navy research efforts. Once the plan of action is completed, it will be submitted to the NMFS Office of Protected Resources.

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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. Literature citations for 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 (WNP) 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 WNP 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 Ocean and Sea of Okhotsk, from which density (0.0022 animals/km^2) and abundance (25,049 individuals) estimates for the WNP "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 eastern tropical Pacific (ETP) are an order of a magnitude lower than those derived by Buckland et al. (1992).

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

D. **North Pacific right whale**: The WNP 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 WNP 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 associated with exposure to LFA sonar. 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 during two seasons.

E. **Sei whale**: Tillman (1977) derived an abundance estimate of 8,600 individuals for sei/Bryde's[17] 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's North Pacific (NP) stock (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

17 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 estimated for the WNP 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 WNP 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 WNP stock. Considering habitat preferences (e.g., water temperature and bathymetry), the best population data available to extrapolate for the Cuvier's WNP stock located 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, 0.0036 animals/km^2, was derived for the WNP Pelagic stock of false killer whales in this mission area. 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 (NP) 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 this beaked whale in 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 NP 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 to estimate the WNP stock, the best available data from which to extrapolate abundance estimate is the ETP time series data, where Ferguson and Barlow (2001, 2003) derived an abundance estimate of 12,256 animals. A density of 0.0001 animals/km^2 was estimated from LGL (2011) data. The LGL (2011) density estimated for the WNP stock is 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 the WNP 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 (Ferguson and Barlow, 2001; 2003) from which to extrapolate a density of undifferentiated *Kogia* in the WNP 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 WNP 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 WNP 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) described a known distribution of pantropical spotted dolphins occurring east of Japan. Miyashita (1993) reports an abundance estimate of 438,064 individuals (CV=0.174) and a seasonal 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 WNP 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 waters of the tropical Pacific off Japan. However, since no population data are available for pygmy killer whales in the western North Pacific Ocean, 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 WNP 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 WNP 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 WNP 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 WNP 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 WNP 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 the southern stock found south of the Kuroshio Current front (south of 35° N) while the northern stock occurs between the frontal boundaries of the Kuroshio and Oyashio Currents (~35° to 43°N). Miyashita (1993) questioned the stock delineation of short-finned pilot whales in this region 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 WNP 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 whose females summer off the Kuril Islands (~50°N) and winter off Hokkaido and Sanriku (~40°N) and a southwestern stock whose females summer off Hokkaido and Sanriku (~40°N) and winter around the Bonin Islands (~25°N). The males of both stocks are thought to occur north of the corresponding female's ranges, 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 only the North Pacific (NP) stock as a whole. The best available population estimate for sperm whales occurring in the NP 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 the NP stock of sperm whales 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 for the WNP stock, 1,015,059 animals, is estimated from the ETP population data (Ferguson and Barlow, 2001 and 2003) while the density, 0.0008 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 WNP population estimate of 570,038 individuals (CV=0.186) and a density estimate of 0.0111 animals/km^2 was used for this mission area to represent the WNP striped dolphin stock.

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[18]. 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 (CNP) 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 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 WNP. The IWC (2009) provides the best available population estimate, 20,501 whales, for the WNP stock of Bryde's whales. The density estimate (0.0006 animals/km^2) for the WNP 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). Minke whales 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 minke whales in 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 WNP "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 WNP stock are not expected to occur in summer and fall in LFA mission area #2. Density, 0.0002 animals/km^2 for winter and spring, and abundance, 9,250 individuals, estimates of the WNP stock were derived from encounter rates of scouting boats during Japanese 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

18 The 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).

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 WNP stock of humpback whales (Acebes et al., 2007; LGL, 2008).

F. **North Pacific right whale**: The WNP right whale population 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 (CV=0.433, 95% CI=404-2,108) (Best et al., 2001) for the WNP stock of North Pacific right whales. The WNP 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. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales. Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

H. **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 the WNP stock of 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.

I. **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 WNP stock, which occurs in this mission area. 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).

J. **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 WNP 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).

K. **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 WNP 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).

L. **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 WNP stock of Fraser's dolphins, which occurs in this mission area. However, the density estimate derived for Hawaiian waters, 0.0050 animals/km^2 (Barlow, 2006), is most appropriate and representative of the stock.

M. **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 NP 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).

N. **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 WNP 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).

O. ***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 WNP 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* spp. 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).

P. **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 WNP 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 region are considered most appropriate to represent the WNP stock of Longman's beaked whale.

Q. **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 Islands region were the best available data to use to represent the WNP 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.

R. **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 WNP 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 density estimate of 0.0119 animals/km^2 from the ETP (Ferguson and Barlow, 2001, 2003) are most appropriate as a proxy to represent the WNP stock of Pacific white-sided dolphins occurring in this mission area during winter and spring. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Mobley et al., 2000; Barlow, 2006).

S. **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 WNP stock of pantropical spotted 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).

T. **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 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).

U. **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 WNP 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).

V. **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 WNP 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 WNP 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).

W. **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 WNP 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 WNP stock of short-beaked common dolphins.

X. **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 that two stocks of short-finned pilot whales occurred in the western North Pacific Ocean off Japan and Taiwan, with a southern stock located 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). Although Miyashita (1993) questioned the stock delineation of short-finned pilot whales in this region, he had no way of defining stock boundaries. Miyashita (1993) estimated the abundance of short-finned pilot whales in the WNP 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.

Y. **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 a 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 NP 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).

Z. **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 WNP stock of spinner dolphins, the abundance estimate, 1,015,059 animals derived for spinner dolphins in waters of the ETP (Ferguson and Barlow, 2001, 2003) at a similar latitude is appropriate to characterize this stock in this region. 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.

AA. **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 and 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 WNP 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

A. **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[18]. 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 ETP (Ferguson and Barlow, 2003).

B. **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 WNP stock Bryde's whales. Barlow (2006) observed Bryde's whales around the Hawaiian Islands, deriving a higher 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). 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 WNP 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.

D. **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 WNP 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 WNP stock are comparable to the density estimated for this species in offshore areas of the ETP (Ferguson and Barlow, 2001 and 2003).

E. **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 WNP stock of humpback whales are only expected in the western Philippine Sea mission area during winter, spring, and part of 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 WNP stock in mission area #3 (Acebes et al., 2007; LGL, 2008).

F. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales.

Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

G. **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 WNP 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).

H. **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).

I. **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 WNP 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).

J. **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 WNP 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).

K. **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) best represented the WNP stock of Fraser's dolphins.

L. **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).

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 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).

N. ***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. Considering the lack of data for the western North Pacific, Ferguson and Barlow's (2001, 2003) data are the most appropriate to represent *Kogia* spp. in 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 WNP 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).

O. **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 WNP 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 WNP stock.

P. **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 WNP 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.

Q. **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 WNP 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).

R. **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 to use as a proxy to represent the WNP 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).

S. **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 WNP 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).

T. **Rough-toothed dolphin:** Since no data on abundance or density estimates are available for the WNP 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 charactize 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).

U. **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 form found south of the Kuroshio Current front (south of 35°N) and a different 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). From 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.

V. **Sperm whale**: Stock structure of this species has not been completely delineated in the North Pacific Ocean. 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.

W. **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 WNP 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 from the offshore stratum of the outer Hawaiian EEZ are considered most appropriate to represent this stock in this mission area.

X. **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 WNP 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, 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 blue whale stock structure throughout the

North Pacific Ocean[18] and limited occurrence data for this species, blue whales found in waters near Guam are considered part of the CNP 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 WNP stock at 20,501 whales (IWC, 2009). Sightings from the Fulling et al. (2011) 2007 surveys in the Marianas region produced an abundance of 233 Bryde's whales. 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**: Minke whales were heard but not sighted during recent surveys in Guam and the Mariana Islands waters (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 WNP 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 WNP 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). Humpbacks in the Guam region are part of the WNP stock, with an estimated abundance of 1,107 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. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales. Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

G. **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 of the Mariana Islands (Fulling et al., 2011), during which 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 the 2007 surveys (Fulling et al., 2011). The Marianas 2007 surveys 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 NP 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]).

H. **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, resulting in a total of 8,032 animals, was considered best to represent the WNP stock. 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).

I. **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).

J. **Cuvier's beaked whale:** With few population data available for the western North Pacific Ocean, the best data available density and abundance estimates for the WNP stock of Cuvier's beaked whales 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).

K. **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 to use as an abundance proxy 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.

L. **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) for the WNP Pelagic stock is calculated from the winter/spring surveys in the waters of 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).

M. **Fraser's dolphin**: With few population data available for the WNP stock, Barlow's (2006) estimated density of 0.0042 animals/km^2 and abundance of 10,226 for Fraser's dolphins in Hawaiian waters during summer/fall surveys is the most appropriate density for this species in this mission area.

Although Fraser's dolphins are estimated to occur regularly and year-round in the Mariana region's waters of the Guam mission area, no Fraser's dolphins were observed during the 2007 surveys of this area (Fulling et al., 2011).

N. **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 for the Ginkgo-toothed beaked whale in this mission area.

O. **Killer whale**: Killer whales are considered rare with limited sightings reported, and during the 2007 surveys of this area, no killer whales were observed (Fulling et al., 2011; 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.

P. **Longman's beaked whale:** Few population data are available for this rarely observed beaked whale. No density estimates for Longman's beaked whales are available from the Mariana Islands area (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 Hawaii offshore surveys (Barlow, 2006).

Q. **Melon-headed whale**: The best available density (0.0043 animals/km^2) and abundance (2,455 animals) estimates for the melon-headed whale's Northern Mariana Island stock found in this mission area are derived from the winter/spring 2007 surveys 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).

R. **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 surveys 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).

S. **Pygmy killer whale**: One sighting of six animals was observed during the 2007 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) for the WNP stock of pygmy killer whales. The density for this mission area for this species is comparable to that observed in the Hawaii EEZ (0.00039 animals/km^2; Barlow, 2006), but no pygmy killers were sighted in nearshore Hawaii waters (Mobley et al., 2000).

T. **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 WNP stock in the Guam mission 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 mission 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.

U. **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 WNP stock estimate of 83,289 animals (CV=0.179). The density estimate of 0.0010 animals/km^2 was used for the WNP stock in this mission area and 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).

V. **Rough-toothed dolphin**: Fulling et al. (2011) did not collect sufficient sighting data to derive density or abundance estimates for this species during the 2007 surveys of this region. 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).

W. **Short-finned pilot whale:** Insufficient sighting data were collected on this species during the 2007 surveys of this mission areas waters to derive density or abundance estimates for this species (Fulling et al., 2011). However, Miyashita's (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 to represent the WNP stock in this mission area. 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).

X. **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 boundaries delineation and review by the IWC are woefully out of date (Donovan, 1991). Sperm whales in the Guam mission area are part the NP stock. Since an abundance estimate is needed for the calculation of impacts, the best available abundance estimate for the NP stock is the estimate is Kato and Miyashita's (1998) of 102,112 individuals. In the 2007 surveys of the southern Mariana Islands, 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).

Y. **Spinner dolphin:** Although a stock structure incorporating an inshore (insular) and pelagic stock of spinner dolphins has been suggested for the Mariana region following the stock delineation for the species in the Hawaiian archipelago (i.e., DoN, 2013a), currently sufficient population level abundance data are not available to designate insular and pelagic stocks of spinner dolphins, as are needed for computation of the percentage of the stocks affected by SURTASS LFA sonar. Similarly, in the American Samoan Islands, NMFS currently is only able to define one stock of spinner dolphins, and no stocks are designated in the Marianas Islands (Carretta et al., 2010). Thus, for the purposes of this LOAs application, spinner dolphins in the Mariana region are estimated to be part of the WNP stock, with an estimated abundance of 1,015,059 animals, as derived from Ferguson and Barlow (2001, 2003) ETP data estimates. Further, the best available density estimate for the WNP stock of spinner dolphins, 0.0008 animals/km^2, is derived from the Hawaiian pelagic survey data (Barlow, 2006). 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).

