

ANNUAL REPORT 5: SURTASS LFA SONAR OPERATIONS ONBOARD USNS VICTORIOUS, USNS ABLE, USNS EFFECTIVE, AND USNS IMPECCABLE DURING 2016 TO 2017



**DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS**

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LIST OF ACRONYMS AND ABBREVIATIONS

μ	micro
CEE	controlled exposure experiment
CFR	Code of Federal Regulations
CLFA	Compact Low Frequency Active
CNO	Chief of Naval Operations
CNP	Central North Pacific
dB	decibel(s)
dB re 1 μPa @ 1 m	decibel(s) relative to one microPascal at one meter from center of acoustic source
DoN	Department of the Navy
DPS	distinct population segment
ECS	East China Sea
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ft	foot/feet
HF	high frequency
HF/M3	High Frequency Marine Mammal Monitoring (sonar)
HLA	horizontal line array
hr	hour(s)
Hz	Hertz
IA	Inshore Archipelago
ITS	incidental take statement
km	kilometer(s)
kph	kilometer(s) per hour
kt	knot(s)
LF	low frequency
LFA	Low Frequency Active
LOA	Letter of Authorization
m	meter(s)
M3	Marine Mammal Monitoring
MILCREW	military crew
min	minute(s)

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MMPA	Marine Mammal Protection Act
NEPA	National Environmental Policy Act
nmi	nautical mile(s)
NMFS	National Marine Fisheries Service
NMI	Northern Mariana Islands
NP	North Pacific
OBIA	Offshore Biologically Important Area
OEIS	Overseas Environmental Impact Statement
OIC	Officer in Charge
Pa	Pascal
RL	received level
rms	root mean square
ROD	Record of Decision
SAG	Scientific Advisory Group
SCS	South China Sea
sec	second(s)
SEIS/SOEIS	Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement
SEL	sound exposure level
SL	source level
SOJ	Sea of Japan
SPE	single ping equivalent
SPL	sound pressure level
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Tactical Auxiliary General Ocean Surveillance (vessel)
U.S.	United States of America
U.S.C.	United States Code
USNS	United States Naval Ship
WNP	Western North Pacific
yd	yard(s)
yr	year(s)

1 PURPOSE

As a requirement of the Marine Mammal Protection Act (MMPA) Final Rule (50 CFR 218 Subpart X) (NOAA, 2012) and the annual Letters of Authorization (NOAA, 2016; Appendix A) for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar, this annual report provides an unclassified summary of SURTASS LFA¹ sonar operations onboard the United States Naval Ship (USNS) VICTORIOUS (Tactical Auxiliary General Ocean Surveillance [T-AGOS] 19) (Figure 1), USNS ABLE (T-AGOS 20), USNS EFFECTIVE (T-AGOS 21), and USNS IMPECCABLE (T-AGOS 23) for the annual effective period 15 August 2016 through 14 August 2017. This annual report has been prepared in accordance with the requirements of the MMPA Final Rule 50 CFR § 218.236(b) (NOAA, 2012), Condition 13(f) of the annual Letters of Authorization (LOAs) (NMFS, 2016; Appendix A), and Condition 6 of the Incidental Take Statement (ITS) (NMFS, 2016) for SURTASS LFA sonar issued by the National Marine Fisheries Service (NMFS).



Figure 1. SURTASS LFA Sonar Vessel, USNS VICTORIOUS (T-AGOS 19).

The purpose of this annual report is to provide NMFS and the public with:

1. An unclassified summary of the SURTASS LFA sonar operations over the annual effective period and synopses the quarterly mission reports,
2. Estimates of the percentages of marine mammals stocks affected by SURTASS LFA sonar transmissions from all SURTASS LFA sonar vessels during the annual effective period,

1 In this annual report, “SURTASS LFA sonar systems” refers to both the LFA and compact LFA (CLFA) systems, each having similar acoustic transmission characteristics.

3. Analysis of the effectiveness of the mitigation measures employed for SURTASS LFA sonar,
4. Assessment of any discernible long-term effects and estimated cumulative impacts on marine mammals associated with operation of SURTASS LFA sonar.

This report demonstrates the Navy's conformance to the Conditions of the annual LOAs under the MMPA (Appendix A) as well as the Terms and Conditions of the ITS under the Endangered Species Act (ESA) (NMFS, 2016) for employment of SURTASS LFA sonar in authorized mission areas.

2 SURTASS LFA SONAR SYSTEM

The SURTASS LFA sonar system is comprised of a passive acoustic component, SURTASS, and an active sonar component, LFA (Figure 2). 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, which travels at a speed of about 3 knots (kt) (5.6 kilometers per hour [kph]) when towing the SURTASS LFA sonar system.

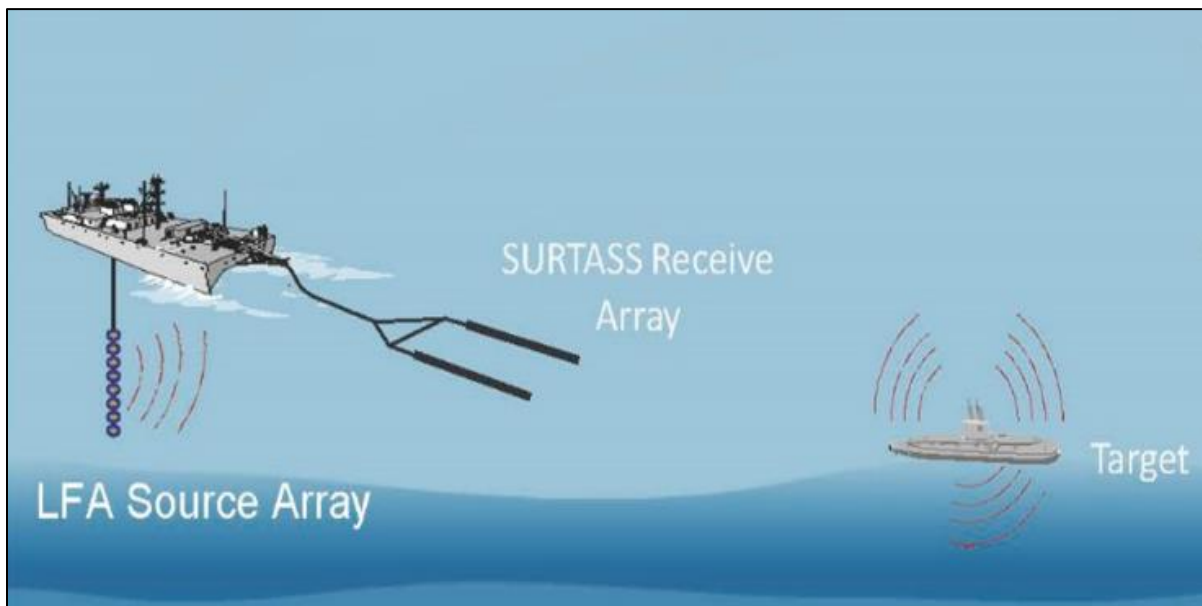


Figure 2. Schematic of a SURTASS LFA Sonar System Illustrating the Locations Relative to the T-AGOS Vessel of the Passive SURTASS Horizontal Line Array of Hydrophones and the Vertical Line Array of LFA Sonar Projectors as well as a Potential Target Submarine.

The LFA sonar source is a vertical line array (VLA), composed of up to 18 source projectors, that is suspended beneath the SURTASS LFA sonar 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 μ Pa @ 1 m) (root mean square [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 wavetrain or ping is a complete sequence of sonar sound transmissions. These sonar pings have durations of 6 to 100 seconds (sec), with an average duration of 60 sec but no more than a duration of 10 sec at any single

References to Underwater Sound Levels

- References to underwater sound pressure level (SPL) in this report are values given in decibels (dBs), and are assumed to be standardized at 1 microPascal at 1 m (root mean square) (dB re 1 μ Pa at 1 m [rms]) for source level (SL) and dB re 1 μ Pa (rms) for received level (RL), unless otherwise stated (Urlick, 1983; ANSI, 2006).
- Underwater sound exposure level (SEL) is a measure of energy, specifically the squared instantaneous pressure integrated over time; the appropriate units for SEL are dB re 1 μ Pa²-sec (Urlick, 1983; ANSI, 2006; Southall et al., 2007).
- The term “Single Ping Equivalent” (SPE) used herein is an intermediate calculation for input to the risk continuum used in the acoustic impact analysis for SURTASS LFA sonar. SPE accounts for the energy of all LFA sonar transmissions that a modeled animal (“animat”) receives during a 24-hr period of a SURTASS LFA sonar mission as well as an approximation of the manner in which the effect of repeated exposures accumulate. As such, the SPE metric incorporates both physics and biology. Calculating the potential risk from exposure to SURTASS LFA sonar is a complex process and the reader is referred to the Navy’s 2012 Supplemental Environmental Impact Statements (DoN, 2012) for details on the analytical process. SPE levels will be expressed as “dB SPE” in this document.
- Briefly, SPE accounts for the increased potential for behavioral response due to repeated exposures by adding $5 \times \log_{10}$ (number of pings) to each 1-dB RL increment (Kryter, 1985; Richardson et al., 1995; Ward, 1968). This calculation is done for each dB level of RL and then summed across all dB levels to determine the dB SPE for that animal.

frequency. The time between sonar ping transmissions is typically 6 to 15 minutes. The average duty cycle (ratio of sound “on” time to total time) is less than 20 percent, with a typical duty cycle, based on LFA operational parameters since 2003, ranging nominally between 7.5 to 10 percent.

3 OPERATIONAL REQUIREMENTS

The Navy is authorized to operate SURTASS LFA sonar during routine training, testing, and military operations such that underwater sound transmitted by SURTASS LFA sonar systems is between 100 and 500 Hz with a SL of no more than 215 dB re 1 μ Pa @ 1 m (rms) for each of the 18 LFA sonar projectors and a maximum duty cycle of 20 percent. Each SURTASS LFA sonar vessel is authorized to transmit up to 432 hours (hr) per annual period.

Under the NMFS 2012 MMPA Final Rule (50 CFR Part 218, Subpart X), the Navy is authorized to conduct routine SURTASS LFA sonar training, testing, and military operations in the oceanic areas of the Pacific, Atlantic, and Indian Oceans, and the Mediterranean Sea. Additionally, the Navy does not conduct SURTASS LFA sonar operations in polar waters. Taking of marine mammals is authorized for non-lethal Level A and Level B harassment within 15 geographic mission areas of the western and central North Pacific Ocean as well as Indian Ocean (Table 1), but takes by Level B incidental harassment cannot exceed 12 percent of any marine mammal stock per annual period (LOAs Condition 6).

Table 1. Fifteen Sonar Mission Areas for SURTASS LFA Sonar in the Indian Ocean as well as the Western and Central North Pacific Ocean.

<i>Mission Area Number</i>	<i>SURTASS LFA Mission Area</i>
<i>Western North Pacific Ocean</i>	
1	East of Japan
2	North Philippine Sea
3	West Philippine Sea
4	Offshore Guam
5	Sea of Japan
6	East China Sea
7	South China Sea
8	Offshore Japan (25° to 40° N)
9	Offshore Japan (10° to 25° N)
15	Northeast of Japan
<i>Central North Pacific Ocean</i>	
10	Hawaii North
11	Hawaii South
<i>Indian Ocean</i>	
12	Arabian Sea
13	Andaman Sea
14	Northwest of Australia

Transmission of SURTASS LFA sonar is restricted in certain geographic areas including the coastal standoff range, offshore biologically important areas (OBIAs), and known human diver locations, wherein the sound field generated by LFA sonar cannot exceed specific received levels. SURTASS LFA sonar transmissions cannot exceed 180 dB re 1 μ Pa (rms) in the coastal standoff range, which is the area within 12 nautical miles (nmi) (22 kilometers [km]) of any emergent land (regardless of size and including islands) (LOA Condition 8(h)(i)) or within 0.54 nmi (1 km) of the outer perimeter of any OBIA (LOA Condition 8h(ii)). In addition, the received sonar sound field at recreational dive sites cannot exceed 145 dB re 1 μ Pa (rms).

Mitigation monitoring measures include visual, passive acoustic, and active acoustic (high frequency marine mammal monitoring [HF/M3] sonar) monitoring to prevent injury to marine mammals or sea turtles when SURTASS LFA sonar is transmitting. These monitoring mitigation measures provide the means to detect marine mammals or sea turtles within proximity to the transmitting LFA sonar (i.e., in the mitigation zone for SURTASS LFA sonar) so that the LFA sonar transmissions can be delayed or suspended to prevent any marine mammal being subjected to a sound pressure level (SPL) of 180 dB re 1 μ Pa (rms) or greater. Additional details of the comprehensive program of preventative measures for SURTASS LFA sonar follow.

4 MITIGATION REQUIREMENTS

Mitigation protocols, operational restrictions, and mitigation monitoring requirements under which the Navy is authorized to operate SURTASS LFA sonar were set forth in the 2012 Record of Decision (ROD; DoD, 2012), MMPA Final Rule (NOAA, 2012), and in the annual LOAs (Appendix A). The goal of the complete suite of mitigation and monitoring measures required for the employment of SURTASS LFA sonar is to minimize, to the greatest extent practicable, adverse impacts on marine mammal species, stocks, or their habitat. The objectives of this goal are met through geographical restrictions on LFA sonar employment; maintenance of a mitigation and buffer zone around the transmitting LFA sonar source; monitoring by visual (daylight hours only), passive acoustics, and active acoustics whenever LFA sonar is transmitting; ramp-up procedures for the HF/M3 sonar system; suspension or delay of LFA sonar transmissions when marine mammals or sea turtles are detected in the mitigation or buffer zones; and mission planning.

4.1 GEOGRAPHIC RESTRICTIONS

As previously noted, geographic restrictions for the use of SURTASS LFA sonar require that the RL of the sound field transmitted by LFA sonar remain below 180 dB re 1 μ Pa (rms) in the coastal standoff range for SURTASS LFA sonar, which encompasses the distance within 12 nmi (22 km) of any emergent land, including islands, and within 0.54 nmi (1 km) from the outer perimeter of designated OBIA's for SURTASS LFA sonar (Table 2). During military operations, however, SURTASS LFA sonar transmissions may exceed 180 dB re 1 μ Pa (rms) within the boundaries of SURTASS LFA sonar OBIA's when: 1) operationally necessary to continue tracking an existing underwater contact; or 2) operationally necessary to detect a new underwater contact within the OBIA (50 CFR 218.234(g)(1) and LOA Condition 8h(i)).

OBIA's are areas of the world's oceans that are located outside the coastal standoff range where marine mammals aggregate to conduct biologically important activities such as breeding/calving, foraging, or migration. The Navy and NMFS designated 22 marine mammal OBIA's for SURTASS LFA sonar in 2012 (NOAA, 2012) (Table 2). Additionally, as part of the preparation for the Navy's 2017 SEIS/SOEIS for SURTASS LFA sonar, the Navy and NMFS identified several marine areas for consideration as OBIA's, including three proposed marine areas located within the mission areas authorized under the 2016 to 2017 LOAs. Although the OBIA designation process for these areas had not been completed, the Navy agreed to treat these three marine areas as OBIA's during the 2016 to 2017 LOA annual period and would not transmit LFA sonar above a received level of 180 dB SPL (rms) within 0.54 nmi (1 km) of the boundary of these potential OBIA's during the periods of biologically important activities, pending a final decision on their designation (NOAA, 2012).

4.2 MITIGATION AND BUFFER ZONE

The mitigation zone for SURTASS LFA sonar encompasses an ocean volume ensonified to a RL greater than 180 dB re 1 μ Pa (rms) by LFA sonar transmissions. Based on spherical spreading, this zone will vary between the nominal horizontal ranges of 0.40 to 0.54 nmi (0.75 to 1.0 km) over a depth of approximately 25 to 515 feet (ft) (87 to 157 meters [m]) from the LFA sonar source array, with the center of the LFA sonar source array located at an approximate depth of 400 ft (122 m) below the sea surface. Under rare environmental conditions (e.g., strong acoustic duct), this range could be somewhat greater than 0.54 nmi (1 km). Knowledge of local environmental conditions (such as sound speed profiles [depth versus sound speed] and sea state) that affect sound propagation is critical to maintaining the appropriate mitigation zone distance.

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Table 2. SURTASS LFA Sonar Offshore Biologically Important Areas (OBIA)s for Marine Mammals and the Period When Biologically Significant Behavior Occurs.

<i>OBIA Number</i>	<i>OBIA</i>	<i>Period of Effectiveness</i>
1	Georges Bank	Year-round
2	Roseway Basin Right Whale Conservation Area	June through December, annually
3	Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank NMS	January 1 to November 14, annually; year-round for Stellwagen Bank NMS
4	Southeastern U.S. Right Whale Seasonal Habitat	November 15 to April 15, annually
5	North Pacific Right Whale Critical Habitat	March through August, annually
6	Navidad Bank	December through April, annually
7	Coastal waters of Gabon, Congo and Equatorial Guinea	June through October, annually
8	Patagonian Shelf Break	Year-round
9	Southern Right Whale Seasonal Habitat	May through December, annually
10	Central California National Marine Sanctuaries	June through November, annually
11	Antarctic Convergence	October through March, annually
12	Piltun and Chayvo Offshore Feeding Grounds in the Sea of Okhotsk	June through November, annually
13	Coastal waters off Madagascar	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales
14	Madagascar Plateau, Madagascar Ridge, and Walters Shoal	November through December, annually
15	Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary in the Mediterranean Sea	July to August, annually
16	Hawaiian Islands Humpback Whale NMS and Penguin Bank	November through April, annually
17	Costa Rica Dome	Year-round
18	Great Barrier Reef between 16° S and 21° S	May through September, annually
19	Bonney Upwelling off the southern coast of Australia	December through May, annually
20	Northern Bay of Bengal and Head of Swatch-of-No-Ground	Year-round
21	Olympic Coast NMS, The Prairie, Barkley Canyon, and Nitinat Canyon	Olympic NMS: December, January, March, April, and May, annually; The Prairie, Barkley Canyon, and Nitinat Canyon: June through September, annually
22	Abrolhos Bank	August through November, annually

Thus, it is necessary to determine the distance to the 180-dB rms isopleth (radius of the LFA mitigation zone) from the LFA sonar source during SURTASS LFA sonar missions. Local marine environmental data and underwater acoustic prediction models are used to determine the propagation of the LFA sonar signal in real-time. These sound field estimates are completed prior to and during LFA sonar transmissions. The propagation of the LFA sonar sound field is updated at least every 12 hours, if not more frequently, as meteorological or oceanographic (environmental) conditions vary (LOA Condition 8[c]). If the sound field analysis indicates that the distance to the 180-dB re 1 μ Pa isopleth (i.e., radius of the mitigation zone) has changed, the Officer in Charge (OIC) of the military crew (MILCREW) aboard the SURTASS LFA sonar vessels notifies the pertinent crewmembers conducting visual and acoustic mitigation monitoring so that their monitoring procedures incorporate the correct distance for the LFA mitigation zone.

To further minimize the potential for injury to marine mammals, per the 2012 MMPA Final Rule and annual LOAs, NMFS requires a 0.54-nmi (1-km) buffer zone in addition to the LFA mitigation zone. Thus, monitoring for marine mammal or sea turtle presence is conducted in the mitigation plus the buffer zones during LFA sonar transmissions. If a marine mammal or sea turtle is detected by any of the three types of monitoring procedures, LFA sonar transmissions are suspended or delayed. While the implementation of this additional buffer zone has proven to be practicable under current operations, the Navy's analysis indicates that adverse impacts below 180-dB re 1 μ Pa (rms) RL are not minimized appreciably (DoN, 2007).

4.3 RAMP-UP PROCEDURES FOR HF/M3 SONAR

Prior to transmission of SURTASS LFA sonar for any purpose, the power level of the HF/M3 sonar system is ramped up over a period of no less 5 minutes from the maximum starting SL of 180 dB re 1 μ Pa @ 1 m (rms) (SPL) in 10-dB increments until the operating level is attained. This ramp-up of the HF/M3 sonar system ensures that there are no inadvertent exposures of marine mammal or sea turtles close to the SURTASS LFA sonar vessel to RLs greater or equal to 180 dB re 1 μ Pa (rms) from the HF/M3 sonar. This ramp-up procedure is conducted at least 30 minutes prior to any SURTASS LFA sonar transmission, prior to LFA sonar calibrations or testing that are not part of regular LFA sonar transmissions, and any time the HF/M3 sonar has been powered down for more than two minutes.

If a marine mammal is detected during the ramp-up procedure, the SPL of the HF/M3 sonar cannot be increased. Once marine mammals are no longer detected by visual or passive acoustic monitoring, the HF/M3 ramp-up process may resume.

4.4 SUSPENSION OR DELAY OF SURTASS LFA SONAR SIGNALS

If a marine mammal or sea turtle are detected within the mitigation and buffer zones, SURTASS LFA sonar transmissions are immediately suspended or delayed. LFA sonar transmissions can only resume/commence when no further detections of marine mammals or sea turtles within the LFA mitigation and buffer zones has occurred for 15 minutes.

4.5 MISSION PLANNING

The Navy must ensure that no more 12 percent of any marine mammal stock is taken by MMPA Level B harassment during the annual LOA period for SURTASS LFA sonar. To accomplish this requirement, the Navy coordinates the mission planning for the SURTASS LFA sonar vessels and mission areas in which they operate and maintains a running total of the percentage of each marine mammal stock taken by

MMPA Level B harassment by all LFA sonar operations associated with all four SURTASS LFA sonar vessels.

4.6 MITIGATION MONITORING TO PREVENT INJURY TO MARINE ANIMALS

The purpose of mitigation monitoring is to ensure, to the greatest extent practicable, that no marine mammal is subjected to a sound pressure level of 180 dB re 1 μ Pa (rms) or greater. In accordance with the Navy's 2012 ROD (DoD, 2012), 2012 MMPA Final Rule (50 CFR §218.235) (NOAA, 2012), and LOA conditions 9 and 10, three types of mitigation monitoring (Table 3) are conducted onboard SURTASS LFA sonar vessels when LFA sonar is transmitting:

- **Visual monitoring** from the bridge of the SURTASS LFA sonar vessel during daylight hours by personnel trained to detect and identify marine mammals using standard (7x) binoculars and the naked eye;
- **Passive acoustic monitoring** using the passive low-frequency (LF) SURTASS array to listen for sounds (vocalizations) generated by marine mammals as an indicator of their presence; and
- **Active acoustic monitoring** using the HF/M3 sonar, which is a Navy-developed, enhanced HF commercial sonar used to detect, locate, and track marine mammals (and sometimes sea turtles).

Monitoring must commence at least 30 minutes before the first SURTASS LFA sonar transmissions are initiated, continue between sonar transmissions (pings), and persist until 15 minutes after the completion of SURTASS LFA sonar transmissions (or 30 minutes after sunset for visual monitoring) or until such time as marine mammals showing abnormal behavioral patterns return to normal or conditions prevent continued observations.

Additionally, marine mammal biologists qualified in conducting visual at-sea monitoring for marine mammals are required to train the personnel of SURTASS LFA sonar vessels designated to conduct visual monitoring. These crewmembers are trained in conducting at-sea visual monitoring and in effectively communicating information about their visual detections within their command structure.

5 MONITORING AND REPORTING REQUIREMENTS

5.1 MONITORING

In addition to designating qualified personnel to conduct the mitigation, monitoring, and reporting required by the MMPA rulemaking and annual LOAs for SURTASS LFA sonar employment, the Navy also cooperates with NMFS and other Federal agencies in monitoring the impacts potentially associated with SURTASS LFA sonar activities. Further, the Navy is tasked with conducting four types of monitoring actions designed to increase the knowledge of affected marine mammal species or their environment.

5.1.1 Consider Research and Monitoring Recommendations on Potential Effects to Beaked Whales and/or Harbor Porpoises

To increase understanding of how harbor porpoises and beaked whale species might respond behaviorally and physiologically when exposed to SURTASS LFA sonar transmissions, the 2012 MMPA rulemaking for SURTASS LFA sonar employment (NOAA, 2012) and annual LOAs charged the Navy with assessing different types of monitoring and research that might address this goal. The Navy was to prepare an action plan outlining their strategy for implementing monitoring or research to address these taxa's responses to LFA sonar exposure or describe, in writing, why none of the research or monitoring recommendations were feasible.

Table 3. Summary of Mitigation Monitoring Measures to Prevent Injury to Marine Mammals Whenever SURTASS LFA Sonar is Transmitting.

Mitigation Monitoring Measure	Criteria	Actions
Visual Monitoring	Marine mammal or sea turtle observed outside the LFA mitigation zone plus 1-km (0.54-nmi) buffer zone	MILCREW OIC notified and animals tracked for possible intersection with mitigation/buffer zone
	Marine mammal or sea turtle sighted inside the LFA mitigation zone plus 1-km (0.54-nmi) buffer zone	SURTASS LFA sonar transmissions immediately delayed/suspended
Passive Acoustic Monitoring	Marine mammal vocalizations detected in the LFA mitigation zone plus 1-km (0.54-nmi) buffer zone	MILCREW OIC notified; SURTASS LFA sonar transmissions immediately delayed/suspended
Active Acoustic (HF/M3) Monitoring	Valid detection of marine mammal or sea turtle determined to have a track that would pass within the LFA mitigation zone plus 1-km (0.54-nmi) buffer zone	MILCREW OIC notified and animals tracked for possible intersection with mitigation/buffer zone
	Potentially affected marine mammal or sea turtle detected inside the LFA mitigation zone plus 1-km (0.54-nmi) buffer zone	SURTASS LFA sonar transmissions immediately delayed/suspended

5.1.2 Assessment of Data Generated by Marine Mammal Monitoring (M3) Program

Condition 12b of the LOAs for SURTASS LFA sonar requires the Navy to continue assessing data acquired and compiled by the Marine Mammal Monitoring (M3) program and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on the M3 data that are determined to be unclassified after appropriate security reviews are to be made publicly available. The Navy's M3 program entails the use of Navy static and mobile passive acoustic systems to detect, identify, and track marine mammal species and the movements of individuals or groups of cetaceans, often over long periods.

5.1.3 Use of SURTASS for Passive Acoustic Monitoring

Since the SURTASS component is such an effective passive acoustic monitoring system, as a condition of the annual LOAs (Condition 12[c]) and Final Rule, NMFS has requested that the Navy continue to explore the feasibility to use the SURTASS towed HLA with other Navy assets or range monitoring programs to augment the collection of data on marine mammal vocalizations prior to, during, or after Navy exercises.

5.1.4 Collection of Ambient Noise Data

Ambient noise is the typical or persistent background noise that is present in the marine environment. Ambient noise is broadband in all frequencies and directional both horizontally and vertically. Under LOA condition 12(d), the Navy is to continue collecting data on ambient underwater noise and explore the feasibility of declassifying and archiving the data for future incorporation into oceanic underwater noise budgets and databases.