Z. **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, 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, although none of these are located in the Sea of Japan. However, Evans (1987) described the Bryde's whale range from northern Japan to the equator in the western North Pacific. Considering habitat preferences (e.g., water temperature, bathymetry), the best density data available are the long-term time series from the ETP (Ferguson and Barlow, 2001 and 2003), with an appropriate density estimate (0.0001 animals/km^2) to represent the WNP stock in this area. The IWC population estimate of 20,501 whales for the WNP stock was used for in analyses for this mission area (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 density estimate of 0.0004 animals/km^2 derived from ETP surveys was deemed most appropriate to represent the "O" stock animals (Ferguson and Barlow, 2001, 2003). An abundance estimate of 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 in this mission area.

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). An historic stock estimate for the WNP stock of fin whales, 9,250 animals, was 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 WNP stock 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 to 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 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 to 2,108) (Best et al., 2001) for the WNP 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. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales. Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

F. **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 WNP 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 WNP stock of gray whales migrates 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 WNP 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.

G. **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 for a 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. This density estimate is comparable to that derived from the ETP by Ferguson and Barlow, 2001 and 2003.

H. **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 members of an inshore Archipelago stock that are separate from animals in the WNP stock found in the waters of the western North Pacific Ocean. 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 tripled to derive an abundance for the inshore Archipelago stock estimate as 105,138 animals. No density estimates are available for the inshore Archipelago stock; therefore the density estimate (0.0008 animals/km^2) was calculated from LGL (2011) data.

I. **Cuvier's beaked whale:** No density or stock estimate data are available for this region, but 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) ETP survey estimates, with a representative density for the WNP stock in this area estimated as 0.0031 animals/km^2 and an abundance estimated as 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).

J. **Dall's porpoise**: Dall's porpoise are found only in the North Pacific, primarily north of 36°N in the western North Pacific Ocean. 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 the Sea of Japan stock in this mission area (Ferguson and Barlow, 2001, 2003). This density estimates a concentration of Dall's porpoises probably larger 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.

K. **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 found 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 tripled for the inshore Archipelago stock estimate of 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 density estimate (0.0027 animals/km^2) for this inshore Archipelago stock is derived 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).

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) was derived from LGL (2011) data. The most representative abundance estimate of 12,256 animals for the WNP stock 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.

M. ***Kogia* spp.:** With no available population data available for the WNP stock in the Sea of Japan, Ferguson and Barlow's (2001, 2003) abundance estimated for *Kogia* spp. of 350,553 in the ETP and their density of 0.0017 animals/km^2 were deemed the best estimate available for the Sea of Japan 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.

N. **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 stock, it is roughly estimated that the abundance estimate from the WNP (931,000 animals) and the density estimate (0.0030 animals/km^2) from the ETP (Ferguson and Barlow, 2001, 2003) are most appropriate to represent the inshore Archipelago stock. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Barlow, 2006; Mobley et al., 2000).

O. **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 Risso's summering in the Sea of Japan represent a separate, inshore Archipelago stock separate from the WNP stock. There are no separate data reported for the Sea of Japan or East China Sea, however. Therefore, the WNP stock estimate (83,289 animals, CV=0.179) and density estimate (0.0073 animals/km^2) derived from the Pacific coast of Japan (Miyashita, 1993) are most appropriate to represent the inshore Archipelago stock that occurs in the Sea of Japan. This stock density 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).

P. **Rough-toothed dolphin**: With the absence of population data for this dolphin in the Sea of Japan, the best available density estimate (0.0036 animals/km^2) to represent the WNP stock that occurs in the Sea of Japan 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).

Q. **Short-beaked common dolphin:** Common dolphins have been caught on the Tsushima Islands in the Korea Strait (Kishiro and Kasuya, 1993). However, no data on density or stock estimates are available (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 are the most appropriate to represent the WNP stock of short-beaked common dolphins in the Sea of Japan.

R. **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. Due to limited data specific to this region, data from the Pacific coast of Japan and Taiwan and the eastern North Pacific were used to represent this stock in this area. Miyashita (1993) estimated a short-finned pilot whale abundance of 53,608 animals (CV=0.224) from 34 sighting cruises associated with the Japanese drive fishery 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).

S. **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 Mariana Islands (Fulling et al., 2011) represents the best available density for this mission area. Kato and Miyashita's (1998) sperm whale abundance estimate of 102,112 animals for the NP stock that migrates between Alaska and the western North Pacific is the best currently available for the overall stock. The Sea of Japan 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) for this species.

T. **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 Sea of Japan. 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). Thus, the best available density estimate (0.0008 animals/km^2) for possible occurrence in summer and fall is derived 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 (1,015,059 animals) for spinner dolphins in the WNP stock is that derived from ETP surveys (Ferguson and Barlow, 2001, 2003).

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

V. **Striped dolphin**: Recent research on genetic differentiation suggests that dolphins 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). However, with no specific data on this inshore stock, Miyashita's (1993) total population estimate of 570,038 (CV=0.186) for the WNP stock is roughly considered most appropriate to represent the inshore Archipelago stock, as is the best available density estimate of 0.0058 animals/km^2 derived from LGL (2011) data. This density 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 WNP 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 WNP, 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. Although minke whales in the East China Sea are believed to be from the J-stock (Butterworth et al., 1996; Gong, 1988), migrating into the region in the winter, conservatively however, estimates are included for both the O stock and the J stock, given the limited amount of data on either stock. Therefore, an estimate for the WNP O stock of 25,049 animals with the density of 0.0044 animals/km^2 were derived based on encounter rates in the favored whaling grounds of the western North Pacific (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 is considered to represent a distinct population (Evans, 1987). There are limited data on distribution and abundance, however, for fin whales in this region

(Mizroch et al., 2009). Density and stock estimates for the East China Sea stock of fin whales were thus derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977; Mizroch et al., 2009), resulting in an abundance estimated as 500 fin whales and a density estimated as 0.0002 animals/km^2. This density is comparable to density estimates in the ETP (Ferguson and Barlow, 2001, 2003) and around Hawaii (Barlow, 2006).

D. **North Pacific right whale**: The WNP 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 WNP 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 during winter and spring.

E. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales. Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

F. **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, WNP 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 WNP 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.

G. **Blainville's beaked whale:** With no population data available for this species in the East China Sea, the best available data are the density estimate (0.0005 animals/km^2) and abundance estimate of 8,032 animals derived from the eastern Pacific survey data (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).

H. **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, this population estimate is tripled to represent 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).

I. **Cuvier's beaked whale:** No density or stock estimate data are available for this region for Cuvier's beaked whales. Considering habitat preferences (e.g., water temperature, bathymetry) of this species elsewhere in the North Pacific Ocean, the best data available to represent the WNP stock are those derived for the ETP with a density estimate 0.0003 animals/km^2 and an abundance estimate of 90,725 animals (Ferguson and Barlow, 2001, 2003).

J. **False killer whale**: Miyashita (1993) suggested that animals summering in the eastern Asian continental seas are probably from a separate, inshore Archipelago stock than animals offshore in the western North Pacific (i.e., WNP stock) 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 animals. Since these data represent only about one-third of the habitat of false killer whales in the East China Sea, the population estimate of 3,259 animals was tripled to represent the inshore Archipelago stock estimate (9,777 animals). There are no data on density estimates for the East China Sea. Thus, the best available density estimate (0.0011 animals/km^2) to represent the inshore Archipelago stock is derived from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011). This density 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).

K. **Fraser's dolphin:** Kishiro and Kasuya (1993) reported catches off the Pacific coast of Japan in drive fisheries. With no data available on stock or density estimates for the western North Pacific or the East China Sea, the population estimate (220,789 animals) from the ETP (Ferguson and Barlow, 2001, 2003) is most appropriate for application to this area, while Barlow's (2006) density estimate of 0.0042 animals/km^2 derived for the Hawaiian EEZ is the most appropriate density for this mission area.

L. **Ginkgo-toothed beaked whale:** Miyazaki et al. (1987) reported no strandings of ginkgo-toothed beaked whales in the East China Sea. Although the ginkgo-toothed beaked whales in the East China Sea probably represent a separate population from that of the offshore western North Pacific, no data are available for a distinct stock. With no data on density or stock estimates available for this species, density was roughly estimated as 0.0005 animals/km^2 and abundance estimated at 22,799 animals for *Mesoplodon* spp. at the same latitude from the eastern Pacific survey data (Ferguson and Barlow, 2001, 2003). 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).

M. **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) data for the WNP stock while the best abundance estimate (12,256 animals) are derived from the eastern North Pacific by Ferguson and 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 Mariana Islands.

N. ***Kogia* spp.:** At the latitude of this mission area, *Kogia breviceps* and *Kogia sima* are both expected to occur. However, no density or abundance estimates are available for these species in this region. 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, and this abundance is thus deemed most appropriate to represent the WNP stock of *Kogia* spp. 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 considered the best available for this stock in this region. This density estimate is comparable to that derived 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:** Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings were south of 25ºN. No population estimates are available for this beaked whale in this mission area. Therefore, the density estimate of 0.0003 animals/km^2 derived from LGL (2011) data and the abundance estimate of 1,007 animals derived from the Hawaii offshore area (Barlow, 2006) were considered best to represent the WNP stock, animals of which potentially occur in the East China Sea.

P. **Melon-headed whale:** Very few records of melon-headed whales are available for this region. The first record of melon-headed whales in Korean waters occurred in January 2009 with the stranding of an adult male reported from the southeast corner of the country (Kim et al., 2010). Melon-headed whales are probably uncommon in the colder waters of the East China Sea. The best available density estimate (0.0043 animals/km^2) to represent the WNP stock 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 of 36,770 animals derived from the survey data of eastern North Pacific best represents the WNP stock (Ferguson and Barlow, 2001, 2003).

Q. **Pacific white-sided dolphin:** Recent research on genetic differentiation suggests that animals found in continental eastern Asian seas belong to a separate, inshore Archipelago (IA) 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). However, with no other data available to represent the IA population, the abundance of 931,000 animals was roughly estimated from the western North Pacific, and the density estimate (0.0028 animals/km^2) from the ETP (Ferguson and Barlow, 2001, 2003) was most appropriate to represent the occurrences of this dolphin in this area during winter and spring. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Barlow, 2006; Mobley et al., 2000).

R. **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; the data showed no discontinuity in sightings to suggest different stocks, but based on data from the ETP, it is possible that multiple populations exist in the western North Pacific (Miyashita, 1993). Following the division of stocks for other dolphins in the eastern Asian continental seas, pantropical dolphins in the East China Sea are considered to belong to an IA stock (after Miyashita, 1993). Although Miyashita (1993) computed a total WNP population size of pantropical spotted dolphins as 438,064 animals (CV=0.174), this stock abundance was halved (219,032 individuals) to best represent the IA stock of this species. Miyashita's (1993) density estimated at 0.0137 animals/km^2 for the WNP stock is the best available to represent the IA stock. This density 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).

S. **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 surveys 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 and is considered the best available to represent the WNP stock of pygmy killer whales.

T. **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 this area represent a separate, IA stock from the WNP stock. However, no population data have been reported for the Sea of Japan or East China Sea. Consequently, abundance estimated for the WNP stock as 83,289 animals (CV=0.179) and density estimated as 0.0106 animals/km^2, both derived for the southeast Pacific coast of Japan/east of Taiwan by Miyashita (1993) were used to represent the IA stock in this mission area. 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).

U. **Rough-toothed dolphin:** There are no data on stock or density estimates for the rough-toothed dolphin in the western North Pacific Ocean. Therefore, a density estimated for this species in waters of the Hawaii EEZ (0.0036 animals/km^2; Barlow, 2006) was deemed most appropriate to characterize the WNP stock. An abundance of 145,729 animals was estimated from Ferguson and Barlow's (2001, 2003) ETP data to represent the WNP stock, which occurs in this mission area. 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).

V. **Short-beaked common dolphin**: Common dolphins 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. Miyashita (1993) reported no data on density or stock estimates for this species. Lacking data on stock or population estimates for the central or western North Pacific for the short-beaked common dolphin, the abundance, 3,286,163 animals, and density, 0.0461 animals/km^2, derived from the same latitude in the ETP (Ferguson and Barlow, 2001, 2003) were considered most optimal to distinguish the WNP stock.

W. **Short-finned pilot whale:** 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 to 43°N). However, Kishiro and Kasuya (1993) reported that short-finned pilot whales are uncommon in the East China Sea and that information is insufficient to ascertain whether the southern or northern form occurs in this region. Further, the northern form has not been harvested by Japanese drive fisheries (Kishiro and Kasuya, 1993) and was not, thus, included in the Miyashita (1993) analyses, in which he estimated an abundance (53,608 animals, CV=0.224) of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery. Miyashita's (1993) abundance was considered the best available to represent the WNP stock. The best available density estimate (0.0016 animals/km^2) is calculated from the winter/spring surveys around Guam and the Mariana Islands (Fulling et al., 2011). This density 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).

X. **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 NP 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 NP 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).

Y. **Spinner dolphin**: Gilpatrick et al. (1987) reported a high density of spinner dolphin sightings in the Korea Strait and adjacent waters to the north, but no spinner dolphin sightings were reported from the East China Sea. Neither is this species mentioned in historical Japanese whaling records (Kishiro and Kasuya, 1993), and no data on density or stock estimates are available (Miyashita, 1993). Given this lack of available data, the best available density estimate (0.0008 animals/km^2) is calculated from the Hawaii EEZ survey data (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) is derived from surveys of the ETP (Ferguson and Barlow, 2001, 2003).

Z. **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. 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 IA stock, as analogy from bottlenose dolphins (Miyashita, 1993). Miyashita's (1993) total population estimate of 570,038 animals (CV=0.186) best represents the IA stock of striped dolphins, while LGL's (2011) density of 0.0058 animals/km^2 is most appropriate for this stock in 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 mission 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 WNP populations. Further, Bryde's whale in this region are considered to be the offshore form of *Balaenoptera edeni*. De Boer (2000) sighted Bryde's whales in this region but reported no stock data. Lacking stock data for the Southeast Asia stock of Bryde's whales, Ohsumi's (1977) western North Pacific density estimate is most appropriate and is comparable to that derived by Fulling et al. (2007) (0.00041 animals/km^2) in Mariana waters, Barlow (2006) (0.00019 animals/km^2) in Hawaiian waters, and Ferguson and Barlow (2001, 2003) for the ETP. The IWC population estimate of 20,501 whales for the WNP Bryde's whale stock is the best available abundance to also represent the SE Asian 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, Smith et al. (1997) did not document them during their cruises, nor were they reported 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 in the South China Sea might be from the J-stock, migrating into the region in the winter. To be conservative, estimates are included for both the O stock and the J stock for the South China Sea, given the limited amount of data on either stock. Therefore, an estimate for the WNP O stock of 25,049 animals with the density of 0.0044 animals/km^2 were derived based on encounter rates in the favored whaling grounds of the western North Pacific (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**: 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). A population of fin whales is thought to be resident and may represent a distinct East China Sea population (Evans, 1987). Without any population data for fin whales in the South China Sea, data from the WNP stock are estimated to be most appropriate to represent fin whales in this mission area (Mizroch et al., 2009). Density (0.0002 animals/km^2) and abundance (9,250 animals) estimates were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Tillman, 1977). This density is 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 for this mission area. 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. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales.

Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

F. **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 but also may 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 in the western North Pacific 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 WNP 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 mission area to reflect the extremely low potential for this species occurring.

G. **Blainville's beaked whale:** Miyazaki et al. (1987) did not report any strandings of *M. densirostris* from the South China Sea. Neither De Boer (2000) nor Miyashita et al. (1996) observed any *M. densirostris* during their research cruises. Lacking data on stock or density estimates for the western North Pacific for this species, data from the ETP surveys (Ferguson and Barlow, 2001, 2003) are most appropriate to represent this species in this mission area. The *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate in the ETP data results in an abundance estimate of 8,032 animals while the *Mesoplodon* spp. density estimate, 0.0005 animals/km^2, is 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).

H. **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, IA stock than animals in the western North Pacific. It is highly likely that bottlenose dolphins found in the Sea of Japan, East China Sea, and South China Sea belong to the same IA stock. For this reason, the stock of bottlenose dolphins in the South China Sea is classified as part of the IA stock. Kishiro and Kasuya (1993) cite Miyashita (1986) as estimating the abundance of the stock in the East China Sea as 35,046 animals. Since these data represent only about one-third of the habitat of bottlenose dolphins in the East China Sea, the population estimate was tripled (105,138 animals) to represent the IA stock, and that abundance represents the IA stock in this sea. 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).

I. **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, however. Considering habitat preferences (e.g., water temperature, bathymetry), the best available data to characterize the WNP stock found in this mission area are the density estimate (0.0003 animals/km^2)

and the abundance estimate of 90,725 animals from the same latitude in the eastern Pacific (Ferguson and Barlow, 2001, 2003). This 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:** False killer whales are sighted infrequently in the South China Sea (De Boer, 2000; Miyashita et al., 1996; Smith et al., 1997). Miyashita (1993) suggested that animals summering in the Sea of Japan are probably from a separate, IA stock, by analogy of Pacific white-sided dolphins, than animals from the WNP stock. It is reasonable to assume that false killer whales occurring in the Sea of Japan, East China Sea, and South China Sea are all part of same, IA 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 area, the population estimate was tripled (9,777 individuals) to represent the IA stock estimate. With no data available on density estimates for this species in the South China Sea, the best available density estimate (0.0011 animals/km^2) calculated from the winter/spring survey around Guam and the Mariana Islands (Fulling et al., 2011) was used for this species in this mission area. This density 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).

K. **Fraser's dolphin**: Kishiro and Kasuya (1993) report catches of Fraser's dolphins off the Pacific coast of Japan in drive fisheries. No population data are available on this species in the western North Pacific Ocean or in the South China Sea. Lacking stock or density data, an abundance most appropriate to represent the WNP stock of Fraser's dolphins of 220,789 animals is derived from the ETP (Ferguson and Barlow, 2001, 2003) while the best available density estimate of 0.0042 animals/km^2 is derived from the Hawaii EEZ survey (Barlow, 2006).

L. **Ginkgo-toothed beaked whale:** Miyazaki et al. (1987) report no strandings of *M. ginkgodens* from the South China Sea. Neither De Boer (2000) nor Miyashita et al. (1996) observed ginkgo-toothed beaked whales during their research cruises. Since no data on density or stock estimates are available for this species in the North Pacific Ocean, a density (0.0005 animals/km^2) and abundance (22,799 animals) estimated for *Mesoplodon* spp. at the same latitude in the eastern Pacific (Ferguson and Barlow, 2001, 2003) was considered most appropriate to characterize this species' population in this mission area. 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).

M. **Killer whale**: Killer whales are considered rare with limited sightings reported (Carretta et al., 2013), especially in the western North Pacific Ocean. The best available density estimate (0.0001 animals/km^2) derived by LGL (2011) and abundance estimate (12,256 animals) calculated from ETP survey data (Ferguson and Barlow, 2001 and 2003) are used to characterize the WNP stock of killer whales found in this mission area. 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 2007 surveys around the Mariana Islands (Fulling et al., 2011).

N. ***Kogia* spp.**: Both *Kogia breviceps* and *Kogia sima* potentially may occur in this region. Smith et al. (1997) reported that *Kogia* were found in "whale temples" in nations surrounding the South China Sea. No sightings of *Kogia* spp. were made by De Boer (2000) during his survey. No density or abundance estimates are available for this species in this region. 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 and best represents the WNP stock of *Kogia* spp. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N, the derived density estimate of 0.0017 animals/km^2 from that area best represents the WNP stock (Ferguson and Barlow, 2001 and 2003). 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).

O. **Longman's beaked whale:** Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings occurred south of 25ºN. No population data are available for this species in this mission area or for the WNP stock. Lacking data, the best available density estimate for Longman's beaked whales in the WNP stock is that estimated of by LGL (2011) as 0.0003 animals/km^2, while the best available abundance for this stock is that estimated as 1,007 animals from the Hawaii offshore area (Barlow, 2006).

P. **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, melon-headed whales have been observed in the South China Sea (De Boer, 2000) and are reported from "whale temples" on islands surrounding the South China Sea (Smith et al., 1997). However, they were not observed by Miyashita et al. (1996). With no specific population data for this mission area, the best available density estimate (0.0043 animals/km^2) is calculated from the winter/spring surveys around Guam and the Mariana Islands (Fulling et al., 2011). This density 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 (36,770 animals) derived from the eastern North Pacific survey data (Ferguson and Barlow, 2001, 2003) was considered most appropriate to represent the WNP stock of these whales.

Q. **Pantropical spotted dolphin**: These animals have been reported during the De Boer (2000) research cruise, were observed in winter (January to February) in the South China Sea by Miyashita et al. (1996), were reported from historical "whale temples" (Smith et al., 1997), and also summarized by Gilpatrick et al. (1987) from one record west of Taiwan in the northern portion of the South China Sea. It is reasonable to assume that false killer whales occurring in the Sea of Japan, East China Sea, and South China Sea are all part of same, IA stock, which reflects data fro this species from the ETP, where multiple populations exist (Miyashita, 1993). Miyashita (1993) summarized data from 34 sighting cruises conducted as part of the Japanese drive fishery and derived a population estimate for the western North Pacific as 438,064 animals (CV=0.174) and a density estimate as 0.0137 animals/km^2. Based on these Miyashita (1993) data, the IA population in the South China Sea of 219,032 animals was estimated by halving the abundance of the WNP stock (with the same density estimate of 0.0137 animals/km^2). This density 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).

R. **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). Therefore, the best available density estimate to represent the WNP stock in this mission area was judged to be 0.0001 animals/km^2 derived from the winter/spring 2007 surveys around Guam and the Mariana Islands (Fulling et al., 2011). This density is comparable to the density estimate (0.00039 animals/km^2) calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). The best available abundance estimate of 30,214 animals from the eastern Pacific (Ferguson and Barlow, 2001, 2003) was considered to best represent the WNP stock of pygmy killer whales.

S. **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 Risso's dolphins summering in the Sea of Japan are part of a separate, IA stock different from the WNP stock. Since it is reasonable to assume that Risso's dolphins occurring in the Sea of Japan, East China Sea, and South China Sea are all part of same, IA stock, Risso's in this mission area are considered to be part of the IA stock. Since population data are lacking for the IA stock region, the WNP 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 to represent the IA stock. Miyashita's density 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).