5.2 REPORTING REQUIREMENTS

During routine training, testing, and military operations of SURTASS LFA sonar, technical and environmental data are collected and recorded, including data on visual and acoustic monitoring, ocean environmental measurements, and sonar transmission data. As stipulated in the MMPA Final Rule and LOAs, the following reporting for SURTASS LFA sonar is required as part of the Navy's authorizations:

- Quarterly classified and unclassified mission reports for each SURTASS LFA sonar vessel must be submitted within 30 days following the end of each quarter beginning on the date of the LOA's effectiveness. Even if no missions were conducted by a vessel, a report of negative activity must be submitted. Dates, times, and locations of each SURTASS LFA sonar mission will be included in the classified quarterly mission reports, while information on LFA sonar transmissions, including the number of times the sonar transmissions were suspended or delayed due to mitigation protocol procedures, will be included in both the unclassified and classified mission reports. The distance from the LFA sonar array to the 180 dB re 1 μ Pa (rms) isopleth is also to be noted. Additionally, any detection of marine mammals, including their range and bearing to the SURTASS LFA sonar vessel will be reported. Incidental take estimates of marine mammals possibly exposed to the duration of the each mission's LFA sonar transmissions that quarter are to be detailed in the report as well as the running total of affected stock percentages over the annual period.
- An annual report, which is the unclassified summary of all quarterly reports, is to be submitted to NMFS 45 days after the expiration of the LOAs. In addition to the summary of all annual LFA sonar operations, the annual report should include the Navy's estimates of the marine mammal stocks affected by all SURTASS LFA sonar vessel operations for the annual effective LOA period, summary of the mitigation effectiveness, and an assessment of any long-term or discernable cumulative effects associated with exposure of marine mammals to SURTASS LFA sonar transmissions.
- A final comprehensive report, which is an unclassified assessment of any impacts of SURTASS LFA sonar on marine mammal stocks during the 5-year period of the MMPA regulations, is submitted to NMFS at least 240 days prior to expiration of the MMPA Final Rule regulations. The final comprehensive report for the 2012 Final Rule period was submitted to NMFS 16 December 2016.
- Research action plan that outlines the Navy's strategy for implementing recommendations on beaked whales and/or harbor porpoise research on the effects of exposure to SURTASS LFA sonar is to be submitted to NMFS. However, if such research is not feasible/or is unlikely to increase the understanding of the potential effects of SURTASS LFA sonar transmissions on beaked whales and/or harbor porpoises, written documentation describing the reasons for this decision will be submitted to NMFS, to be followed by a meeting with NMFS to discuss any other potential options.
- Status update provided as part of the Navy's LOAs application on its efforts to assess the data collected by the M3 program and its progress toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances.
- Monitor the principal marine mammal stranding networks and media for correlative strandings of marine mammals that overlap in time and space with SURTASS LFA sonar operations.

6 SUMMARY OF SURTASS LFA SONAR OPERATIONS FROM 2016 TO 2017

As noted previously, per 50 CFR § 218.236(b) and Condition 13(f) of the LOAs, this annual report is the unclassified summary of the Navy's SURTASS LFA sonar operations for the period from 15 August 2016 through 14 August 2017 under the fifth year LOAs for the USNS VICTORIOUS, USNS ABLE, USNS EFFECTIVE, and USNS IMPECCABLE, as reported in four mission summary reports submitted to NMFS one month following the end of each annual quarter. During the fifth annual reporting period of the MMPA 2012 Final Rule for SURTASS LFA sonar, the Navy conducted a total of seven at-sea missions over 8.8 days in three of the Navy's northwestern Pacific Ocean mission areas for SURTASS LFA sonar during which LFA sonar was transmitted for a total of 23.8 hr.

No SURTASS LFA sonar missions were conducted in the Hawaii North or South mission areas during the 2016 to 2017 LOA effective period. SURTASS LFA sonar OBIA 16, Penguin Bank of the Hawaiian Islands Humpback Whale National Marine Sanctuary, is located in the Hawaii South mission area for SURTASS LFA sonar and is the only designated OBIA to have potentially been located in an area in which SURTASS LFA sonar may be operated during the annual period.

This annual report details the four SURTASS LFA sonar missions conducted by the USNS ABLE (T-AGOS 20), one mission conducted by the USNS EFFECTIVE (T-AGOS 21), and two missions conducted by the USNS IMPECCABLE (T-AGOS 23) during the 2016 to 2017 reporting period (Table 4); the USNS VICTORIOUS (T-AGOS 19) conducted no at-sea missions during the annual period.

The 23.8 hr of LFA sonar transmissions were less than the number of transmit hours authorized for the four SURTASS LFA sonar vessels during the 2016 to 2017 annual period. In accordance with the mitigation monitoring protocol for SURTASS LFA sonar, LFA sonar transmissions were suspended or delayed five times due to one visual and four active acoustic (HF/M3) detections of possible marine mammals or sea turtles in the LFA mitigation plus buffer zones (Table 4); no passive acoustic detections of marine mammal vocalizations were made in the LFA mitigation or buffer zones. During the 2016 to 2017 LFA sonar missions, LFA sonar transmissions were suspended or delayed 112 times for non-mitigation related causes. No passive acoustic detections of marine mammal vocalizations beyond (outside) the LFA mitigation and buffer zones were made by any of the LFA sonar vessels during the annual reporting period.

6.1 USNS ABLE MISSION SUMMARIES

The USNS ABLE (T-AGOS 20) conducted four SURTASS LFA sonar missions during the first and third quarters of the 2016 to 2017 annual reporting period, with no (negative) operations reported for Quarters 2 and 4. During Quarter 1, the USNS ABLE conducted two sonar missions over 3.3 days during which LFA sonar was transmitted for a total of 10.8 hr. No visual or passive acoustic detections were reported during the ABLE's two missions, but one active acoustic detection of possible marine animals in the LFA mitigation or buffer zones resulted in one delay/suspension of LFA sonar transmissions due to mitigation monitoring protocols. LFA sonar transmissions were additionally delayed/suspended 25 times during the Quarter 1 missions due to non-mitigation protocol factors.

During Quarter 3 of the annual reporting period, the USNS ABLE conducted two at-sea missions that encompassed 0.7 days during which LFA sonar was transmitted 0.8 hr. The ABLE reported no visual, passive acoustic, or active acoustic detections of marine animals during these missions, with no shutdowns or delays of LFA sonar transmissions due to mitigation monitoring protocol. However, LFA

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Table 4. Summary of SURTASS LFA Sonar Operations and Mitigation Monitoring for the LOA Annual Reporting Period 15 August 2016 through 14 August 2017 for All Vessels.

<i>LFA Vessel</i>	<i>Number Total Annual Missions</i>	<i>Total Mission Duration (days)</i>	<i>Total LFA Sonar Transmissions (hours)</i>	<i>Number Visual Detections</i>	<i>Number Passive Acoustic Detections</i>	<i>Number Passive Acoustic Detections Outside Mitigation/ Buffer Zones</i>	<i>Number Active Acoustic (HF/M3) Detections</i>	<i>Number LFA Sonar Suspensions/ Delays Per Mitigation Protocol</i>	<i>Number LFA Sonar Suspensions/D elays Due to Non-Mitigation Factors</i>
USNS VICTORIOUS (T-AGOS 19)									
USNS ABLE (T-AGOS 20)	4	4.0	11.6	0	0	0	1	1	30
USNS EFFECTIVE (T-AGOS 21)	1	1.7	4.6	0	0	0	0	0	49
USNS IMPECCABLE (T-AGOS 23)	2	3.1	7.6	1	0	0	3	4	33
ANNUAL TOTALS	7	8.8	23.8	1	0	0	4	5	112

sonar transmissions were suspended/delayed five times during the missions due to non-mitigation monitoring factors.

6.2 USNS EFFECTIVE MISSION SUMMARIES

One at-sea mission was completed by the USNS EFFECTIVE (T-AGOS 21) during the fourth quarter of the 2016 to 2017 LOA reporting period with no activity having been reported for T-AGOS 21 for Quarters 1 through 3. The EFFECTIVE's mission was conducted over 1.7 days during which LFA sonar was transmitted for 4.6 hr (Table 4). No visual, passive acoustic, or active acoustic detections of marine animals were reported within the LFA mitigation and buffer zones during the EFFECTIVE's mission, resulting in no suspensions or delays of LFA sonar transmissions per mitigation monitoring protocol. However, LFA sonar transmissions were delayed or suspended 49 times during the mission due to non-mitigation related causes.

6.3 USNS IMPECCABLE MISSION SUMMARIES

Over the 2016 to 2017 LOA annual period, the USNS IMPECCABLE (T-AGOS 23) conducted one mission each during the second and fourth quarters, with negative (no) activity having been reported for Quarters 1 and 3. The IMPECCABLE's Quarter 2 mission was conducted over 2.6 days, with a 5.8 hr of LFA sonar having been transmitted. During the IMPECCABLE's first mission, one visual, no passive acoustic, and three active acoustic (HF/M3) detections resulted in four delays/suspensions of LFA sonar transmissions. Unrelated to mitigation protocol, 33 suspensions/delays of LFA sonar transmissions occurred during the Quarter 2 mission of T-AGOS 23.

During the IMPECCABLE's first mission of 2016 to 2017, visual observers reported a whale fluke at a bearing of 295T and a range of 1 nmi (1.9 km). The three individual HF/M3 detections were reported with the following bearings and ranges:

- 195R, 1,780 yards (yd) (1.6 km)
- 196R, 1,986 to 1,426 yd (1.8 to 1.3 km)
- 138R 1,616 yd (1.5 km)/196R 1,952 yd (1.8 km)

In the first two HF/M3 detections, the marine animal's movement direction was unchanged and the animal closed the distance to T-AGOS 23 and the transmitting LFA sonar. The animals' movements during the first two detections do not indicate avoidance of LFA sonar transmissions nor of the vessel's approach, while interpretation of the animal's behavior in the third detection is inconclusive. The animal could have been engaged in a behavior, such as feeding, which would naturally have resulted in a change in course and distance, or the animal could have been exhibiting avoidance behavior by its change in course and apparent movement away from the transmitting LFA sonar and vessel.

In Quarter 4 of 2016 to 2017, T-AGOS 23 conducted one at-sea mission over 0.5 days during which LFA sonar was transmitted 1.9 hr. No visual, passive acoustic, nor active acoustic detections of possible marine mammals or sea turtles were made during the fourth quarter mission.

7 ANNUAL TRAINING

No visual-monitoring training of designated ship personnel that act as lookouts during missions when LFA sonar is actively transmitted was conducted during the annual LOA period.

7.1 PASSIVE ACOUSTIC TRAINING

The 2016 to 2017 LOAs and ITS under which the Navy is authorized to conduct LFA sonar operations aboard USNS VICTORIOUS, USNS ABLE, USNS EFFECTIVE, and USNS IMPECCABLE stipulate the conditions governing the sonar's operation. One of the mitigation monitoring conditions requires the Navy to use the passive SURTASS to listen for vocalizing marine mammals. To meet this requirement, by direction of CNO Undersea Capabilities Branch (N2/N6F24), a senior marine acoustician from Marine Acoustics, Inc. conducted two passive acoustic trainings during the 2016 to 2017 LOA effective period of the MILCREWs that conduct passive acoustic monitoring as part of their duties as sonar operators onboard the USNS VICTORIOUS, ABLE, EFFECTIVE, and IMPECCABLE during SURTASS LFA sonar missions. Additionally, the MILCREW of the USNS LOYAL, an USNS T-AGOS vessel that is not outfitted with SURTASS LFA sonar, was also trained to increase their ability as sonar operators to distinguish biological sounds from those of mission-directed sounds.

The passive acoustic trainings consisted of a classified presentation that covered the following topics: 1) an introductory component that covered the requirements of passive acoustic monitoring for marine species specified under permits for SURTASS LFA sonar employment; 2) a marine mammal identification component that described basic information about the primary marine mammal species they may detect on SURTASS and species-specific characteristics for visual identification on spectrograms during passive acoustic monitoring; and 3) recommended sonar display parameters to facilitate the detection and identification of marine mammal species.

The introductory component included an overview of the reasons why mitigation monitoring of marine species is conducted during SURTASS LFA sonar transmissions, the monitoring requirements and procedures per the LOAs and ITS permits, and the importance of this task to the Navy's continued ability to operate SURTASS LFA sonar. The other types of mitigation monitoring required during SURTASS LFA sonar operations, that is, visual monitoring and active acoustic monitoring with the HF/M3 sonar were also discussed. Passive acoustic reporting procedures were reviewed, including an explanation of how the information the MILCREW collects is reported to other Navy organizations and ultimately to NMFS.

The marine mammal identification component of the trainings included basic information about the species of marine mammals that could be detected by the SURTASS passive array. The migratory and vocalization behavior of each of those marine mammal species was described, as well as key features of exemplar spectrograms used to identify each species. The parameters of the sonar displays were discussed, with recommended settings to aid with classifying detected biological signals to a specific marine mammal species. Many of the settings used by M3 acousticians when reviewing data from Navy fixed and mobile (i.e., SURTASS) arrays for marine mammal vocalizations are different from those typically used for mission-directed sonar operations.

Passive acoustic monitoring crews from the VICTORIOUS, ABLE, EFFECTIVE, and IMPECCABLE have been made aware of their mitigation monitoring and reporting duties and responsibilities when SURTASS LFA sonar is transmitting and the importance of their role in the Navy's continuing ability to operate SURTASS LFA sonar. The MILCREWs that conduct passive acoustic monitoring as part of their duties as sonar operators have expanded their awareness of the methods for detecting and identifying biological sounds from those of mission-directed importance.

8 ESTIMATES OF AFFECTED MARINE MAMMAL STOCKS

In its annual LOAs applications, the Navy provided estimates of the percentage of marine mammal stocks potentially affected during a proposed 20 nominal missions in the 15 mission areas requested for

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SURTASS LFA sonar employment during the August 2016 to 2017 LOA period (DoN, 2016). The same analysis methodology and population data (densities and abundances) were utilized to compute the post-mission take estimates. Per LOAs Condition 13(e), quarterly reports on the SURTASS LFA sonar activities that occurred during the preceding 3-month period were submitted to NMFS; these reports included the Navy's estimates of the marine mammal stock percentages and associated numbers of marine mammals in each stock that were affected by the actual number of LFA sonar hours transmitted by each SURTASS LFA sonar vessel that conducted at-sea sonar missions. Additionally, to ensure that no more than 12 percent of any marine mammal stock were taken incidentally to SURTASS LFA sonar activities, in each quarterly report, the Navy provided the running total of the estimated percentage of each marine mammal stock and number of marine mammals in that stock affected by LFA sonar transmissions over the annual LOA period.