T. **Rough-toothed dolphin:** Rough-toothed dolphins have been reported from "whale temples" in South China Sea nations (Smith et al., 1997). Few other population data, however, are available for this dolphin species in this region. Given that lack of data, the best available density (0.0036 animals/km^2) is estimated from the Hawaiian EEZ surveys (Barlow, 2006) and the best available abundance estimate of 145,729 animals derived from the eastern Pacific (Ferguson and Barlow, 2001, 2003) best represent the WNP stock of rough-toothed dolphins found in this mission area. Although 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), it is 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-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. 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). With limited data for this particular region, data from the Pacific coast of Japan were used to estimate population data for the WNP stock of pilot whales in this region. Miyashita's (1993) estimated abundance of 53,608 (CV=0.224) short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery is considered the best available to characterize the WNP stock. The best available density estimate (0.0016 animals/km^2) was calculated from the winter/spring 2007 surveys around Guam and the Mariana Islands (Fulling et al., 2011). This density 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).

V. **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 NP 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).

W. **Spinner dolphin:** Gilpatrick et al. (1987) reported a high density of spinner dolphin 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), nor were they reported during the De Boer (2000) research cruise, nor encountered in historical "whale temples" (Smith et al., 1997). No data on density or stock estimates are available (Miyashita, 1993). Given that lack of regional data, the best available density estimate for the WNP stock found in this mission area is that derived (0.0008 animals/km^2) 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 for spinner dolphins (1,015,059 animals) in the WNP stock is derived from the ETP surveys (Ferguson and Barlow, 2001, 003).

X. **Striped dolphin:** These dolphins were not reported during the De Boer (2000) research cruise in March to April but were sighted by Miyashita et al. (1996) in the South China Sea during the January to February cruise. No data on density or abundance estimates for the South China Sea are available on striped dolphins. Based on stock differentiation among other small odontocetes in the eastern Asian continental seas, the striped dolphins ranging throughout the Sea of Japan, East China Sea, and South China Sea are part of the IA stock, as suggested by Miyashita (1993). Miyashita (1993) derived a total population estimate of 570,038 striped dolphins (CV=0.186). LGL's (2011) density of 0.0058 animals/km^2 was considered best for this species in this region. This density 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 to represent the WNP stock in this mission area is 0.0004 animals/km^2 derived from the 2007 winter/spring surveys around Guam and the Mariana Islands (Fulling et al., 2011). This density 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, at 20,501 whales, for the WNP Bryde's whale stock (IWC, 2009).

B. **Common minke whale:** Historically, the waters along the south coast of Honshu and Shikoku were whaling grounds for this species (Ohsumi, 1978). Minke whales occurring in these waters are thought to be migratory from the offshore western North Pacific waters. Minke whales in the waters of the mission area belong to the WNP "O" stock. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk and derived a density estimate of 0.0003 animals/km^2 (SE = 0.17) from encounter rates and effective search widths for the offshore population (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 the 2007 surveys around Guam and the Mariana Islands (Fulling et al., 2011). An abundance of 25,049 minke whales is most appropriate to represent the WNP O stock (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), 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, 0.0001 animals/km^2 and 9,250 animals, respectively, for the WNP 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). This density is 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 waters of the 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 NP 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 surveys 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 1,000 m (3,281 ft). Kasuya (1986) collected sighting data from 25 years of aerial survey records and 1984 shipboard sightings off the Pacific coast of Japan; based on Kasuya's (1986) encounter rate and effective search width, a density estimate of 0.0001 animals/km^2 was derived for the Baird's beaked whale stock in this mission area. Kasuya's (1986) abundance estimate of 4,220 animals (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 (1986) surveys did not include habitat further north or east, the Kasuya stock estimate is increased to 8,000 to account for unsurveyed areas. Since the density Kasuya (1986) computed already represents the lowest density used in modeling, Kasuya's density estimate of 0.0001 animals/km^2 was not reduced further 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 WNP 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), which is used to represent the WNP stock in this mission area while LGL (2011) derived a density estimate of 0.0008 animals/km^2 for pelagic bottlenose dolphins in this region. 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 Cuvier's beaked whales in this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that the best available abundance of 90,725 animals derived from the long-term ETP time series (Ferguson and Barlow, 2001, 2003) and the best available density estimate of 0.0037 animals/km^2 derived by LGL (2011) most optimally represent this stock in this region. This 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).

I. **Dwarf sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic, non-aggregated distribution. Although only the pygmy sperm whale is expected to occur in this area, given the lack of information about this species in this region, the dwarf sperm whale is also included in this mission area. Given the lack of population level data on either *Kogia* species in the western North Pacific, the most representative abundance for the WNP stock of the dwarf sperm whale was derived by summing the abundances of *Kogia* spp. in the geographic ETP strata defined by Ferguson and Barlow (2001, 2003), resulting in an overall abundance of 350,553 animals. LGL's (2011) density estimate of 0.0043 animals/km^2 is the best available 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**: Little occurrence or population data are available in these waters for the false killer whale. The most representative estimates of the WNP stock and density of false killer whales is Miyashita's (1993) estimated abundance of 16,668 animals (CV=0.263) from 34 sighting cruises associated with the Japanese drive fishery and his density 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 NP 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).

Y. **Killer whale**: Killer whales have been observed in the waters 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 derived 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 derived from LGL's (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 WNP 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 WNP stock in this mission area.

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 and information available, a density estimate of 0.0027 animals/km^2 from LGL (2011) was considered most appropriate to represent the WNP stock in this region. This density is 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 whales was derived from ETP data (Ferguson and Barlow, 2001, 2003) was used to represent the WNP stock in this region.

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 so very little occurrence or population data are available for this species, especially in this oceanic region, data on *Mesoplodon* spp. from the northernmost ETP stratum (Ferguson and Barlow, 2001, 2003) were considered most appropriate to represent the Mesoplodon genus in this mission area. Ferguson and Barlow's (2001, 2003) derived density estimate of 0.0005 animals/km^2 and abundance estimate of 22,799 animals represents *Mesoplodon* whales in the WNP stock. 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 of Pacific white-sided dolphins in this region are available (Miyashita, 1993). Due to this lack, the density (0.0048 animals/km^2) estimated from eastern Pacific waters (Ferguson and Barlow, 2001, 2003) was used to best represent the WNP stock of these dolphins in this mission area, while Buckland et al.'s (1993) abundance of 931,000 animals is most appropriate to characterize the WNP stock of Pacific white-sided dolphins. No sightings of Pacific white-sided dolphins were reported in Hawaii surveys (Mobley et al., 2000; Barlow, 2006).

P. **Pantropical spotted dolphin:** With the lack of population level data on pantropical spotted dolphins in this offshore mission area, Miyashita's (1993) abundance estimate of 438,064 animals (CV=0.174) and LGL's (2011) density estimate of 0.0113 animals/km^2 best characterize this species in this oceanic area. 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 and reported that no pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan). Leatherwood and Reeves (1983), however, reported that pygmy killer whales were seen relatively frequently in the tropical Pacific off Japan. Given such sparsely available data on this species in this region, the best available density estimate (0.0001 animals/km^2) was derived from LGL (2011) data in the Mariana Islands. This density 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). The best available abundance estimate of 30,214 animals from the eastern Pacific survey data (Ferguson and Barlow, 2001, 2003) best represents the WNP stock of this species.

R. **Pygmy sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic, non-aggregated distribution. At this northern latitude, only *Kogia breviceps* is expected to occur. With so few *Kogia* data available in this region, an abundance was derived for the WNP stock by summing the abundances of *Kogia* spp. in the ETP geographic strata defined by Ferguson and Barlow (2001, 2003), which resulted in an overall abundance of 350,553 animals. LGL

(2011) calculated a density estimate of 0.0018/km^2 for the pygmy sperm whale in the Mariana region and this estimate was considered to be represent this species in this mission area. This density 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:** With little occurrence information available on the Risso's dolphin in this ocean mission area, Miyashita's (1993) abundance of 83,289 animals (CV=0.179) best represents the WNP stock, while LGL's (2011) density estimate of 0.0005 animals/km^2 derived for the species in the waters of the Mariana Islands is the best available density.

T. **Rough-toothed dolphin:** Due to the very limited amount of population data available on this dolphin species in this offshore Japan mission area, the best available density estimate of 0.0019 animals/km^2 derived from LGL's (2011) data from the Mariana region. This density 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 representative abundance of 145,729 animals is estimated 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 for the short-beaked common dolphin (Miyashita, 1993). With no data on stock or density estimates for the western North Pacific, the data from the ETP for the short-beaked common dolphin is considered most representative for the WNP stock with a density estimated at 0.0863 animals/km^2 and an abundance estimated at 3,286,163 animals (Ferguson and Barlow, 2001, 2003).

V. **Short-finned pilot whale:** 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 available data. Thus, Miyashita (1993) estimated the abundance of short-finned pilot whales for one stock as 53,608 animals (CV=0.224) from data from 34 sighting cruises associated with the Japanese drive fishery; this abundance is considered the best available to typify the WNP of short-finned pilot whales. The most appropriate density estimate for this offshore site, 0.0021 animals/km^2, was derived from LGL (2011) data in the Mariana region.

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 southWNP 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). However, until further data are available, sperm whales are considered to belong to only one NP stock. Potentially, sperm whales of the NP stock, numbering 102,112 individuals (Kato and Miyashita, 1998), may occur year-round in the waters of this offshore 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 that derived by Mobley et al. (2000) (0.0010 animals/km^2), where sperm whales were generally seen in the outer 5% of the survey effort, and is higher than the Fulling et al. (2011) density estimate (0.00123 animals/km^2) calculated from the winter/spring surveys around Guam and Mariana Islands.

X. **Spinner dolphin:** Gilpatrick et al. (1987) did not report any sightings of spinner dolphins from the Pacific coast of Japan and neither is this species mentioned in historical Japanese whaling records

(Kishiro and Kasuya, 1993). With no data on density or stock estimates available (Miyashita, 1993), the best stock and density estimates for the WNP stock of spinner dolphins is considered to be Ferguson and Barlow (2001, 2003) estimate of 1,015,059 spinner dolphins from a similar latitude of the ETP and LGL's (2011) estimate of 0.0019 animals/km^2, respectively.

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, with a third possible east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita (1993) derived a total population estimate for the WNP striped dolphin stock of 570,038 animals (CV=0.186). LGL (2011) derived a density estimate of 0.0058 animals/km^2 from data derived from the Mariana region. This density 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 northwest Hawaiian Islands (NWHI) (Carretta et al., 2013). Monk seals from Kure Atoll may forage on the Hancock Banks, NW of Kure Atoll. Parrish et al. (2002) compiled information on monk seal diving wherein the authors 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 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 the marine mammal fauna for this mission area. The abundance of the Hawaiian monk seal stock 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[18]. 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 the Stafford et al. (2001) data and the lack of population data on blue whales in this region, the most appropriate proxy abundance data would be those from fin whales derived from sighting surveys associated with Japanese whaling (Tillman, 1977; Carretta et al., 2013). Thus, the best available abundance for the CNP blue whale stock is 9,250 animals (Tillman, 1977). 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 (Tillman, 1977, Ferguson and Barlow, 2001 and 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 WNP Bryde's whale stock (IWC, 2009). The best available density estimate for this species in this region, 0.0003 animals/km^2, is calculated by LGL (2011). This density 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 occur in the summer from a line north of Japan to the Chukchi Sea and Aleutian Islands (Evans, 1987). Population data for the fin whale are sparse in this area of the North Pacific Ocean, but an abundance for the WNP 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 during winter and spring.

D. **Omura's whale:** Little population information is known or available for this species only described in 2003 but this baleen whale ranges from roughly northern Japan to Australia in the eastern Indian Ocean and western Pacific Ocean (Yamada, 2009). With so little information available, the Omura's whale is assumed to comprise one stock, the WNP, throughout its range in the western Pacific Ocean. The only abundance information available is an estimate made by Ohsumi (1980) for Bryde's whales in the Solomon Sea, which are now known to have been Byrde's and Omura's whales. Lacking other data, Ohsumi's (1980) abundance of 1,800 animals was used to represent the WNP stock of Omura's whales. While no density estimate is available but one is needed to assess risk to this species due to exposure from SURTASS LFA sonar, a density of 0.0001 animals/km^2 was used to represent the scarcity of this species in this area.

E. **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 NP 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 seasonal density estimate of 0.0001 animals/km^2 was derived from LGL (2011) data and information collected in the Mariana Islands region.

F. **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 WNP 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 the WNP stock. The density estimate derived by LGL (2011), 0.0007 animals/km^2; is most appropriate for this beaked whale in this oceanic mission area. 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:** Little population data are available on the bottlenose dolphin in this oceanic region. Given this lack of data, the best available WNP stock abundance estimate was derived from Miyashita's (1993) estimate of 168,791 animals (CV=0.261), while the best available density of bottlenose dolphins in this mission area of 0.0008 animals/km^2 as derived by LGL (2011) for this species in waters of the Mariana region. This density 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 Cuvier's beaked whales in this oceanic region. Considering habitat preferences (e.g., water temperature, bathymetry), the best available abundance for the WNP stock of 90,725 animals was derived for this beaked whale from long-term time ETP series data (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 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).

I. **Dwarf sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic, disbursed distribution. Although at this latitude only the pygmy sperm whale is expected to occur, the dwarf sperm whale is included in this mission area due to the lack of concrete data and information on it's deep ocean occurrence. To derive the best available abundance for the WNP stock of dwarf sperm whales, the abundances of *Kogia* spp. in the appropriate geographic ETP strata were summed to derive an overall abundance of 350,553 animals (Ferguson and Barlow, 2001 and 2003). LGL's density estimate of 0.0043 animals/km^2 best represents this species in this region. This density 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).

J. **False killer whale:** With so sparse occurrence data available for false killer whales in this oceanic mission area, Miyashita's (1993) abundance of 16,668 false killer whales (CV=0.263) from 34 sighting cruises associated with the Japanese drive fishery best typifies the WNP stock. LGL's (2011) density of 0.0006 animals/km^2 is most representative of this species in mission area #9. This density is much lower than the average densities estimated in the eastern North Pacific (0.0045 animals/km^2; Ferguson and Barlow, 2001, 2003).

K. **Fraser's dolphin**: Without data on abundance or density estimates for the western North Pacific Ocean for the Fraser's dolphin, Ferguson and Barlow's (2001, 2003) abundance estimate of 220,789 animals is extrapolated to represent the WNP stock of Fraser's dolphins. The density estimated by LGL (2011) as 0.0025 animals/km^2 is considered the best available and most appropriate to characterize Fraser's dolphin in this mission area.

L. **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 for the WNP stock was derived from Ferguson and Barlow's (2001, 2003) long time series of ETP data. The best available density for the killer whale in this region is represented by the density of 0.0001 animals/km^2 (LGL, 2011) estimated 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).

M. **Longman's beaked whale:** Ferguson and Barlow (2001) reported that all Longman's beaked whale sightings in their ETP surveys occurred south of 25ºN. Considering the lack of occurrence or population data for the WNP 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 WNP stock in this oceanic region.

N. **Melon-headed whale:** Leatherwood and Reeves (1983) stated that melon-headed whales are rare in all western North Pacific waters except those of the Philippine Sea. With such limited data available, a density estimate derived by LGL (2011) of 0.0027 animals/km^2 is the best available to characterize the occurrence of melon-headed whales in this region. This density 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 derived from eastern Pacific data by Ferguson and Barlow (2001, 2003) is most optimal to represent the WNP stock.

O. **Pantropical spotted dolphin:** Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Japan. With so little data available on this dolphin in this mission area, Miyashita's (1993) abundance estimate of 438,064 animals (CV=0.174) is judged best to portray the size of the WNP stock. The best available density of 0.0113 animals/km^2 is estimated from this species data from the Mariana region (LGL, 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).

P. **Pygmy killer whale:** Kishiro and Kasuya (1993) reviewed the historical catches of Japanese drive fisheries and reported that no pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan). However, Leatherwood and Reeves (1983) reported that pygmy killer whales were seen relatively frequently in the tropical Pacific waters off Japan. Few data are available for this species in this oceanic mission area. Thus, the best available density estimate of 0.0001 animals/km^2 for this area was derived by LGL (2011) from Mariana Islands data. This density 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 by Mobley et al. (2000). The best abundance estimate to represent the WNP stock of pygmy killer whales is 30,214 animals derived from the eastern Pacific survey data(Ferguson and Barlow, 2001, 2003).

Q. **Pygmy sperm whale:** Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic, dispersed distribution. Although only this species of *Kogia* is expected to occur at this the latitude of this site, due to the lack of concrete data, to be conservative both *Kogia* species are included for this mission area. The best estimated abundance for the WNP stock of pygmy sperm whales is derived by summing the abundances of *Kogia* spp. in the ETP geographic strata defined by Ferguson and Barlow (2001, 2003), which results in an overall abundance of 350,553 animals. The density of 0.0018 animals/km^2 derived for the greater Mariana Islands region (LGL, 2011) is the most representative of this species in this region. This density 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).

R. **Risso's dolphin:** Very sparse occurrence or population level data are available for the Risso's dolphin in this oceanic area. Miyashita's (1993) estimated abundance for the WNP stock of 83,289 animals (CV=0.179) is the best data available. Likewise, LGL's (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).

S. **Rough-toothed dolphin:** With few data available for this dolphin species in mission area #9, the best available density, 0.0019 animals/km^2, is estimated from data for the Mariana region LGL (2011). This density 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 of 145,729 animals to typify the WNP stock of rough-toothed dolphins is derived from eastern Pacific data (Ferguson and Barlow, 2001, 2003).

T. **Short-finned pilot whale:** 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 to 43°N). Miyashita (1993) questioned the stock delineation of this species but had insufficient information to further define the stock. For this reason, Miyashita (1993) estimated an abundance of short-finned pilot whales for the entire WNP as 53,608 animals (CV=0.224) from 34 sighting cruises associated with the Japanese drive fishery. The most appropriate and best available density for this whale in this region is 0.0021 animals/km^2, estimated by LGL (2011).

U. **Sperm whale**: 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. However, data is insufficient to clearly define the stock structure of sperm whales in the North Pacific Ocean, except in the U.S. EEZ waters. For this reason, Kato and Miyashita's (1988) stock estimate of 102,112 animals is the best available estimate of the NP stock of sperm whales in this mission area. A density estimate of 0.0022 animals/km^2 was derived from LGL data (2011) and is considered optimal to represent this species occurrence in this area. While 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 surveys around Guam and Mariana Islands (Fulling et al., 2011), it is very close to the density calculated from the summer/fall survey off Hawaii in 2002 (0.00282 animals/km^2) (Barlow, 2006).

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

W. **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, but it is likely that only one population exists south of 30°N. However, the boundaries between these populations have not been resolved (Miyashita, 1993). Therefore, Miyashita's (1993) total WNP population estimate of 570,038 animals (CV=0.186) is the best available for this stock in this area. The best existing 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 main Hawaiian Islands (MHI) have been systematically aerially surveyed as part of the Acoustic Thermometry of Ocean Climate Marine Mammal Research Program during the peak humpback season (mid-Feb through mid-April) (Mobley, 2006). 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. Monitoring of Hawaii's marine mammal populations continues as part of the Navy's Hawaii Range Complex monitoring program.

A. **Blue whale**: Due to the general lack of occurrence data for blue whales in the North Pacific Ocean, stock structure remains uncertain[18]. 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); only one published sighting of blue whales near Hawaii was recorded in 1966 (Carretta et al., 2013). Further evidence of their occurrence in the area exists from 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 by NMFS to be part of the CNP 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) derived for blue whales in the ETP is considered appropriate to represent this stock (Ferguson and Barlow, 2001 and 2003).

A. **Bryde's whale:** Sightings of the Bryde's whale in Hawaiian waters have been recorded sporadically since 1977 (Carretta et al., 2013). Occurrence data are sufficient to define a Hawaiian stock of Bryde's whales. Barlow's (2006) estimates of the Hawaiian stock of Bryde's whales remain the best available, with a density for the whales estimated as 0.0002 animals/km^2 and a stock abundance of 469 animals (CV=0.45), calculated for the summer/fall surveys in the Hawaii EEZ.

B. **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 (54 nmi) 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). Lacking abundance data for this stock in Hawaiian waters, the best estimate of abundance (25,049 animals) is derived 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, for minkes in Hawaiian waters is calculated from the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

C. **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 in this herein. 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.

D. **Humpback whale**: The CNP 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 CNP 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.

E. **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 best represents this species low occurrence potential.

F. **Blainville's beaked whale:** Blainville's beaked whales potentially occur in the deep waters of this mission area. 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). This density estimate is comparable to nearshore Hawaiian waters (0.0012 animals/km^2; Mobley et al., 2000).

G. **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), two of which occur in this northern mission area. 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 this oceanic stock of bottlenose dolphins 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 mission area, 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 for the Kauai/Niihau stock is 147 animals (CV=0.11) 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).

H. **Cuvier's beaked whale:** The best available density estimate (0.00621 animals/km^2) and abundance estimate (15,242 individuals, CV=1.43) for the Hawaiian stock of Cuvier's beaked whales 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).

I. **Dwarf sperm whale**: Dwarf sperm whales are known in Hawaii from both strandings and sightings, with Mobley et al. (2000) having observed two pods of dwarf and pygmy sperm whales for a total of five individuals during his 1993 to 1998 survey efforts, although no density or abundance estimates were derived. Dwarf sperm whales were also observed near Niihau, Kauai, Lanai, and Hawaii during small boat surveys between 2000 and 2003 (Baird, 2005). The best available estimates for the Hawaiian stock of dwarf sperm whales are the density and abundance, 0.0029 animals/km2 and 17,519 animals, respectively, estimated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006).

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 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.

   Main Hawaiian Islands insular stock: The best available abundance estimate (151 animals, CV=0.20) for the Main Hawaiian Islands 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 (Carretta et al., 2013). The best available density estimate for the Hawaii pelagic stock, 0.0006 individuals/km^2, was also estimated from the 2010 dedicated survey of Hawaiian 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 (Carretta et al., 2013). 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 Hawaiian waters during a recent summer/fall survey (Barlow, 2006), resulting in the best available density estimate of 0.0042 animals/km^2 and abundance estimate of 10,226 animals (CV=1.16).

L. **Killer whale**: Killer whales are considered rare in Hawaiian waters with limited sightings having been 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 waters of the Hawaii EEZ (Barlow, 2006). Mobley et al. (2000) did not report any sightings in their surveys of coastal waters of the Main Hawaiian Islands.

M. **Longman's beaked whale:** Longman's beaked whale has only recently been identified to species (Dalebout et al., 2003; Pitman et al.,1999) and is considered one of the rarest and least known of cetacean species. The best available density estimate (0.0004 animals/km^2) and abundance estimate (1,007 animals, CV=1.26) for the Hawaiian stock of this beaked whale were 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).

N. **Melon-headed whale**: Recent 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), with 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. 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). However, at this point, NMFS recognizes only one stock of melon-headed whales, the Hawaiian stock, within the Hawaiian EEZ (Carretta et al., 2013). The best available density estimate (0.0012 animals/km^2) and abundance estimate (2,950 whales, CV=1.17) for the Hawaiian stock of melon-headed whales 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).