In this annual report, the Navy provides the compiled quarter and annual post-mission summaries of the estimated percentages of the marine mammal stocks and number of marine mammals in each stock incidentally harassed for each SURTASS LFA sonar vessel and all combined vessels over the annual period. These estimates are based upon predictive modeling of the length of sonar exposure (i.e., actual LFA sonar transmit hours) associated with each of the four SURTASS LFA sonar vessels, the season during which the LFA sonar missions occurred, ocean location of the missions, LFA sonar operational characteristics, oceanographic/environmental conditions, and marine mammal demographics (abundances and density estimates). Since Omura's whales are not an authorized species under the 2012 Final MMPA Rule for SURTASS LFA sonar, the takes estimate values for Omura's whales that occur in some mission areas for SURTASS LFA sonar are combined with the closely related Bryde's whale. An overview of the methodology, criteria, and thresholds used for the predictive modeling of the acoustic impact analysis and resulting computation of the incidental harassment estimates detailed herein may be found in the SURTASS LFA sonar Final SEIS/SOEIS (DoN, 2012).

8.1 POST-MISSION ESTIMATES OF POTENTIALLY AFFECTED MARINE MAMMAL STOCKS

Overall mission planning during the annual period of the LOAs was fundamentally based on national security and operational anti-submarine warfare requirements as well as the need for incidental harassment associated with exposures of 120 to 180 dB SPE of any one stock of marine mammals to remain under 12 percent annually. Thus, mission planning for each quarter of the annual LOA period considered the estimated running total of the marine mammal stock percentage so that no more than 12 percent of any marine mammal stock would be taken by MMPA Level B harassment annually by all SURTASS LFA sonar vessels combined (LOA Condition 6).

During the August 2016 through August 2017 LOA period, the highest post-mission percentage of any marine mammal stock predicted to be taken as the result of exposures to LFA sonar transmissions at 120 to 180 dB SPE for all SURTASS LFA sonar vessels combined during the seven LFA sonar missions and 23.8 hr of transmitted LFA sonar was estimated as 0.99 percent or 15 humpback whales of the Western North Pacific (WNP) stock and distinct population segment (DPS) which is represented by a population estimated as 1,328 individuals (Table 5). This total maximum percentage of Level B harassment is clearly well below the authorized limit of 12 percent, as 0.99 percent is only 8 percent of the allowable Level B harassment per stock annually. The second highest Level B take percentage for the annual period was 0.9 percent, or 23 whales, of the Northern Mariana Islands (NMI) stock of 2,455 melon-headed whales (Table 5). The highest estimated number of affected marine mammals from all LFA sonar transmissions during the annual LOA period was 1,643 long-beaked common dolphins of the WNP stock (Table 5), with an estimated abundance of 279,182 dolphins. This maximum total number of affected long-beaked

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Table 5. Total Annual and Quarterly Summary of Post-Mission Percentages of Affected Marine Mammal Stocks and Number of Marine Mammals Resulting from 7 LFA Sonar Missions and 23.8 Hours of LFA Sonar Transmissions Conducted by Three SURTASS LFA Sonar Vessels from 15 August 2016 through 14 August 2017 (ESA-Listed Marine Mammal Species Highlighted).

All Affected Marine Mammal Species/Species Groups	Number Marine Mammals in Stock	Stock Name ¹	120 to 180 dB SPE										≥180 dB (with Mitigation)		
			Quarter 1 (August to November)—All Vessels		Quarter 2 (November to February)—All Vessels		Quarter 3 (February to May)—All Vessels		Quarter 4 (May to August)—All Vessels		Annual Total— All Vessels		Annual Total— All Vessels		
			Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	
Mysticetes															
Blue whale	9,250	WNP	0.00055%	1	0.00111%	1					0.00166%	2	0.00000%	0	
Bryde's whale [*]	20,501	WNP	0.02920%	4	0.06404%	7	0.00607%		1	0.07649%	9	0.17580%	21	0.00000%	0
Common minke whale	25,049	WNP "O"	0.00606%	2	0.17970%	46	0.01332%		4	0.21464%	55	0.41371%	107	0.00000%	0
	893	WNP "J"					0.20376%		2			0.20376%	2	0.00000%	0
Fin whale	9,250	WNP	0.00063%	1			0.00210%		1			0.00273%	2	0.00000%	0
Humpback whale	1,328	WNP DPS	0.27700%	4	0.68561%	10	0.02721%		1			0.98982%	15	0.00000%	0
North Pacific right whale	922	WNP					0.00168%		1			0.00168%	1	0.00000%	0
Sei whale	7,000	WNP	0.02899%	3								0.02899%	3	0.00000%	0
Western North Pacific gray whale	140	WNP					0.00188%		1			0.00188%	1	0.00000%	0
Odontocetes															
Blainville's beaked whale	8,032	WNP	0.13474%	11	0.04924%	4	0.00365%		1	0.04659%	5	0.23422%	21	0.00000%	0
Common bottlenose dolphin	105,138	WNP	0.00829%	14	0.04414%	75				0.06429%	110	0.11672%	199	0.00000%	0
	105,138	IA					0.00040%		1			0.00040%	1	0.00000%	0
Cuvier's beaked whale	90,725	WNP	0.00982%	9	0.04708%	43	0.00019%		1	0.04455%	41	0.10164%	94	0.00000%	0
Deraniyagala beaked whale	22,799	NP	0.04599%	11			0.00128%		1			0.04727%	12	0.00000%	0
Dwarf sperm whale	350,553	WNP	0.01735%	61								0.01735%	61	0.00000%	0
False killer whale	16,668	WNP	0.03429%	6	0.10584%	18				0.13082%	23	0.27095%	47	0.00000%	0
	9,777	IA					0.00651%		1			0.00651%	1	0.00000%	0
Fraser's dolphin	16,992	CNP	0.26463%	45								0.26463%	45	0.00000%	0
	220,789	WNP			0.01945%	43	0.00172%		4	0.02368%	54	0.04485%	101	0.00000%	0
Ginkgo-toothed beaked whale	22,799	NP	0.04599%	11	0.01735%	4	0.00128%		1	0.01641%	5	0.08103%	21	0.00000%	0
Killer whale	12,256	WNP	0.00608%	1	0.00447%	1	0.00042%		1	0.00552%	2	0.01649%	5	0.00000%	0
<i>Kogia</i> spp.	350,553	WNP			0.00729%	26	0.00037%		2	0.00731%	27	0.01496%	55	0.00000%	0
Long-beaked common dolphin	279,182	WNP			0.26225%	733	0.02580%		73	0.29955%	837	0.58759%	1,643	0.00000%	0
Longman's beaked whale	4,571	WNP	0.46120%	22	0.04326%	2	0.00320%		1	0.04093%	3	0.54860%	28	0.00000%	0
Melon-headed whale	2,455	NMI	0.89778%	23								0.89778%	23	0.00000%	0
Melon-headed whale	36,770	WNP			0.07081%	27	0.00668%		3	0.08752%	33	0.16500%	63	0.00000%	0
Pantropical spotted dolphin	438,064	WNP	0.01566%	69	0.01461%	65	0.00212%		5	0.02031%	90	0.05270%	229	0.00000%	0
Pygmy killer whale	30,214	WNP	0.00239%	1	0.04228%	13	0.00027%		1	0.05226%	17	0.09719%	32	0.00000%	0
Pygmy sperm whale	350,553	WNP	0.00707%	25								0.00707%	25	0.00000%	0
	83,289	WNP	0.03265%	28	0.10111%	85				0.10408%	88	0.23784%	201	0.00000%	0
Risso's dolphin	83,289	IA					0.00884%		8			0.00884%	8	0.00000%	0
Rough-toothed dolphin	145,729	WNP	0.01599%	24	0.03217%	47	0.00060%		1	0.03311%	49	0.08187%	121	0.00000%	0
Short-beaked common dolphin	3,286,163	WNP			0.01081%	356				0.01235%	407	0.02316%	763	0.00000%	0
Short-finned pilot whale	53,608	WNP	0.05102%	28	0.17157%	92	0.00157%		1	0.22184%	120	0.44600%	241	0.00000%	0
Sperm whale	102,112	NP	0.00938%	10	0.00755%	8	0.00064%		1	0.00779%	9	0.02536%	28	0.00000%	0
Spinner dolphin	1,015,059	WNP	0.00025%	3	0.00038%	4	0.00003%		1	0.00053%	6	0.00119%	14	0.00000%	0
Striped dolphin	570,038	WNP	0.00328%	19	0.02697%	154				0.03748%	214	0.06772%	387	0.00000%	0
	570,038	IA					0.00035%		2			0.00035%	2	0.00000%	0

*Bryde's whale take values are inclusive of takes for Bryde's plus Omura's whales.

common dolphins is well below, at 12 percent, the number of long-beaked common dolphins authorized to be taken by Level B harassment (13,936 long-beaked dolphins) (Appendix A). No marine mammal stocks were affected by the combined LFA sonar transmissions at RLs ≥ 180 dB (rms) (with the application of mitigation) during the annual LOA reporting period as all percentage stock's taken were estimated as 0 percent with an associated 0 marine mammals affected (Table 5).

8.1.1 Post-Mission Estimates of Affected Marine Mammal Stocks by USNS VICTORIOUS (T-AGOS 19) Sonar Transmissions

The VICTORIOUS conducted no sonar missions and transmitted no LFA sonar during the 2016 to 2017 annual LOA period.

8.1.2 Post-Mission Estimates of Potentially Affected Marine Mammal Stocks by USNS ABLE (T-AGOS 20) Sonar Transmissions

During the 2016 to 2017 LOA effective period, the USNS ABLE conducted four at-sea missions during which 11.6 hr of LFA sonar were transmitted. The highest estimated percentage of any marine mammal stock affected at exposures of 120 to 180 dB SPE by all the ABLE's LFA sonar transmissions throughout the annual reporting period was 0.9 percent of the NMI stock of melon-headed whale, or 26 whales out of a population estimated at 2455, individuals (Table 6). The largest number of marine mammals in any stock affected by the ABLE's LFA sonar transmissions was 74 WNP pantropical dolphins. The maximum estimated percentage of any ESA-listed marine mammal stock or DPS affected at exposures of 120 to 180 dB SPE was 0.3 percent of the WNP stock of humpback whales. With the application of mitigation measures, exposures at RLs of ≥ 180 dB (rms) were estimated as 0.0 percent for all marine mammal stocks (Table 6).

8.1.3 Post-Mission Estimates of Potentially Affected Marine Mammal Stocks by USNS EFFECTIVE (T-AGOS 21) Sonar Transmissions

The USNS EFFECTIVE's one mission that was conducted during the 2016 to 2017 annual LOA period entailed 4.6 hr of LFA sonar transmissions, which maximally affected an estimated 0.21 percent of the WNP stock of long-beaked common dolphins (or 595 dolphins) at exposures of 120 to 180 dB SPE (Table 7); this was also the stock with the highest number of marine mammals affected at exposures of 120 to 180 dB SPE. The only ESA-listed stock affected by the ABLE's LFA sonar transmissions at exposures of 120 to 180 dB SPE was the North Pacific (NP) stock of sperm whales of 102,112 whales. Exposures at RLs of ≥ 180 dB (rms) were estimated as 0.0 percent for all marine mammal stocks with mitigation applied (Table 7).

8.1.4 USNS IMPECCABLE (T-AGOS 23) Post-Mission Estimates of Potentially Affected Marine Mammal Stocks

Completing two missions during the 2016 to 2017 LOA annual period, the USNS IMPECCABLE was responsible for transmitting 7.6 hr of LFA sonar over 3.1 mission days, which affected an estimated maximum of 0.69 percent of humpback whales in the WNP stock/DPS at exposures of 120 to 180 dB SPE (Table 8). This humpback whale stock/DPS also is an ESA-listed species with the highest Level B takes estimated for any threatened or endangered species. The largest number of individuals of any marine mammal stock affected by exposure to LFA sonar transmissions of 120 to 180 dB SPE is the WNP long-beaked common dolphin, with an estimated 975 animals affected out of a stock of 279,182 individuals (Table 8). Marine mammal exposures at RLs of ≥ 180 dB (rms) were estimated as 0.0 percent with the application of mitigation measures.