O. **Pantropical spotted dolphin:** Genetic analyses support the recognition of three island-associated stocks: a Hawaii Island Stock that extends 65 km (35 nmi) from shore, a 4-Islands Region Stock that extends 20 km (11 nmi) from shore, and an Oahu Stock that extends 20 km (11 nmi) 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 only 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). This density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0407 animals/km^2; Mobley et al., 2000).

P. **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 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).

Q. **Pygmy sperm whale**: Mobley et al. (2000) observed pygmy sperm whales during his 1993 to 1998 survey efforts, while two sightings were observed during Barlow's (2006) 2002 sighting survey; many strandings of this species are also recorded in Hawaiian waters (Carretta et al., 2013). A Hawaii stock of pygmy sperm whales is recognized (Carretta et al., 2013). The best available estimates for the Hawaiian stock of pygmy sperm whales is the density of 0.0071 animals/km^2 and the abundance 7,138 animals calculated from the summer/fall survey data in the Hawaii EEZ (Barlow, 2006; Carretta et al., 2013).

R. **Risso's dolphin:** A Hawaiian stock of Risso's dolphins is recognized, although this dolphin appears to occur rarely in the Hawaiian waters (Carretta et al., 2013). Mobley et al. (2000) observed insufficient sightings of Risso's dolphins to derive density or abundance estimates in nearshore waters. NMFS suggests that based on the locations of Hawaiian longline-fishery interactions of this species, 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). 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).

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

T. **Short-finned pilot whale:** Short-finned pilot whales occur both in the NWHI and the MHI, where they occur commonly, and a Hawaiian stock is recognized (Carretta et al., 2013). The best available density estimate (0.0036 animals/km^2) and abundance estimate (8,870 animals, CV=1.13) were calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). This 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 are known from many strandings and sightings in Hawaiian waters, and 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). This 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). Four of the five Hawaii spinner dolphin stocks are found in the Hawaii North mission area.

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 (0.0008 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). This 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). 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 (0.0070 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

Kure/Midway stock: During a 2010 shipboard line-transect survey within the Hawaiian EEZ, only one off-effort spinner dolphin was sighted at Kure Atoll (Carretta et al., 2013). An earlier multi-year photo-identification study at Midway Atoll identified a population of 260 spinner dolphins based on 139 identified individuals (Karczmarski et al. 1998), which remains the best available stock estimate for the Kure/Midway Atoll stock of spinner dolphins (Carretta et al., 2013). The best available density estimate (0.0070 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

Pearl and Hermes Reef stock: While spinner dolphins in this area have been photo-identified, little survey and low re-sighting rates of these dolphins makes estimating an abundance challenging. However, based on the work of Andrews et al. (2006) and Hoos (2013), the best available abundance for the Pearl and Hermes Reef stock has been estimated at 300 animals, while the best density estimate for this stock, 0.0070 animals/km^2, is derived from the summer/fall survey of the Hawaiian EEZ waters (Barlow, 2006).

W. **Striped dolphin:** Striped dolphins in Hawaiian waters are separated into a discrete Hawaiian stock (Carretta et al., 2013). The best available density and abundance estimates for the Hawaiian stock of striped dolphins are 0.0054 animals/km^2 and 13,143 individuals (CV=0.46), respectively, as derived from the summer/fall surveys in the Hawaiian EEZ (Barlow, 2006). This 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 CNP 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); only one published sighting of blue whales near Hawaii was recorded in 1966 (Carretta et al., 2013). Additional evidence of blue whale occurrence in this mission area exists from 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. Given such limited data for the blue whale occurrences in Hawaiian waters and given the current uncertainty regarding blue whale stock delineation in the North Pacific, the abundance estimated for the CNP stock as 9,250 animals 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:** Sightings of the Bryde's whale in Hawaiian waters have been recorded sporadically since 1977 (Carretta et al., 2013). Occurrence data are sufficient to define a Hawaiian stock of Bryde's whales. Barlow's (2006) estimates of the Hawaiian stock of Bryde's whales remain the best available, with a density for the whales estimated as 0.0002 animals/km^2 and a stock abundance of 469 animals (CV=0.45), calculated for the summer/fall surveys in the Hawaii EEZ.

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 (54 nmi) 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). Lacking abundance data for this stock in Hawaiian waters, the best estimate of abundance (25,049 animals) is derived 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, for minkes in Hawaiian waters is calculated from the eastern North Pacific (Ferguson and Barlow, 2001, 2003).

D. **Fin whale**: A sighting in nearshore waters in February (Mobley et al., 1996) and acoustic data support the presence of fin whale during fall and winter in Hawaiian waters (Thompson and Friedl, 1982; Moore et al., 1998). From the five sightings reported during the 2002 summer/fall survey

(Barlow, 2003), an abundance estimate of 174 animals (CV=0.72) and a density of 0.0001 animals/km^2 fin whales was calculated for the Hawaii stock of fin whales (Carretta et al., 2013). This density 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 in this herein. 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 CNP 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 NWHI, with animals cycled through the breeding grounds with an average residency of approximately 30 to 45 days (Lammers et al., 2010). Based on the recent North Pacific humpback whale abundance updates from Calambokidis et al. (2008), the best available abundance estimate for the CNP 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 for the Hawaii sei whale stock 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 (Carretta et al., 2013). 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:** Blainville's beaked whales potentially occur in the deep waters of this mission area. 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). This 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 (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 an order of magnitude less than nearshore Hawaiian waters (0.0103 animals/km^2; Mobley et al., 2000).

Oahu stock: The Oahu stock's 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). This stock's 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: The best available density estimate (0.0013 animals/km^2) for this stock is calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006), while 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). This 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: The best available density estimate (0.0013 animals/km^2) for the Hawaii Island stock 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). Comparably, this 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. **Dwarf sperm whale**: Dwarf sperm whales are known in Hawaii from both strandings and sightings, with Mobley et al. (2000) having observed two pods of dwarf and pygmy sperm whales for a total of five individuals during his 1993 to 1998 survey efforts, although no density or abundance estimates were derived. Dwarf sperm whales were also observed near Niihau, Kauai, Lanai, and Hawaii during small boat surveys between 2000 and 2003 (Baird, 2005). The best available estimates for the Hawaiian stock of dwarf sperm whales are the density and abundance, 0.0029 animals/km2 and 17,519 animals, respectively, estimated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006).

K. **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 (MHI) and Pelagic stocks of false killer whales potentially occur in the Hawaii-South mission area.

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 (Carretta et al., 2013). The best available density estimate for the Hawaii pelagic stock, 0.0006 individuals/km^2, was also estimated from the 2010 dedicated survey of Hawaiian EEZ waters (Bradford et al., 2012).

Main Hawaiian Islands 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).

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

M. **Killer whale:** Killer whales are considered rare in Hawaii waters with limited sightings having been 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 MHI.

N. **Longman's beaked whale:** Longman's beaked whale has only recently been identified to species (Dalebout et al., 2003; Pitman et al.,1999) and is considered one of the rarest and least known of cetacean species. The best available density estimate (0.0004 animals/km^2) and abundance estimate (1,007 animals, CV=1.26) for the Hawaiian stock of this beaked whale were 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:** Recent 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), with 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. 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). However, at this point, NMFS recognizes only one stock of melon-headed whales, the Hawaiian stock, within the Hawaiian EEZ (Carretta et al., 2013). The best available density estimate (0.0012 animals/km^2) and abundance estimate (2,950 whales, CV=1.17) for the Hawaiian stock of melon-headed whales 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).

P. **Pantropical spotted dolphin:** Genetic analyses support the recognition of three island-associated stocks: a Hawaii Island Stock that extends 65 km (35 nmi) from shore, a 4-Islands Region Stock that extends 20 km (11 nmi) from shore, and an Oahu Stock that extends 20 km (11 nmi) 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 only 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). This 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 pygmy killer whales in the Hawaii region. Mobley et al. (2000) did not report any sightings in their surveys of waters of the MHI. 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) for the Hawaii stock of pygmy killer whales.

R. **Pygmy sperm whale**: Mobley et al. (2000) observed pygmy sperm whales during his 1993 to 1998 survey efforts, while two sightings were observed during Barlow's (2006) 2002 sighting survey; many strandings of this species are also recorded in Hawaiian waters (Carretta et al., 2013). A Hawaii stock of pygmy sperm whales is recognized (Carretta et al., 2013). The best available estimates for the Hawaiian stock of pygmy sperm whales is the density of 0.0071 animals/km^2 and the abundance 7,138 animals calculated from the summer/fall survey data in the Hawaii EEZ (Barlow, 2006; Carretta et al., 2013).

S. **Risso's dolphin:** A Hawaiian stock of Risso's dolphins is recognized, although this dolphin appears to occur rarely in the Hawaiian waters (Carretta et al., 2013). Mobley et al. (2000) observed insufficient sightings of Risso's dolphins to derive density or abundance estimates in nearshore waters. NMFS suggests that based on the locations of Hawaiian longline-fishery interactions of this species, 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). 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).

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

U. **Short-finned pilot whale:** Short-finned pilot whales occur both in the NWHI and the MHI, where they occur commonly, and a Hawaiian stock is recognized (Carretta et al., 2013). The best available density estimate (0.0036 animals/km^2) and abundance estimate (8,870 animals, CV=1.13) were calculated from the summer/fall survey in the Hawaii EEZ (Barlow, 2006). This density estimate is an order of magnitude less than near-shore Hawaiian waters (0.0237 animals/km^2; Mobley et al., 2000).

V. **Sperm whale**: Sperm whales are known from many strandings and sightings in Hawaiian waters, and 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). This density estimate is slightly higher but comparable to near-shore Hawaiian waters (0.0010 animals/km^2; Mobley et al., 2000).

W. **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). Three of the five Hawaii spinner dolphin stocks, the Hawaii Pelagic, Oahu/4 Islands, and Hawaii Island, are found within the Hawaii South mission area.

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 (0.0070 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). This 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: The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010). 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 (0.0070 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

Hawaii Island: The seaward boundary of the island-associated stocks is 18.5 km (10 nmi) around each island or island group (Hill et al., 2010). 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 (0.0070 animals/km^2) is from the 2002 summer/fall survey in the Hawaii EEZ (Barlow, 2006).