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Table 6. Post-mission quarterly and total annual estimates of the percentages of marine mammal stocks and the associated number of marine mammals affected by the four LFA sonar missions and 11.6 LFA sonar hours transmitted by the USNS ABLE (T-AGOS 20) in the northwestern Pacific Ocean during the LOA reporting period from August 2016 to August 2017. ESA-listed marine mammals highlighted.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name ¹	120 to 180 dB SPE										≥180 dB (with Mitigation)	
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual		Total for Quarter and Annual Period	
			Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected
Mysticetes														
Blue whale	9,250	WNP	0.00055%	1							0.00055%	1	0.00000%	0
Bryde's whale*	20,501	WNP	0.02920%	4			0.00607%	1			0.03527%	5	0.00000%	0
Common minke whale	25,049	WNP O	0.00606%	2			0.01332%	4			0.01937%	6	0.00000%	0
	893	WNP J					0.20376%	2			0.20376%	2	0.00000%	0
Fin whale	9,250	WNP	0.00063%	1			0.00210%	1			0.00273%	2	0.00000%	0
Humpback whale	1,328	WNP DPS	0.27700%	4			0.02721%	1			0.30421%	5	0.00000%	0
North Pacific right whale	922	WNP					0.00168%	1			0.00168%	1	0.00000%	0
Sei whale	7,000	NP	0.02899%	3							0.02899%	3	0.00000%	0
Western North Pacific gray whale	140	WNP					0.00188%	1			0.00188%	1	0.00000%	0
Odontocetes														
Blainville's beaked	8,032	WNP	0.13474%	11			0.00365%	1			0.13839%	12	0.00000%	0
Common bottlenose dolphin	168,791	WNP	0.00829%	14							0.00829%	14	0.00000%	0
	105,138	IA					0.00040%	1			0.00040%	1	0.00000%	0
Cuvier's beaked whale	90,725	WNP	0.00982%	9			0.00019%	1			0.01001%	10	0.00000%	0
Deraniyagala's beaked whale	22,799	NP	0.04599%	11			0.00128%	1			0.04727%	12	0.00000%	0
Dwarf sperm whale	350,553	WNP	0.01735%	61							0.01735%	61	0.00000%	0
False killer whale	16,668	WNP	0.03429%	6							0.03429%	6	0.00000%	0
	9,777	IA					0.00651%	1			0.00651%	1	0.00000%	0
Fraser's dolphin	16,992	CNP	0.26463%	45							0.26463%	45	0.00000%	0
	220,789	WNP					0.00172%	4			0.00172%	4	0.00000%	0
Ginkgo-toothed beaked whale	22,799	NP	0.04599%	11			0.00128%	1			0.04727%	12	0.00000%	0
Killer whale	12,256	WNP	0.00608%	1			0.00042%	1			0.00650%	2	0.00000%	0
<i>Kogia</i> spp.	350,553	WNP					0.00037%	2			0.00037%	2	0.00000%	0
Long-beaked common dolphin	279,182	WNP					0.02580%	73			0.02580%	73	0.00000%	0
Longman's beaked whale	4,571	WNP	0.46120%	22			0.00320%	1			0.46440%	23	0.00000%	0
Melon-headed whale	2,455	NMI	0.89778%	23			0.00668%	3			0.90446%	26	0.00000%	0
Pantropical spotted dolphin	438,064	WNP	0.01566%	69			0.00212%	5			0.01778%	74	0.00000%	0
Pygmy killer whale	30,214	WNP	0.00239%	1			0.00027%	1			0.00265%	2	0.00000%	0
Pygmy sperm whale	350,553	WNP	0.00707%	25							0.00707%	25	0.00000%	0
Risso's dolphin	83,289	WNP	0.03265%	28							0.03265%	28	0.00000%	0
	83,289	IA					0.00884%	8			0.00884%	8	0.00000%	0
Rough-toothed dolphin	145,729	WNP	0.01599%	24			0.00060%	1			0.01660%	25	0.00000%	0
Short-finned pilot whale	53,608	WNP	0.05102%	28			0.00157%	1			0.05259%	29	0.00000%	0
Sperm whale	102,112	NP	0.00938%	10			0.00064%	1			0.01002%	11	0.00000%	0
Spinner dolphin	1,015,059	WNP	0.00025%	3			0.00003%	1			0.00028%	4	0.00000%	0
Striped dolphin	570,038	WNP	0.00328%	19							0.00328%	19	0.00000%	0
	570,038	IA					0.00035%	2			0.00035%	2	0.00000%	0
					No LFA Sonar Missions—Negative Activity Report				No LFA Sonar Missions—Negative Activity Report					

*Bryde's whale take values includes those for Omura's whales.

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Table 7. Post-mission quarterly and total annual estimates of the percentages of marine mammal stocks and the associated number of marine mammals affected by the six LFA sonar missions and 28.8 sonar hours transmitted by the USNS EFFECTIVE (T-AGOS 21) in the northwestern Pacific Ocean during the LOA reporting period from August 2016 to August 2017. ESA-listed marine mammals highlighted.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name ¹	120 to 180 dB SPE										≥180 dB (with Mitigation)	
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual		Total for Quarter and Annual Period	
			Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected
Mysticetes														
Bryde's whale*	20,501	WNP							0.0544%	6	0.0544%	6	0.0000%	0
Common minke whale	25,049	WNP O							0.1527%	39	0.1527%	39	0.0000%	0
Odontocetes														
Blainville's beaked whale	8,032	WNP							0.0331%	3	0.0331%	3	0.0000%	0
Common bottlenose dolphin	168,791	WNP							0.0457%	78	0.0457%	78	0.0000%	0
Cuvier's beaked whale	90,725	WNP							0.0317%	29	0.0317%	29	0.0000%	0
False killer whale	16,668	WNP							0.0931%	16	0.0931%	16	0.0000%	0
Fraser's dolphin	220,789	WNP							0.0168%	38	0.0168%	38	0.0000%	0
Gingko-toothed beaked whale	22,799	NP							0.0117%	3	0.0117%	3	0.0000%	0
Killer whale	12,256	WNP							0.0039%	1	0.0039%	1	0.0000%	0
<i>Kogia</i> spp.	350,553	WNP							0.0052%	19	0.0052%	19	0.0000%	0
Long-beaked common dolphin	279,182	WNP							0.2131%	595	0.2131%	595	0.0000%	0
Longman's beaked whale	4,571	WNP							0.0291%	2	0.0291%	2	0.0000%	0
Melon-headed whale	36,770	WNP							0.0623%	23	0.0623%	23	0.0000%	0
Pantropical spotted dolphin	438,064	WNP							0.0144%	64	0.0144%	64	0.0000%	0
Pygmy killer whale	30,214	WNP							0.0372%	12	0.0372%	12	0.0000%	0
Risso's dolphin	83,289	WNP							0.0740%	62	0.0740%	62	0.0000%	0
Rough-toothed dolphin	145,729	WNP							0.0236%	35	0.0236%	35	0.0000%	0
Short-beaked common dolphin	3,286,163	WNP							0.0088%	289	0.0088%	289	0.0000%	0
Short-finned pilot whale	53,608	WNP							0.1578%	85	0.1578%	85	0.0000%	0
Sperm whale	102,112	NP							0.0055%	6	0.0055%	6	0.0000%	0
Spinner dolphin	1,015,059	WNP							0.0004%	4	0.0004%	4	0.0000%	0
Striped dolphin	570,038	WNP							0.0267%	152	0.0267%	152	0.0000%	0
			No LFA Sonar Missions—Negative Activity Report		No LFA Sonar Missions—Negative Activity Report		No LFA Sonar Missions—Negative Activity Report							

*Bryde's whale take values are inclusive of takes for Bryde's plus Omura's whales.

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Table 8. Post-mission quarterly and total annual estimates of the percentages of marine mammal stocks and the associated number of marine mammals affected by the one LFA sonar mission and 2.6 sonar hours transmitted by the USNS IMPECCABLE (T-AGOS 23) in the northwestern Pacific Ocean during the LOA reporting period from August 2016 to August 2017. ESA-listed marine mammals highlighted.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name ¹	120 to 180 dB SPE										≥180 dB (with Mitigation)	
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual		Total for Quarter and Annual Period	
			Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected	Percent Stock Affected	Number Animals Affected
Mysticetes														
Blue whale	9,250	WNP			0.00111%	1					0.00111%	1	0.0000%	0
Bryde's whale*	20,501	WNP			0.06404%	7			0.02207%	3	0.08612%	10	0.0000%	0
Common minke whale	25,049	WNP O			0.17970%	46			0.06194%	16	0.24164%	62	0.0000%	0
Humpback whale	1,328	WNP DPS			0.68561%	10					0.68561%	10	0.0000%	0
Odontocetes														
Blainville's beaked	8,032	WNP			0.04924%	4			0.01345%	2	0.06269%	6	0.0000%	0
Common bottlenose dolphin	168,791	WNP			0.04414%	75			0.01855%	32	0.06269%	107	0.0000%	0
Cuvier's beaked whale	90,725	WNP			0.04708%	43			0.01286%	12	0.05994%	55	0.0000%	0
False killer whale	16,668	WNP			0.10584%	18			0.03775%	7	0.14359%	25	0.0000%	0
Fraser's dolphin	220,789	WNP			0.01945%	43			0.00683%	16	0.02629%	59	0.0000%	0
Ginkgo-toothed beaked whale	22,799	NP			0.01735%	4			0.00474%	2	0.02208%	6	0.0000%	0
Killer whale	12,256	WNP			0.00447%	1			0.00159%	1	0.00606%	2	0.0000%	0
Kogia spp.	350,553	WNP			0.00729%	26			0.00211%	8	0.00940%	34	0.0000%	0
Long-beaked common dolphin	279,182	WNP			0.26225%	733			0.08644%	242	0.34869%	975	0.0000%	0
Longman's beaked whale	4,571	WNP			0.04326%	2			0.01181%	1	0.05508%	3	0.0000%	0
Melon-headed whale	36,770	WNP			0.07081%	27			0.02526%	10	0.09606%	37	0.0000%	0
Pantropical spotted dolphin	438,064	WNP			0.01461%	65			0.00586%	26	0.02047%	91	0.0000%	0
Pygmy killer whale	30,214	WNP			0.04228%	13			0.01508%	5	0.05736%	18	0.0000%	0
Risso's dolphin	83,289	WNP			0.10111%	85			0.03004%	26	0.13115%	111	0.0000%	0
Rough-toothed dolphin	145,729	WNP			0.03217%	47			0.00955%	14	0.04172%	61	0.0000%	0
Short-beaked common dolphin	3,286,163	WNP			0.01081%	356			0.00356%	118	0.01438%	474	0.0000%	0
Short-finned pilot whale	53,608	WNP			0.17157%	92			0.06402%	35	0.23559%	127	0.0000%	0
Sperm whale	102,112	NP			0.00755%	8			0.00225%	3	0.00980%	11	0.0000%	0
Spinner dolphin	1,015,059	WNP			0.00038%	4			0.00015%	2	0.00054%	6	0.0000%	0
Striped dolphin	570,038	WNP			0.02697%	154			0.01081%	62	0.03778%	216	0.0000%	0
			No LFA Sonar Missions—Negative Activity Report				No LFA Sonar Missions—Negative Activity Report							

*Bryde's whale take values includes those for Omura's whales.

8.2 SUMMARY OF AFFECTED MARINE MAMMAL SPECIES AND STOCKS

The post-activity incidental harassment estimates (Tables 5 through 8) for SURTASS LFA sonar transmissions during the 2016 to 2017 annual LOA period demonstrate that 0.0 percent marine mammals from any stocks in the western North Pacific Ocean were exposed to RLs at or above 180 dB (rms) with the application of visual, passive acoustic, and active acoustic mitigation measures. The highest overall percentage of any marine mammal stock exposed LFA sonar transmissions at 120 to 180 dB from all SURTASS LFA vessel transmissions during the seven total missions conducted over the annual LOA reporting period by all SURTASS LFA sonar vessels was estimated as 0.99 percent for the WNP stock/DPS (Table 5). The post-activity take estimates are, therefore, significantly below the 12 percent limit for any marine mammal stock under conditions of the 2016 to 2017 LOAs and the MMPA Final Rule (77 FR 50290) (NOAA, 2012). In addition, no marine mammal stranding events were associated with the times and/or locations of SURTASS LFA sonar missions were reported during this annual LOA period. Last, no acute responses or effects to threatened or endangered species were observed in response to exposure from SURTASS LFA sonar transmissions. Only one detected marine mammal responded to SURTASS LFA sonar activities in a way that could possibly have been an avoidance reaction, but because the animal's behavioral state prior to detection was unknown, its apparent movement away from the LFA sonar vessel may have merely been part of a normal foraging or transiting behavior.

The incidental harassment of marine mammals associated with exposure to SURTASS LFA sonar transmissions that occurred during this LOA reporting period was much lower than the predicted incidental harassment estimates proposed by the Navy in its 2016 to 2017 LOAs application. In its LOAs application, the Navy predicted the highest estimated percentage of any stock potentially taken by Level B harassment from all SURTASS LFA sonar transmission would be 11.15 percent of the WNP stock of humpback whales, or 155 whales. The actual highest take of WNP humpback whales associated with exposure to SURTASS LFA sonar was far more conservative than predicted, with the actual maximum take percentage representing only about 9 percent of the predicted take estimate. As a result, the Navy's conclusion about the potential effect on marine mammal stocks from exposure to SURTASS LFA is that although behavioral responses (Level B incidental harassment) may occur, the incidental taking of marine mammals by the employment of SURTASS LFA sonar was so minor that exposure had a negligible impact on the affected marine mammal stocks or species of marine mammals.

9 SUMMARY OF MONITORING AND REPORTING FOR LOA PERIOD AUGUST 2016 TO AUGUST 2017

9.1 CONSIDERATION OF RESEARCH ON THE EFFECTS OF SURTASS LFA SONAR ON BEAKED WHALES AND/OR HARBOR PORPOISES

To assess the potential for effects to beaked whale species and harbor porpoises from exposure to SURTASS LFA sonar, the Navy convened a Scientific Advisory Group (SAG) of recognized scientific subject matter experts to identify feasible monitoring and/or research options the Navy could potentially implement. The SAG recommendations are considered independent scientific findings that are accessible to the public on the website for SURTASS LFA sonar (<http://www.surtass-lfa-eis.com>). The Navy also convened an Executive Oversight Group (EOG) to evaluate the SAG recommendations in relation to available Navy research funding and needs as well as existing Navy research programs. The EOG was composed of Navy and NMFS personnel as well as a representative of the Marine Mammal Commission. The EOG provided the Navy with: 1) independent, objective review of the SAG's findings, 2) research guidance and prioritization, and 3) final recommendations to the Navy and NMFS.

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After consideration of the SAG recommendations and input and prioritization by the EOG, the possible research-monitoring studies of effects on beaked whales and harbor porpoises were ranked (from highest to lowest potential) and divided into three categories according to the estimated cost of the proposed research efforts: those research efforts estimated to be fairly minimal in cost (less than \$100,000); those moderately costly research efforts estimated from \$100,000 to \$500,000; and costly research estimated at \$500,000 and above.