W. **Striped dolphin**: Striped dolphins in Hawaiian waters are separated into a discrete Hawaiian stock (Carretta et al., 2013). The best available density and abundance estimates for the Hawaiian stock of striped dolphins are 0.0054 animals/km^2 and 13,143 individuals (CV=0.46), respectively, as derived from the summer/fall surveys in the Hawaiian EEZ (Barlow, 2006). This 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 in the MHI 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 interactions 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. Percent and number of blue whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
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	1
10	Hawaii-North	2	CNP	9,250	0.14	14
11	Hawaii-South	2	CNP	9,250	0.08	9
Totals		**14**			**0.26**	**30**

19 Stock names: CNP=Central North Pacific; WNP=Western North Pacific; ECS=East China Sea; NP=North Pacific; SOJ=Sea of Japan; IA=Inshore Archipelago; NMI=Northern Mariana Islands

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

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

Table B2. Percent and number of Bryde's whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	20,501	0.03	7
2	North Philippine Sea	3	WNP	20,501	0.26	56
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	0.10	21
7	South China Sea	1	WNP	20,501	0.04	9
8	Offshore Japan (25° to 40°N)	1	WNP	20,501	0.04	9
9	Offshore Japan (10° to 25°N)	1	WNP	20,501	0.05	10
			Total WNP Stock		***0.98***	***213***
10	Hawaii-North	2	Hawaiian	469	3.56	18
11	Hawaii-South	2	Hawaiian	469	1.36	7
			Total Hawaiian Stock		***4.92***	***25***
Totals		**20**				**238**

Table B3. Percent and number of common minke whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP "O"	25,049	0.10	26
2	North Philippine Sea	3	WNP "O"	25,049	1.41	354
3	West Philippine Sea	3	WNP "O"	25,049	1.20	305
4	Offshore Guam	3	WNP "O"	25,049	0.08	20
5	Sea of Japan	2	WNP "O"	25,049	0.10	25
6	East China Sea	1	WNP "O"	25,049	0.61	154
7	South China Sea	1	WNP "O"	25,049	0.17	43
8	Offshore Japan (25° to 40°N)	1	WNP "O"	25,049	0.04	10
			Total WNP "O" Stock		***3.71***	***937***
5	Sea of Japan	2	WNP "J"	893	1.10	11
6	East China Sea	1	WNP "J"	893	2.64	24
7	South China Sea	1	WNP "J"	893	2.62	24
			Total WNP "J" Stock		***6.36***	***59***
10	Hawaii-North	2	Hawaiian	25,049	0.05	13
11	Hawaii-South	2	Hawaiian	25,049	0.03	7
			Total Hawaiian Stock		***0.08***	***20***
Totals		**23**				**1,016**

Table B4. Percent and number of fin whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	9,250	0.05	5
2	North Philippine Sea	3	WNP	9,250	0.09	8
3	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	0.77	73
7	South China Sea	1	WNP	9,250	0.04	4
8	Offshore Japan (25° to 40°N)	1	WNP	9,250	0.05	6
9	Offshore Japan (10° to 25°N)	1	WNP	9,250	0.01	1
			Total WNP Stock		***1.11***	***107***
6	East China Sea	1	ECS	500	1.48	8
			Total ECS Stock		**1.48**	**8**
10	Hawaii-North	2	Hawaiian	174	3.59	7
11	Hawaii-South	2	Hawaiian	174	2.25	5
			Total Hawaiian Stock		***5.84***	***12***
Totals		**20**				**127**

Table B5. Percent and number of humpback whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	1,107	6.89	78
3	West Philippine Sea	3	WNP	1,107	1.47	18
4	Offshore Guam	3	WNP	1,107	0.18	2
		Total WNP Stock			***8.54***	***98***
10	Hawaii-North	2	CNP	10,103	0.09	10
11	Hawaii-South	2	CNP	10,103	0.11	12
		Total CNP Stock			***0.20***	***22***
Totals		**13**				**120**

Table B6. Percent and number of North Pacific right whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	922	—[22]	—
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**

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

Table B7. Percent and number of Omura's whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	2,050	0.21	6
3	West Philippine Sea	3	WNP	2,050	0.40	7
4	Offshore Guam	3	WNP	2,050	0.30	5
5	Sea of Japan	2	WNP	2,050	0.03	2
6	East China Sea	1	WNP	2,050	0.10	3
7	South China Sea	1	WNP	2,050	0.06	1
9	Offshore Japan (10° to 25°N)	1	WNP	2,050	0.06	2
Totals		**14**			**1.16**	**26**

Table B8. Percent and number of sei whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	NP	8,600	0.07	7
4	Offshore Guam	3	NP	8,600	0.20	18
8	Offshore Japan (25° to 40°N)	1	NP	8,600	0.07	6
9	Offshore Japan (10° to 25°N)	1	NP	8,600	0.05	5
		Total NP Stock			***0.39***	***36***
10	Hawaii-North	2	Hawaiian	77	0.11	1
11	Hawaii-South	2	Hawaiian	77	0.69	2
		Total Hawaiian Stock			***0.80***	***3***
Totals		**10**				**39**

Table B9. Percent and number of Western Pacific gray whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
5	Sea of Japan	2	WNP	121	0.10	2
6	East China Sea	1	WNP	121	—[22]	—
7	South China Sea	1	WNP	121	0.31	1
Totals		**4**			**0.41**	**3**

Table B10. Percent and number of Baird's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	8,000	0.80	64
5	Sea of Japan	2	WNP	8,000	0.36	30
8	Offshore Japan (25° to 40°N)	1	WNP	8,000	0.04	3
Totals		**4**			**1.20**	**97**

Table B11. Percent and number of Blainville's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	8,032	0.36	31
3	West Philippine Sea	3	WNP	8,032	0.50	41
4	Offshore Guam	3	WNP	8,032	1.05	86
6	East China Sea	1	WNP	8,032	0.16	13
7	South China Sea	1	WNP	8,032	0.08	7
8	Offshore Japan (25° to 40°N)	1	WNP	8,032	0.07	16
9	Offshore Japan (10° to 25°N)	1	WNP	8,032	0.06	14
			Total WNP Stock		***2.28***	***208***
10	Hawaii-North	2	Hawaiian	2,872	3.70	107
11	Hawaii-South	2	Hawaiian	2,872	1.19	35
			Total Hawaiian Stock		***4.89***	***142***
Totals		**17**				**350**

Table B12. Percent and number of common bottlenose dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	168,791	0.11	189
2	North Philippine Sea	3	WNP	168,791	0.56	952
3	West Philippine Sea	3	WNP	168,791	0.77	1,292
4	Offshore Guam	3	WNP	168,791	0.05	98
8	Offshore Japan (25° to 40°N)	1	WNP	168,791	0.01	18
9	Offshore Japan (10° to 25°N)	1	WNP	168,791	0.01	24
			Total WNP Stock		***1.51***	***2,573***
5	Sea of Japan	2	IA	105,138	0.05	50
6	East China Sea	1	IA	105,138	0.02	26
7	South China Sea	1	IA	105,138	0.01	5
			Total IA Stock		***0.08***	***81***
10	Hawaii-North	2	Hawaii Pelagic	3,178	0.93	31
11	Hawaii-South	2	Hawaii Pelagic	3,178	0.96	32
			Total Hawaii Pelagic Stock		***1.89***	***63***
10	Hawaii-North	2	Kauaii/ Niihau	147	2.71	5
11	Hawaii-South	2	Oahu	594	0.03	2
11	Hawaii-South	2	4-Islands Region	153	0.12	2
11	Hawaii-South	2	Hawaii Island	102	0.60	2
Totals		**28**				**2,717**

Table B13. Percent and number of Cuvier's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	90,725	0.08	69
2	North Philippine Sea	3	WNP	90,725	0.34	312
3	West Philippine Sea	3	WNP	90,725	0.03	25
4	Offshore Guam	3	WNP	90,725	0.50	447
5	Sea of Japan	2	WNP	90,725	0.32	290
6	East China Sea	1	WNP	90,725	0.01	8
7	South China Sea	1	WNP	90,725	0.01	4
8	Offshore Japan (25° to 40°N)	1	WNP	90,725	0.09	86
9	Offshore Japan (10° to 25°N)	1	WNP	90,725	0.08	72
			Total WNP Stock		***1.46***	***1,313***
10	Hawaii-North	2	Hawaiian	15,242	3.70	566
11	Hawaii-South	2	Hawaiian	15,242	1.19	181
			Total Hawaiian Stock		***4.89***	***747***
Totals		**20**				**2,060**

Table B14. Percent and number of Dall's porpoises potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
5	Sea of Japan	2	SOJ	76,720	3.44	2,637
Totals		**2**			**3.44**	**2,637**

Table B15. Percent and number of false killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	16,668	0.50	84
2	North Philippine Sea	3	WNP	16,668	1.19	199
3	West Philippine Sea	3	WNP	16,668	1.58	264
4	Offshore Guam	3	WNP	16,668	0.46	78
8	Offshore Japan (25° to 40°N)	1	WNP	16,668	0.20	34
9	Offshore Japan (10° to 25°N)	1	WNP	16,668	0.11	18
			Total WNP Stock		***4.04***	***677***
5	Sea of Japan	2	IA	9,777	1.12	111
6	East China Sea	1	IA	9,777	0.32	32
7	South China Sea	1	IA	9,777	0.19	19
			Total IA Stock		***1.63***	***162***
10	Hawaii-North	2	Hawaii Pelagic	1,503	3.44	53
11	Hawaii-South	2	Hawaii Pelagic	1,503	0.98	16
			Total Hawaii Pelagic Stock		***4.42***	***98***
10	Hawaii-North	2	Main Hawaiian Islands Insular	151	0.22	2
10	Hawaii-North	2	North-western Hawaiian Islands Insular	552	0.02	2
11	Hawaii-South	2	Main Hawaiian Islands Insular	151	0.62	2
			Total Main Hawaiian Islands Insular Stock		***0.84***	***4***
Totals		**24**				**941**

Table B16. Percent and number of Fraser's dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	220,789	0.14	331
3	West Philippine Sea	3	WNP	220,789	0.18	383
4	Offshore Guam	3	WNP	10,226	2.97	304
6	East China Sea	1	WNP	220,789	0.06	139
7	South China Sea	1	WNP	220,789	0.03	60
9	Offshore Japan (10° to 25°N)	1	WNP	220,789	0.03	66
Total WNP Stock					***3.41***	***1,283***
10	Hawaii-North	2	Hawaiian	10,226	3.45	353
11	Hawaii-South	2	Hawaiian	10,226	1.23	128
Total Hawaiian Stock					***4.68***	***481***
Totals		**16**				**1,764**

Table B17. Percent and number of ginkgo-toothed beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	NP	22,799	0.13	31
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	69
6	East China Sea	1	NP	22,799	0.06	13
7	South China Sea	1	NP	22,799	0.03	7
Totals		**12**			**0.85**	**199**

Table B18. Percent and number of Hubbs' beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	NP	22,799	0.05	12
8	Offshore Japan (25° to 40°N)	1	NP	22,799	0.05	12
Totals		**2**			**0.10**	**24**

Table B19. Pecent and number of killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	12,256	0.01	2
2	North Philippine Sea	3	WNP	12,256	0.05	8
3	West Philippine Sea	3	WNP	12,256	0.07	10
4	Offshore Guam	3	WNP	12,256	0.07	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	0.03	5
9	Offshore Japan (10° to 25°N)	1	WNP	12,256	0.02	3
Total WNP Stock					***0.37***	***56***
10	Hawaii-North	2	Hawaiian	349	2.61	10
11	Hawaii-South	2	Hawaiian	349	1.16	5
Total Hawaiian Stock					***3.77***	***15***
Totals		**20**				**71**

Table B20. Percent and number of dwarf and pygmy sperm whales as well as *Kogia* spp. potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2015 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
***Kogia* spp.**						
1	East of Japan	1	WNP	350,553	0.02	65
2	North Philippine Sea	3	WNP	350,553	0.08	284
3	West Philippine Sea	3	WNP	350,553	0.05	166
5	Sea of Japan	2	WNP	350,553	0.04	137
6	East China Sea	1	WNP	350,553	0.02	61
7	South China Sea	1	WNP	350,553	0.01	31
Dwarf Sperm Whale						
4	Offshore Guam	3	WNP	350,553	0.14	531
8	Offshore Japan (25° to 40°N)	1	WNP	350,553	0.05	192
9	Offshore Japan (10° to 25°N)	1	WNP	350,553	0.03	119
10	Hawaii-North	2	Hawaiian	17,519	3.59	628
11	Hawaii-South	2	Hawaiian	17,519	1.61	283
Pygmy Sperm Whale						
8	Offshore Japan (25° to 40°N)	1	WNP	350,553	0.02	79
9	Offshore Japan (10° to 25°N)	1	WNP	350,553	0.01	49
4	Offshore Guam	3	WNP	350,553	0.07	217
10	Hawaii-North	2	Hawaiian	7,138	3.59	257
11	Hawaii-South	2	Hawaiian	7,138	1.61	116
Total WNP Stock Kogia spp.					***0.22***	***744***
Total WNP Stock Dwarf sperm whale					***0.22***	***842***
Total Hawaiian Stock Dwarf sperm whale					***5.20***	***911***
Total WNP Stock Pygmy sperm whale					***0.10***	***345***
Total Hawaiian Stock Pygmy sperm whale					***5.20***	***373***
Totals		**29**				**3,611**