1. Research efforts estimated to cost less than \$100,000:
 - Geospatial desktop analysis of the extent of the potential overlap of the harbor porpoise's distributional range and habitat with the sound field generated by SURTASS LFA sonar activities, including the coastal standoff range (i.e., geographic restriction that the LFA sound field not exceeding 180 dB re: 1 μ Pa [rms] at a distance less than 12 nmi [22 km] from any emergent land), given that the harbor porpoise has a known coastal distribution. The Navy has funded this effort.
 - Review existing data collected from already deployed high-frequency acoustic recording package (HARP) sensors to determine spatiotemporal overlap with SURTASS LFA sonar missions and the presence of beaked whales. Pacific government and institutional researchers were contacted by NMFS regarding HARP deployments in the North Pacific Ocean and the potential for accessing their compiled data. Additionally, Baumann-Pickering et al. (2014) published the results of over eleven cumulative years of HARP deployments in the North Pacific, some in areas that may overlap with SURTASS LFA sonar missions. A research effort to define the spatiotemporal overlap of HARP deployments and potentially beaked whale recordings in conjunction with the locations of LFA sonar missions is estimated to require minimal cost. If geospatial overlap exists with HARP deployment and SURTASS LFA sonar locations, the cost for data analysis would depend on the extent of the overlap.
2. Research efforts estimated to cost between \$100,000 and \$500,000 but for which methodologies exist and implementation could extend existing studies:
 - Targeted deployment of one HARP sensor for one year in the western North Pacific Ocean in a location where SURTASS LFA sonar missions have historically occurred. The estimated cost of such a deployment is \$250,000. The objective of this study would be to document beaked whale vocal behavior before, during, and after LFA sonar transmissions. Careful consideration of lessons learned from previous deployments would be needed to increase the probability of a successful project.
 - Anatomical modeling of LF sound reception by beaked whales, with an approximate cost estimated between \$150,000 and \$200,000. Since the EOG meetings in 2014, Cranford and Krysl (2015) presented a synthetic, predicted audiogram of a fin whale, based predominantly on bone conduction of sound through the head to the ear. NMFS (2016) noted that the predicted audiogram does not match the typical U-shaped audiogram expected with normal hearing in mammals in that there is "hump" at low frequencies and shallow roll-off of sensitivity at high frequencies. Given these difficulties, additional funding may well be required to determine the source of the abnormal results.
3. Research recommendations that require additional methodological developments and/or would cost in excess of \$500,000:

- Controlled exposure experiment (CEE) for beaked whales with an appropriate LF source (i.e., one as similar to the SURTASS LFA sonar array or individual array element as is possible). Many complexities are associated with this recommendation, particularly considering the results of the ongoing mid-frequency sonar behavioral response studies demonstrating the importance of real-world exposures for characterizing behavioral responses. It is possible that existing LF sources already in use on Navy ranges could be surrogates for SURTASS LFA sonar, but such extrapolations would need to be considered carefully. SURTASS LFA sonar is currently authorized for use in the western and central North Pacific and Indian oceans, regions in which CEEs have not been conducted, making experiments using the LFA sonar system particularly difficult and more costly, since an experimental infrastructure does not exist. Given the cost and complexities associated with this recommendation, it was ranked as a lower priority. This recommendation should also be revisited as future tagging technologies are developed, particularly for harbor porpoises.
- Acquire LF behavioral audiograms for harbor porpoise or LF auditory evoked potential (AEP)/auditory brainstem response (ABR) audiograms of beaked whale species. Since meeting of the EOG concluded, the Navy funded a study led by James Finneran (http://greenfleet.dodlive.mil/files/2017/05/LMRFactSheet_Project9.pdf) to correlate AEP measurements of hearing sensitivity with perceived loudness (Muslow et al., 2015). Part of this study included attempts to extend the LF range of AEP measurements, which may be transferable to studies of hearing sensitivity of harbor porpoise or beaked whales. There are difficulties with the transmission of LF sounds, in achieving the required power with manageable laboratory systems, and creating a far-field sound field consistent across the measurement experiment. The final results of the study have not yet been published, but the study found that AEPs were only successful to frequencies of 10 kHz for bottlenose dolphins (where 10 kHz is the upper range of what is considered mid-frequency) and 1 kHz for California sea lions (the upper range of what is considered low-frequency). In addition, the correlation of equal latency contours only applied over a limited frequency range, providing limited benefit beyond the frequency range of auditory thresholds. Therefore, it is currently not feasible to conduct ABR/AEPs at frequencies within the range of SURTASS LFA sonar (100 to 500 Hz).

The ranking of research and monitoring recommendations has helped inform Navy and NMFS decision makers of the scientific priority, feasibility, and cost of possible experiments to increase understanding of potential effects of SURTASS LFA sonar on harbor porpoises and beaked whales. Discussions amongst Navy decision makers from OPNAV N2/N6F24, Office of the Deputy Assistant Secretary of the Navy for the Environment, Office of Naval Research, and Navy Living Marine Resources Program will continue to leverage research among various programs. N2/N6F24 has put in funding requests for FY17 and beyond, but there are significant budgetary constraints throughout the Federal agency. Ongoing discussions between Navy and NMFS will continue to evaluate the most efficient and cost effective way forward for Navy environmental compliance research efforts.

9.2 STRANDING INCIDENT MONITORING

Per conditions of the LOAs and rulemaking for SURTASS LFA sonar, the Navy is responsible for systematically observing SURTASS LFA sonar operations for injured or disabled marine mammals and monitoring the principal marine mammal stranding networks and other media to correlate analysis of any whale strandings that could potentially be associated with SURTASS LFA sonar operations. Additionally, the Navy must notify NMFS immediately, or as soon as clearance procedures allow, if an

injured, stranded, or dead marine mammal is found during, shortly after, and in the vicinity of any SURTASS LFA operations or anytime an injured, stranded, or dead marine mammal is found.

No injured or disabled marine mammals were observed during any of the seven at-sea LFA sonar missions conducted during the 2016 to 2017 annual LOA period. Monitoring of all available media and known stranding databases was conducted for strandings in mission areas in which the Navy conducted LFA sonar missions during the annual period. Strandings were monitored by e-news alerts notifying the Navy and NMFS in real-time of stranding events, via social media for domestic and international stranding organizations, and by searching available stranding networks for relevant regional information. From 15 August 2016 through 14 August 2017, numerous individual marine mammal strandings were reported in or adjacent to SURTASS LFA sonar mission areas in the western North Pacific Ocean in which SURTASS LFA sonar at-sea missions were conducted, especially in Philippine waters. Strandings are increasingly being reported from China and to a lesser extent, Vietnam.

During the 2016 to 2017 annual period, two mass strandings of marine mammals occurred in the vicinity of the mission areas in which SURTASS LFA sonar missions were conducted in the annual period. A mass stranding of marine mammals occurs when two or more marine mammals do not purposefully come ashore (i.e., purposefully as most pinniped species go ashore to rest, molt, etc.). In April 2017, four Risso's dolphins stranded along the shore of Nagasaki Prefecture; the dolphins were successfully moved back to sea. In June 2017, seven pygmy killer whales stranded in Miyazaki, Japan, which is located to the east of Nagasaki Prefecture on Kyushu Island. Although most of the pygmy killer whales were alive when they stranded, none were returned to the sea and all later died.

The Navy has evaluated the spatial and temporal overlap of these mass strandings with SURTASS LFA sonar activities and no overlap exists. Thus, these marine mammal strandings in the western North Pacific Ocean were not correlated spatially or temporally to the transmission of LFA sonar or SURTASS LFA sonar activities. From the commencement of SURTASS LFA sonar use in 2002 through the present, neither LFA sonar nor operation of T-AGOS vessels has been associated with any mass or individual strandings of marine mammals.

9.3 PASSIVE ACOUSTIC DATA

SURTASS LFA sonar's M3 program uses the Navy's fixed and mobile passive acoustic monitoring systems to enhance the Navy's collection of long-term data on individual and population levels of acoustically active marine mammals, principally baleen whales. At present, the M3 program's data are classified, as are the data reports created by M3 analysts, due to the inclusion of sensitive national security information. In the past, however, researchers have based unclassified research and the resulting scientific papers on information from classified M3 program data or other Navy passive acoustic assets. The Navy continues to assess and analyze M3 data collected from Navy passive acoustic monitoring systems and is working toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances and ultimately to the public. Progress has been achieved on addressing security concerns for the declassification of the results of a specific marine mammal dataset. A scientific paper has been prepared and submitted to a prominent, peer-reviewed scientific journal for publication.

M3 acoustic analysts have detected and reported important acoustic and distributional information about two baleen whale species. From northern Indian Ocean acoustic data, M3 analysts have detected and identified calls from the pygmy blue whale, *Balaenoptera musculus brevicauda*, off Sri Lanka. An acoustically-distinct population of this blue whale sub-species is regularly seen and recorded off Sri

Lanka. M3 analysts have now analyzed and identified five of nine known and published blue whale species' dialects: North Atlantic blue, eastern North Pacific blue, western North Pacific blue, southern Ocean blue (i.e., the "true" blue whale), and the Sri Lanka blue (DoN, 2017). During 2016, M3 analysts identified and tracked two singing blue whales in the western North Pacific Ocean for extended periods based on the distinctive acoustic mid-spectrum characteristics of their songs. One blue whale was tracked for 200 days, from August 2016 through February 2017, as it traveled over 4,753 nmi (8,803 km) in western North Pacific waters (DoN, 2017). A second blue whale was tracked 185 days, from July 2016 through January 2017, as it sang and swam 6,075 nmi (11,251 km) from the central to western North Pacific Ocean. After arriving in western North Pacific waters, this second blue whale changed course and began heading southeast across the North Pacific until its signal faded. M3 analysts believe the blue whale was heading to the Costa Rica Dome, which is a known blue whale foraging area. Interestingly, these two blue whales traveled within 100 nmi (185 km) of one another on two occasions. Although their songs were similar and of the same general form, each whale's song had a distinguishing temporal pattern. M3 analysts are planning will begin searching and hope to regain and re-identify both of these singers during the 2017 to 2018 should they present themselves within the detection range of Navy acoustic sensors.

Additionally, M3 analysts not only train Navy sonar operators (MILCREW) that work aboard SURTASS LFA sonar vessels in the identification of marine mammal vocalizations obtained by the SURTASS sonar system but have also created a 75-page manual, *Tactical Identification Guide for SURTASS LFA Sonar Analysts*. This manual is retained aboard each SURTASS LFA sonar vessel for reference by the MILCREW sonar operators in detecting and analyzing acoustically active marine mammal sonar returns.

9.4 AUGMENTING MARINE MAMMAL MONITORING WITH SURTASS PASSIVE SONAR

In recognition of the monitoring value of the SURTASS passive towed HLA, the Navy is exploring the feasibility of coordinating with other Navy fleet assets to use the SURTASS passive sonar to augment the collection of data on marine mammal vocalizations during Navy exercises and/or as an adjunct to Navy range monitoring programs. The goal would be to determine the extent, if any, of changes in marine mammal vocalizations that could have been caused by SURTASS LFA sonar or other Navy underwater acoustic systems during the exercise. Collection of such passive acoustic data would directly contribute to our knowledge of marine mammals' occurrences and responses, but would also most importantly augment the data available from the Low Frequency Sound Scientific Research Program on the potential responses of baleen whales to LF underwater sound. Such calibrated and validated data would be valuable not only to the Navy but would also potentially be useful to inform NMFS' environmental compliance assessment of underwater LF sonar systems.

For the SURTASS passive HLA to be used in Navy exercises or as an adjunct to range monitoring programs, long-term, detailed planning and a comprehensive data collection and analysis plan would be required that would have to mesh with existing or scheduled operational planning for Navy exercises or range monitoring efforts. One fundamental challenge to using one of the SURTASS LFA sonar vessels in any Navy exercise or range monitoring effort is removal of one of these surveillance assets from its national security mission. Other challenges in using the SURTASS system for monitoring of marine mammals during Navy exercises or range monitoring include:

- Scheduling of assets: availability of a SURTASS LFA sonar vessel to participate in the exercise, time for a T-AGOS vessel to transit to and from the exercise or range location (due to the vessel's travel speed), and the time for pre- and post- exercise data collection and analysis of marine mammal vocalizations.

- Budgetary constraints: additional Navy budget allocations required for a T-AGOS ship to transit to and from the exercise location, additional time at sea for the SURTASS LFA sonar vessel to participate in the exercise including collecting data before and after the exercise for data calibration, and additional labor effort to process the collected data.
- Potential for qualified, professional marine mammal observers to be onboard the SURTASS LFA sonar vessel during the data collection efforts. This poses a challenge since there is typically little available space on the T-AGOS vessels for additional riders, and any observers would need to possess appropriate security clearances.
- Security measures: protocols would need to be developed to ensure that the marine mammal vocalization data collected onboard the SURTASS LFA sonar vessel, or any other data collected during the exercise, can be scrubbed of any potentially classified information, such that the marine mammal data can be unclassified for processing and analysis by other scientists.
- Reconciling the potential behavioral responses of marine mammals associated with SURTASS LFA sonar transmissions versus other Navy underwater sound sources (e.g., mid-frequency active sonars).
- Accounting for other variables that may cause a change in marine mammals' vocalization output; this would be a task for a scientific team made up of marine biologists, LFA sonar operators, and oceanographic experts.

Despite these challenges, the Navy continues to explore and evaluate the budgetary and logistical constraints to make this goal achievable, although it is likely to be several annual cycles before such a goal can be achieved due to the nature of forward budgetary planning and asset availability.

9.5 AMBIENT NOISE DATA

The Navy collects ambient noise data on the marine environment when the SURTASS passive towed HLA is deployed. However, because the collected ambient noise data may also contain sensitive acoustic information, the Navy classifies the data, and thus, does not make these data publicly available. The ambient noise data, especially from areas of the ocean for which marine ambient noise data may be lacking, would be a beneficial addition to the comprehensive ocean noise budget (i.e., an accounting of the relative contributions of various underwater sources to the ocean noise field) that is being developed for the world's oceans. Ocean noise budgets are an important component of varied marine environmental analyses, including studies of masking in marine animals, marine habitat characterization, and marine animal impact analyses.

In acknowledgement of the valuable data the Navy routinely collects, NMFS has recommended that the Navy continue to explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts. Due to national security concerns, these data are currently classified. The Navy continues to study the feasibility of declassifying portions of these data after all related security concerns have been resolved. As an initial step in this process, SURTASS LFA sonar's M3 program is working to compile information on the ambient noise data that have been collected from various systems and assess the range of and usable content of the data prior to further discussions on data dissemination, either at a classified or unclassified level.

9.6 SUMMARY OF REPORTING FOR SURTASS LFA SONAR ACTIVITIES FROM AUGUST 2016 TO AUGUST 2017

During the August 2016 to August 2017 annual LOA period, the Navy prepared and submitted 11 unclassified quarter reports of negative activity and five classified reports, including unclassified enclosures, describing the seven at-sea LFA sonar missions completed by three SURTASS LFA sonar vessels. The Navy's required reporting of SURTASS LFA sonar activities was further augmented by this annual report and submittal of the Final Comprehensive Report, which was submitted to NMFS December 16, 2016. Additionally, in July 2017, the Navy submitted its research action plan outlining potential research that could provide information on the potential for effects to beaked whales and harbor porpoises from exposure to SURTASS LFA sonar. Last, the Navy monitored the principal marine-mammal stranding networks and media for strandings that occurred in the geographic marine areas in which the Navy conducted SURTASS LFA sonar missions during the annual period. Details from that monitoring is included herein.

10 MITIGATION EFFECTIVENESS

LOA Condition 13(f)(iii) requires an analysis of the effectiveness of the mitigation measures associated with the authorized operation of SURTASS LFA sonar with recommendations for improvement, where applicable. The implementation of the required mitigation measures to minimize, to the greatest extent practicable, adverse impacts to marine mammals proved to be very effective during the 2016 to 2017 LOA period. During SURTASS LFA sonar transmissions that occurred in the annual period, the typical radial distance of the LFA mitigation zone (i.e., distance to the 180-dB isopleth), was typically about 1,000 yd (0.9 km), which in combination with the 1,094 yd (1-km) required buffer zone, resulted in an approximate 2,094 yd (1.9 km) monitoring radius around the LFA sonar vessels and transmitting LFA sonar system. This distance did vary nominally throughout the annual period as oceanographic and environmental conditions differed in the mission areas where LFA sonar operations were conducted.

Visual observation of the sea surface surrounding the SURTASS LFA sonar vessels was conducted during daylight hours whenever LFA sonar was transmitting. Throughout the seven LFA sonar missions conducted in 2016 to 2017, one visual observation of a whale fluke was reported by the civilian observers onboard the SURTASS LFA sonar vessels. Visual monitoring of the LFA sonar mitigation zone is only effective during daylight hours, in low sea states, and during good weather. Given these stipulations, the mitigation effectiveness of visual monitoring for marine mammals or sea turtles is estimated at about 9% effectiveness (DoN, 2001).

The MILCREW and system engineers monitored the SURTASS passive sonar system for marine mammal vocalizations. No marine mammal vocalizations were detected on passive sonar within the mitigation/buffer zones close to the LFA sonar system. Monitoring of the SURTASS array received signals for marine mammal calls is only conducted when LFA sonar is transmitting. It's likely that due to the low number of LFA sonar hours transmitted during this annual period and the seasonal timing of those missions is responsible for the lack of marine mammal vocalizations, even from outside the mitigation and buffer zones. The large number of passive acoustic detections and identification to species of the marine mammal vocalizations captured by the SURTASS passive system in the past several years of LFA sonar operation demonstrated the monitoring capability of the SURTASS system to detect the near and far presence of marine mammals.

The HF/M3 sonar systems were operated continuously during LFA sonar transmissions in accordance with MMPA Final Rule requirements and LOA Conditions 8(e) and 9(c) (Appendix A). Four active acoustic

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(HF/M3 sonar) detections were reported during the seven missions of three SURTASS LFA sonar vessels during the 2016 to 2017 LOA period. Per the mitigation protocol in conjunction with the one visual detection of a marine mammal, LFA sonar transmissions were delayed or suspended five times during the seven LFA sonar missions. As expected, the HF/M3 sonar system proved to be the most effective mitigation monitoring measure to detect possible marine animals in proximity to the transmitting LFA sonar array.

The effectiveness of the HF/M3 sonar system to monitor and detect marine mammals has been described in the Navy's 2001 FOEIS/EIS (Chapters 2 and 4) for SURTASS LFA sonar (DoN, 2001) in addition to the technical report by Ellison and Stein (2001). To summarize the effectiveness of the HF/M3 sonar system, the Navy's testing and analysis of the HF/M3 sonar system's capabilities indicated that the system substantially increased the probability of detecting a marine mammal within the LFA mitigation zone and provides a superior monitoring capability, especially for medium- to large-sized marine mammals to a distance of 1.1 to 1.3 nmi (2 to 2.5 km) from the system (DoN, 2001); the LFA mitigation is the distance to the 180-dB isopleth, which is nominally 0.54 nmi (1 km), depending upon the environmental conditions, while the buffer zone imposed by NMFS is an additional 0.54 nmi (1 km). Additionally, qualitative and quantitative assessments of the HF/M3 system's ability to detect marine mammals of various sizes were verified in 170 hours of at-sea testing. The sea testing showed that several detections of a marine mammal by the HF/M3 sonar system would occur before a marine mammal entered the LFA mitigation zone (DoN, 2001). Indeed, based on the scan rate of the HF/M3 sonar system, most animals would receive at least 8 pings from the sonar (i.e., 8 sonar returns or detections) before even entering the LFA mitigation zone. Based on this, the probability of a marine mammal being detected prior to entering the mitigation zone approaches 100 percent (Ellison and Stein, 2001). The probability of the HF/M3 sonar system detecting a medium- to large-sized (~33 to 98 ft [10 to 30 m]) marine mammal swimming towards the system in the LFA mitigation zone with only one HF/M3 ping would be near 100 percent (Ellison and Stein, 2001). During sea tests of the HF/M3 sonar system with trained Navy bottlenose dolphins, the detection rate of the dolphins was about 80 percent, but analysts noted that in more normal at-sea operational conditions with reduced clutter interference and dolphins traveling more typically in pods, the detection rate would be higher (Ellison and Stein, 2001).

During the LOA reporting period of 15 August 2016 through 14 August 2017, all mitigation measures and monitoring required by the LOAs, MMPA Final Rule, and Navy directives were strictly adhered to and conducted in accordance with the protocols specified in those requirements. In examining the results of the mitigation monitoring during this annual LOA reporting period, in addition to the results of the previous fifteen years of SURTASS LFA sonar operations, the Navy has concluded that the mitigation measures/mitigation monitoring have been implemented properly, and accordingly, have successfully minimized the potential adverse effects of SURTASS LFA sonar to marine mammals to greatest extent practicable. This conclusion is supported by documentation that no known mortality or injury to marine mammals has occurred over this period in association with use of SURTASS LFA sonar. The Navy will continue its commitment to training the crews of the SURTASS LFA sonar vessels in the proper and effective implementation of the mitigation protocols.

11 ASSESSMENT OF LONG-TERM EFFECTS AND ESTIMATED CUMULATIVE IMPACTS

The Navy's conclusion that its operation of SURTASS LFA sonar had a negligible impact on affected marine mammal stocks or species of marine mammals in the western North Pacific Ocean during the 2016 to 2017 LOA effective period was consistent with previous assessments of its impacts on regional stocks of marine mammals. Likewise, the Navy's assessment of the long-term effects and estimated

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cumulative impacts from employment of SURTASS LFA sonar has not changed from previous conclusions. That is, cumulative impacts from the operation of up to four SURTASS LFA sonar systems are not a reasonably foreseeable significant adverse impact on marine mammals.

The greatest cumulative impact associated with the employment of SURTASS LFA sonar in combination with other known current or planned maritime activities is the increase in the ambient noise environment, whether on a transient basis from sonar and seismic sound transmissions or a more persistent basis from ship traffic. The operation of four SURTASS LFA sonar systems do not add appreciably to the underwater ambient noise environment in the 100 to 500 Hz frequency band to which marine mammal stocks are exposed, and the impact on the overall noise levels in the ocean is minimal. This is because SURTASS LFA sonar systems are active or transmitting for such a small amount of overall time (i.e., no more than a 20 percent duty cycle, which means that the sonar is off and not transmitting for 80 percent of the time) during a mission and for such a small percentage of the annual period. The Navy was permitted a total of 1,728 hr of LFA sonar transmit time for all four SURTASS LFA sonar vessels per annual LOA period but transmitted far fewer hours for all vessels during the 2016 to 2017 annual period. In most of the ocean, the 10 to 500 Hz portion of the ambient noise spectrum is dominated by anthropogenic noise sources, particularly from shipping and seismic exploration (airguns). Commercial shipping is the most common source of LF noise in the ocean and its impact on the ambient noise environment is basin-wide (Hildebrand, 2009). Although seismic exploration is not extensive in the western North Pacific Ocean, commercial maritime traffic is heavy.

Although the total number of sea-going commercial ships around the world is difficult to quantify, both the carrying capacity and number of ships has increased significantly over the last several decades. Tournadre (2014) estimated that between 1992 and 2002, maritime ship traffic increased by 60 percent, averaging about 6 percent per year, with the largest increases in maritime traffic occurring in the Indian Ocean and South China and East China seas. If the Navy were to operate its SURTASS LFA sonar systems at the fully permitted level of 1,728 hr per year and at an 20 percent duty cycle, the contribution to the LF ambient noise environment from the operation of LFA sonar would be comparable to the noise generated by approximately 22 million ship-days per year by the world's commercial shipping industry (Hildebrand, 2005). Considering the total acoustic energy output of individual sources in calculating an annual noise energy budget in energy units of Joules, commercial supertankers were estimated to contribute 3.7×10^{12} Joules of acoustic energy into the marine environment each year (Joules/year [yr]); seismic airguns were estimated to contribute 3.9×10^{13} Joules/yr; mid-frequency military sonar was estimated to contribute 2.6×10^{13} Joules/yr; and each LFA sonar vessel operating at 432 hr/yr was estimated to contribute 1.7×10^{11} Joules/yr (Hildebrand, 2005). The percentage of the total anthropogenic acoustic energy budget added by each LFA source is estimated to be 0.25 percent when these anthropogenic sources are considered together (Hildebrand, 2005).

Therefore, within the existing ocean environment, as previously concluded, the potential for accumulation of noise due to the intermittent operation of SURTASS LFA sonar is considered negligible (DoN, 2012). Further, the potential impacts associated with the combined LF sound generated by LFA sonar, seismic exploration, and shipping are most likely to be behavioral in nature, likely to be temporary effects, comparatively short in duration, relatively infrequent, and not of the type or severity that would be expected to be additive for the small portion of the marine mammal stocks and species likely to be exposed either annually or in the reasonably foreseeable future.

12 LITERATURE CITED

- ANSI (American National Standard Institute). (2006). *ANSI reference quantities for acoustical levels, ANSI-S1-8-1989*, revised 2006. New York, NY: Acoustic Society of America.
- Baumann-Pickering, S., Roch, M. A., Jr, R. L. B., Simonis, A. E., McDonald, M. A., Solsona-Berga, A., Oleson, E. M., Wiggins, S. M., & Hildebrand, J. A. (2014). Spatio-temporal patterns of beaked whale echolocation signals in the North Pacific. *PLoS ONE*, 9(1), e86072. doi:doi:10.1371/journal.pone.0086072.
- Cranford, T. W., & Krysl, P. (2015). Fin whale sound reception mechanisms: Skull vibration enables low-frequency hearing. *PLoS ONE*, 10(1), e0116222. doi:10.1371/journal.pone.0116222.
- DoD (Department of Defense). (2012). Record of decision for Surveillance Towed Array Sensor System Low Frequency Active sonar. Department of the Navy. *Federal Register*, 77(168), 52317.
- Department of the Navy (DoN). (2001). *Final overseas environmental impact statement and environmental impact statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar*. Washington, DC: Chief of Naval Operations, Department of the Navy.
- DoN. (2007). *Final comprehensive report for the operation of the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar onboard the R/V Cory Chouest and USNS IMPECCABLE (T-AGOS 23) under the National Marine Fisheries Service Regulations 50 CFR Subpart Q*. Washington, D.C.: Department of the Navy, Chief of Naval Operations.
- DoN. (2012). *Final supplemental environmental impact statement/ supplemental overseas environmental impact statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar*. Washington, D.C.: Department of the Navy, Chief of Naval Operations.
- DoN. (2016). *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 2016*. Washington, D.C.: Department of the Navy, Chief of Naval Operations. 168 pages.
- DoN. (2017). 2016 annual report of the Marine Mammal Monitoring (M3) program. Washington, D.C.: Department of the Navy, Chief of Naval Operations. 10 pages.
- Ellison, W. T., & P. J. Stein. (2001). *SURTASS LFA high frequency marine mammal monitoring (HF/M3) system: System description and test and evaluation*. Marine Acoustics, Inc. and Scientific Solutions, Inc., 26 November 1999. Retrieved from <<http://www.surtass-lfa-eis.com/docs/HF-M3%20Ellison%20Report%202-4a.pdf>>.
- Hildebrand, J. A. (2005). Impacts of anthropogenic sound. Pages 101-124 in J.E. Reynolds, W.F. Perrin, R.R. Reeves, S. Montgomery, and T.J. Ragen, (Eds). *Marine mammal research: Conservation beyond crisis*. Baltimore, Maryland: Johns Hopkins University Press.
- Hildebrand, J. A. (2009). Anthropogenic and natural sources of ambient noise in the ocean. *Marine Ecology Progress Series*, 395, 5-20.
- Kryter, K. (1985). *The effects of noise on man*. 2nd edition. New York, NY: Academic Press.