Table B21. Percent and number of Longman's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	1,007	1.45	16
3	West Philippine Sea	3	WNP	1,007	2.03	22
4	Offshore Guam	3	WNP	1,007	2.92	31
6	East China Sea	1	WNP	1,007	0.63	7
7	South China Sea	1	WNP	1,007	0.92	10
8	Offshore Japan (25° to 40°N)	1	WNP	1,007	0.56	6
9	Offshore Japan (10° to 25°N)	1	WNP	1,007	0.47	5
Total WNP Stock					***8.98***	***97***
10	Hawaii-North	2	Hawaiian	1,007	3.61	38
11	Hawaii-South	2	Hawaiian	1,007	1.16	12
Total Hawaiian Stock					***4.77***	***50***
Totals		**17**				**147**

Table B22. Percent and number of melon-headed whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
2	North Philippine Sea	3	WNP	36,770	0.79	294
3	West Philippine Sea	3	WNP	36,770	1.05	390
6	East China Sea	1	WNP	36,770	0.33	122
7	South China Sea	1	WNP	36,770	0.19	71
8	Offshore Japan (25° to 40°N)	1	WNP	36,770	0.07	26
9	Offshore Japan (10° to 25°N)	1	WNP	36,770	0.23	84
				Total WNP Stock	***2.66***	***987***
4	Offshore Guam	3	NMI	2,455	5.37	135
				Total NMI Stock	**5.37**	**135**
10	Hawaii-North	2	Hawaiian	2,950	3.53	105
11	Hawaii-South	2	Hawaiian	2,950	1.01	31
				Total Hawaiian Stock	***4.54***	***136***
Totals		**17**				**1,258**

Table B23. Percent and number of *Mesoplodon* spp. potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
8	Offshore Japan (25° to 40°N)	1	WNP	22,799	0.05	12
Totals		1			**0.05**	**12**

Table B24. Percent and number of Pacific white-sided dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	**Name**					
1	East of Japan	1	WNP	931,000	0.01	41
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	—[22]	—
8	Offshore Japan (25° to 40°N)	1	WNP	931,000	0.01	91
			Total WNP Stock		***0.09***	***775***
			Total IA Stock		***0.01***	***119***
Totals		**8**				**894**

Table B25. Percent and number of pantropical spotted dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	438,064	0.02	90
2	North Philippine Sea	3	WNP	438,064	0.22	984
3	West Philippine Sea	3	WNP	438,064	0.27	1,190
4	Offshore Guam	3	WNP	438,064	0.39	1,666
8	Offshore Japan (25° to 40°N)	1	WNP	438,064	0.04	175
9	Offshore Japan (10° to 25°N)	1	WNP	438,064	0.08	346
			Total WNP Stock		***1.02***	***4,451***
6	East China Sea	1	IA	219,032	0.18	400
7	South China Sea	1	IA	219,032	0.06	142
			Total IA Stock		***0.24***	***542***
10	Hawaii-North	2	Hawaiian	8,978	3.47	312
11	Hawaii-South	2	Hawaiian	8,978	0.81	74
			Total Hawaiian Stock		***4.28***	***386***
Totals		**18**				**5,379**

Table B26. Percent and number of pygmy killer whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	30,214	0.16	49
2	North Philippine Sea	3	WNP	30,214	0.47	144
3	West Philippine Sea	3	WNP	30,214	0.63	191
4	Offshore Guam	3	WNP	30,214	0.03	12
6	East China Sea	1	WNP	30,214	0.01	4
7	South China Sea	1	WNP	30,214	0.01	3
8	Offshore Japan (25° to 40°N)	1	WNP	30,214	0.01	1
9	Offshore Japan (10° to 25°N)	1	WNP	30,214	0.01	2
Total WNP Stock					***1.33***	***406***
10	Hawaii-North	2	Hawaiian	956	3.61	35
11	Hawaii-South	2	Hawaiian	956	1.03	11
Total Hawaiian Stock					***4.64***	***46***
Totals		**18**				**452**

Table B27. Percent and number of Risso's dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	83,289	0.23	192
2	North Philippine Sea	3	WNP	83,289	1.11	931
3	West Philippine Sea	3	WNP	83,289	1.20	1,007
4	Offshore Guam	3	WNP	83,289	0.10	75
8	Offshore Japan (25° to 40°N)	1	WNP	83,289	0.02	19
9	Offshore Japan (10° to 25°N)	1	WNP	83,289	0.01	12
Total WNP Stock					***2.67***	***2,236***
5	Sea of Japan	2	IA	83,289	0.67	558
6	East China Sea	1	IA	83,289	0.43	356
7	South China Sea	1	IA	83,289	0.21	173
Total IA Stock					***1.31***	***1,087***
10	Hawaii-North	2	Hawaiian	2,372	3.74	90
11	Hawaii-South	2	Hawaiian	2,372	1.45	35
Total Hawaiian Stock					***5.19***	***125***
Totals		**20**				**3,448**

Table B28. Percent and number of rough-toothed dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	145,729	0.10	149
2	North Philippine Sea	3	WNP	145,729	0.37	542
3	West Philippine Sea	3	WNP	145,729	0.41	590
4	Offshore Guam	3	WNP	145,729	0.17	254
5	Sea of Japan	2	WNP	145,729	0.21	303
6	East China Sea	1	WNP	145,729	0.08	117
7	South China Sea	1	WNP	145,729	0.04	61
8	Offshore Japan (25° to 40°N)	1	WNP	145,729	0.06	88
9	Offshore Japan (10° to 25°N)	1	WNP	145,729	0.03	44
			Total WNP Stock		***1.47***	***2,148***
10	Hawaii-North	2	Hawaiian	8,709	3.67	321
11	Hawaii-South	2	Hawaiian	8,709	1.57	137
			Total Hawaiian Stock		***5.24***	***458***
Totals		**20**				**2,606**

Table B29. Percent and number of short-beaked common dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	3,286,163	0.04	1,367
2	North Philippine Sea	3	WNP	3,286,163	0.12	3,700
5	Sea of Japan	2	WNP	3,286,163	0.18	6,035
6	East China Sea	1	WNP	3,286,163	0.05	1,503
8	Offshore Japan (25° to 40°N)	1	WNP	3,286,163	0.10	3,365
Totals		**8**			**0.49**	**15,970**

Table B30. Percent and number of short-finned pilot whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area: Number	Mission Area: Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	53,608	0.28	151
2	North Philippine Sea	3	WNP	53,608	2.00	1,078
3	West Philippine Sea	3	WNP	53,608	1.34	720
4	Offshore Guam	3	WNP	53,608	0.55	293
5	Sea of Japan	2	WNP	53,608	0.17	90
6	East China Sea	1	WNP	53,608	0.10	53
7	South China Sea	1	WNP	53,608	0.04	23
8	Offshore Japan (25° to 40°N)	1	WNP	53,608	0.14	75
9	Offshore Japan (10° to 25°N)	1	WNP	53,608	0.12	63
			Total WNP Stock		***4.74***	***2,546***
10	Hawaii-North	2	Hawaiian	8,870	3.66	326
11	Hawaii-South	2	Hawaiian	8,709	1.11	100
			Total Hawaiian Stock		***4.77***	***426***
Totals		**20**				**2,972**

Table B31. Percent and number of sperm whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	NP	102,112	0.02	24
2	North Philippine Sea	3	NP	102,112	0.09	90
3	West Philippine Sea	3	NP	102,112	0.10	108
4	Offshore Guam	3	NP	102,112	0.09	98
5	Sea of Japan	2	NP	102,112	0.12	120
6	East China Sea	1	NP	102,112	0.03	30
7	South China Sea	1	NP	102,112	0.01	13
8	Offshore Japan (25° to 40°N)	1	NP	102,112	0.05	49
9	Offshore Japan (10° to 25°N)	1	NP	102,112	0.04	42
Total North Pacific Stock					***0.55***	***574***
10	Hawaii-North	2	Hawaiian	6,919	3.23	224
11	Hawaii-South	2	Hawaiian	6,919	1.06	74
Total Hawaiian Stock					***4.29***	***298***
Totals		**20**				**872**

Table B32. Percent and number of spinner dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area Number	Mission Area Name	Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
1	East of Japan	1	WNP	1,015,059	0.01	3
2	North Philippine Sea	3	WNP	1,015,059	0.01	61
3	West Philippine Sea	3	WNP	1,015,059	0.01	73
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	25
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	29
9	Offshore Japan (10° to 25°N)	1	WNP	1,015,059	0.01	58
Total WNP Stock					***0.09***	***329***
10	Hawaii-North	2	Hawaii Pelagic	3,351	0.88	30
11	Hawaii-South	2	Hawaii Pelagic	3,351	0.62	22
Total Hawaii Pelagic Stock					***1.50***	***52***
10	Hawaii-North	2	Kauai/ Niihau	601	0.02	2
10	Hawaii-North	2	Kure/ Midway	260	0.02	2
10	Hawaii-North	2	Pearl and Hermes Reef	300	0.02	2
11	Hawaii-South	2	Oahu/4-Islands	355	0.06	2
11	Hawaii-South	2	Hawaii Island	790	0.02	2
Totals		**30**				**391**

Table B33. Percent and number of Stejneger's beaked whales potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
5	Sea of Japan	2	WNP	8,000	0.58	48
Totals		**2**			**0.58**	**48**

Table B34. Percent and number of striped dolphins potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
1	East of Japan	1	WNP	570,038	0.01	39
2	North Philippine Sea	3	WNP	570,038	0.42	2,362
3	West Philippine Sea	3	WNP	570,038	0.25	1,425
4	Offshore Guam	3	WNP	570,038	0.07	454
8	Offshore Japan (25° to 40°N)	1	WNP	570,038	0.02	90
9	Offshore Japan (10° to 25°N)	1	WNP	570,038	0.03	179
			Total WNP Stock		***0.80***	***4,549***
5	Sea of Japan	2	IA	570,038	0.05	289
6	East China Sea	1	IA	570,038	0.03	170
7	South China Sea	1	IA	570,038	0.01	61
			Total IA Stock		***0.09***	***520***
10	Hawaii-North	2	Hawaiian	13,143	3.47	457
11	Hawaii-South	2	Hawaiian	13,143	0.81	108
			Total Hawaiian Stock		***4.28***	***565***
Totals		**20**				**5,634**

Table B35. Percent and number of Hawaiian monk seals potentially exposed to SURTASS LFA sonar in the western and central North Pacific Ocean during 15 August 2014 to 14 August 2015.

Mission Area		Number of Missions Estimated in Each Mission Area	Stock[19]	Number Individuals in Stock	Percent Stock Affected 120 to 180 dB[20]	Number Individuals Affected 120 to 180 dB[21]
Number	Name					
8	Offshore Japan (25° to 40°N)	1	Hawaiian	1,212	0.04	1
10	Hawaii-North	2	Hawaiian	1,212	0.80	10
11	Hawaii-South	2	Hawaiian	1,212	0.28	5
Totals		**5**			**1.12**	**16**