ANNUAL REPORT 5: SURTASS LFA SONAR OPERATIONS 2016 TO 2017

- Muslow, J., Schlundt, C. E., Brandt, L., & Finneran, J. J. (2015). Equal latency contours for bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalophus californianus*). *The Journal of the Acoustical Society of America*, 138(5), 2678-2691.
- NMFS (National Marine Fisheries Service). (2016). Endangered Species Act Section 7 Biological Opinion and Conference Report on U.S. Navy's proposed use of the Surveillance Towed Array Sensor System Low Frequency Active Sonar from August 2016 through August 2016 and NOAA's National Marine Fisheries Service, Office of Protected Resource's issuance of four letters of authorization for the U.S. Navy to "take" marine mammals incidental to Surveillance Towed Array Sensor System Low Frequency Active sonar testing, training and operations in areas of the Pacific Ocean for the period August 15, 2016 to August 14, 2017 pursuant to the 5-year MMPA regulation. NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division, Silver Spring, MD. 439 pages.
- NOAA (National Oceanic and Atmospheric Administration). (2012). Taking and importing marine mammals: Taking marine mammals incidental to U.S. Navy operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar; Final rule. 50 CFR Part 218. *Federal Register*, 77(161), 50290-50322.
- NOAA. (2016). Taking and importing marine mammals: Taking marine mammals incidental to Navy operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar; Notice—Issuance of four Letters of Authorization. *Federal Register*, 81(160), 55175-55177.
- Richardson, W. J., Greene, C. R., Jr., Malme, C. I., & Thomson, D. H. (1995). Marine mammals and noise. San Diego, CA: Academic Press.
- Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., C.R. Greene, J., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A., & Tyack, P. L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals*, 33(4), 411-522.
- Tournadre, J. (2014). Anthropogenic pressure on the open ocean: The growth of ship traffic revealed by altimeter data analysis. *Geophysical Research Letters*, 41(22), 7924-7932. doi:10.1002/2014gl061786.
- Urlick, R. J. (1983). *Principles of underwater sound*, 3rd edition. New York, NY: McGraw-Hill.
- Ward, W. D., (Ed.). (1968). Proposed damage-risk criterion for impulsive noise (gunfire). Committee on Hearing, Bioacoustics and Biomechanics. Washington, DC: National Research Council, National Academy of Science.

APPENDIX A:

**EXEMPLAR² LETTER OF AUTHORIZATION (LOA) GOVERNING THE
TAKING OF MARINE MAMMALS INCIDENTAL TO THE U.S. NAVY'S
OPERATION OF SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW
FREQUENCY ACTIVE (SURTASS LFA) SONAR ONBOARD THE USNS
VICTORIOUS (T-AGOS 19), AUGUST 15, 2016 THROUGH AUGUST 14,
2017**

² Only the LOA for the USNS VICTORIOUS (T-AGOS 19) is included herein. The LOAs for the USNS ABLE, USNS EFFECTIVE, and USNS IMPECCABLE are exactly the same as the LOA for the VICTORIOUS, with only the ship's names changing in each LOA.



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

LETTER OF AUTHORIZATION

The Chief of Naval Operations, Department of the Navy, 2000 Navy Pentagon, Washington, D.C. 20350-2000, and individuals operating under his authority (*i.e.*, Navy), are authorized to take marine mammals incidental to Navy operation of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar in accordance with 50 CFR Part 218, Subpart X- Taking of Marine Mammals Incidental to Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar subject to the provisions of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*; MMPA) and the following Conditions:

1. This Authorization is valid for the period August 15, 2016, through August 14, 2017.
2. This Authorization is valid only for the unintentional taking of the species of marine mammals identified in 50 CFR § 218.230(b) and Condition 5 of this Authorization governing the taking of these animals incidental to the activity specified in Condition 3. This authorization shall be valid only for takes consistent with the provisions in 50 CFR § 218.232 and the terms of this Authorization as specified herein.
3. This Authorization is valid only for activities associated with the routine training, testing, and military operations of SURTASS LFA sonar onboard the United States Naval Ship (USNS) VICTORIOUS (T-AGOS 19). The sound signals transmitted by the SURTASS LFA sonar source must be between 100 and 500 Hertz (Hz) with a source level for each of the 18 projectors of no more than 215 decibels (dB) re: 1 micro Pascal (μ Pa) at 1 meter (m) (root mean square (rms) and a maximum duty cycle of 20 percent.
4. This Authorization, combined with Authorizations for the USNS ABLE (T-AGOS 20), USNS EFFECTIVE (T-AGOS 21), and USNS IMPECCABLE (T-AGOS 23), is valid for an estimated total of 20 nominal active sonar missions among the four SURTASS LFA sonar vessels (or equivalent number of shorter missions but shall not exceed a total of 432 hours of sonar transmit time per vessel during the period of this Authorization's effectiveness) within the following areas:
 - (a) Up to 16 nominal missions in the western North Pacific Ocean, which includes the following mission areas: east of Japan; the north Philippine Sea; the west Philippine Sea; offshore Guam; the Sea of Japan; the East China Sea; the South China Sea; offshore Japan (25° to 40° N and 10° to 25° N), and northeast of Japan.
 - (b) Up to two nominal missions in the central North Pacific Ocean that include the Hawaii North and Hawaii South mission areas.



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- (c) Up to two nominal missions in the Indian Ocean that include the Arabian Sea, the Andaman Sea, and northwest of Australia mission areas.

SPECIES AUTHORIZED AND LEVEL OF TAKE

5. The incidental take of marine mammals under the activity identified in Conditions 3 and 4 of this Authorization is limited to the following species:
- (a) **Mysticetes:** blue whale (*Balaenoptera musculus*), Bryde's whale (*Balaenoptera edeni*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), common minke whale (*Balaenoptera acutorostrata*), north Pacific right whale (*Eubalena japonica*), sei whale (*Balaenoptera borealis*), and Omura's whale (*Balaenoptera omurai*).
 - (b) **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*), Deraniyaga's beaked whale (*Mesoplodon hotaula*), dwarf sperm (*Kogia simus*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*), harbor porpoise (*Phocoena phocoena*), Hubbs' beaked whale (*Mesoplodon carhubbsi*), Indo-Pacific bottlenose dolphin (*Tursiops abuncus*), killer whale (*Orca orcinus*), *Kogia* spp., Longman's beaked whale (*Indopacetus pacificus*), melon-headed whale (*Peponocephala electra*), *Mesoplodon* spp., Northern right whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), pygmy sperm whales (*K. breviceps*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), short-beaked common dolphin (*Delphinus delphis*), short-finned pilot whale (*Globicephala macrorhynchus*), southern bottlenose whale (*Hyperodon planifrons*), sperm whale (*Physeter macrocephalus*), spinner dolphin (*Stenella longirostris*), Stejneger's beaked whale (*Mesoplodon stejnegeri*), and striped dolphin (*Stenella coeruleoalba*).
 - (c) **Pinnipeds:** Hawaiian monk seal (*Monachus shauinslandi*), northern fur seal (*Callorhinus ursinus*), ribbon seal (*Histiophoca fasciata*), spotted seal (*Phoca largha*), and Steller sea lion (*Eumetopia jubatus*).
6. The taking of marine mammals by the Holder of this Authorization is limited to the incidental taking of marine mammal species identified in Condition 5 by Level A and Level B harassment (as defined in the MMPA and 50 CFR § 216.3) within those areas authorized under Condition 4. The take, by Level B harassment, that occurs during the year covered by this Authorization may not exceed 12 percent of any marine mammal stock listed in Condition 5 (see Condition 8j and Tables 2 – 12 of Attachment 2). The take by Level A harassment may not exceed the numbers specified for each category in Table 1 of Attachment 2 for the total effective period of the regulations at 50 CFR Part 218, Subpart X.
7. Taking of marine mammal species not listed under Condition 5 by harassment, injury, or mortality or the taking by mortality of any marine mammal species listed under Condition 5 is prohibited.

MITIGATION

8. The Holder of this Authorization, and any individuals operating under his authority, must conduct the activity identified in 50 CFR § 218.230 and Condition 3 of this Authorization in a manner that minimizes, to the greatest extent practicable, adverse impacts on marine mammals, their habitats, and the availability of marine mammals for subsistence uses.

When conducting operations identified in 50 CFR § 218.230, the following mitigation measures must be implemented:

- (a) The Holder of this Authorization, and any individuals operating under his authority, must not transmit the SURTASS LFA sonar signal at a frequency greater than 500 Hz.
- (b) Through mitigation described under 50 CFR § 218.234 and Condition 9 (Mitigation Monitoring) of this Authorization, the Holder of this Authorization and any individuals operating under his authority must ensure, to the greatest extent practicable, that no marine mammal is subjected to a sound pressure level of 180 dB re: 1 μ Pa (rms) or greater.
- (c) **LFA Sonar Mitigation Zone:** Prior to commencing and during SURTASS LFA sonar transmissions, the Holder of this Authorization will use near real-time environmental data and underwater acoustic prediction models to determine the propagation of the SURTASS LFA sonar signals in the mission area. The Holder of this Authorization must determine the distance from the SURTASS LFA sonar source to the 180-dB re: 1 μ Pa (rms) isopleth (*i.e.*, the LFA sonar mitigation zone) to comply with Condition 8(b).
 - (i) The Holder of this Authorization will update these sound field estimates every 12 hours or more frequently depending upon changing meteorological or oceanographic conditions.
- (d) **Additional 1-Kilometer (km) Buffer Zone:** The Holder of this Authorization will establish a 1-km buffer zone around the LFA sonar mitigation zone.
- (e) **Ramp-Up Procedures for the HF/M3 System:** The Holder of this Authorization and any individuals operating under his authority, will ramp up the High Frequency / Marine Mammal Monitoring (HF/M3) active sonar referenced in 50 CFR § 218.234 from a power level beginning at a maximum source sound pressure level of 180 dB re: 1 μ Pa @ 1 m (rms) in 10-dB increments to operating levels over a period of no less than five minutes:
 - (i) At least 30 minutes prior to any SURTASS LFA sonar transmission;
 - (ii) Prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmissions described in 50 CFR § 218.230; and
 - (iii) Anytime after individuals have powered down the HF/M3 active sonar source for more than two minutes.

Once HF/M3 operators detect a marine mammal, they will not increase the HF/M3 active sonar system's sound pressure level. Resumption of the ramp-up of HF/M3 sonar system would not occur until marine mammals are no longer detected by the

HF/M3 active sonar system, passive acoustic monitoring, or visual monitoring described in Condition 9.

- (f) **Suspension/Delay for SURTASS LFA Sonar Transmissions:** If the Holder of this Authorization, and any individuals operating under his authority, detects a marine mammal through monitoring required under 50 CFR § 218.235 and Condition 9 within either the LFA sonar mitigation zone or the 1-km buffer zone, the Holder of this Authorization will immediately suspend or delay SURTASS LFA sonar transmissions.
- (g) **Resumption of SURTASS LFA Sonar Transmissions:** The Holder of this Authorization and any individuals operating under his authority may resume/commence SURTASS LFA sonar transmissions 15 minutes after:
- (i) All marine mammals have left the area of the LFA sonar mitigation zone and the 1-km buffer zone; and/or
 - (ii) There is no further detection of any marine mammal within the LFA sonar mitigation zone plus the 1-km buffer zone as determined by the passive or active acoustic or visual monitoring protocols described in 50 CFR § 218.235 and Condition 9.
- (h) **Geographic Restrictions:** The Holder of this Authorization and any individuals operating under his authority will not operate SURTASS LFA sonar such that the SURTASS LFA sonar sound field exceeds 180 dB re: 1 μ Pa (rms):
- (i) At a distance of less than or equal to 22 km (14 miles (mi); 12 nautical miles (nmi)) from any coastline, including offshore islands.
 - (ii) At a distance of less than 1 km (0.62 mi; 0.54 nmi) seaward of the outer perimeter of any Offshore Biologically Important Area (OBIA) for marine mammals designated in 50 CFR § 218.234(f)(2) and described in Condition 8(h)(iii) during the period specified.
 - (iii) The OBIAs for marine mammals (with specified periods of effectiveness) for SURTASS LFA sonar routine training, testing, and military operations are:

OBIA	Period of Effectiveness
Georges Bank	Year-round
Roseway Basin Right Whale Conservation Area	June through December, annually
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS)	January 1 to November 14, annually
Southeastern U.S. Right Whale Seasonal Habitat	November 15 to April 15, annually
North Pacific Right Whale Critical Habitat	March through August, annually
Silver Bank and Navidad Bank	December through April, annually
Coastal waters of Gabon, Congo, and Equatorial Guinea	June through October, annually
Patagonian Shelf Break	Year-round

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Southern Right Whale Seasonal Habitat	May through December, annually
Central California NMSSs	June through November, annually
Antarctic Convergence Zone	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-Provençal Basin and Western Pelagos Sanctuary in the Mediterranean Sea	July to August, annually
Hawaiian Islands Humpback Whale NMS and Penguin Bank	November through April, annually
Costa Rica Dome	Year-round
Great Barrier Reef Between 16° S and 21° S	May through September, annually
Bonney Upwelling on the southern coast of Australia	December through May, annually
Northern Bay of Bengal and Head of Swatch-of-No-Ground	Year-round
Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon	Olympic NMS: December, January, March, and May, annually The Prairie, Barkley Canyon, and Nitnat Canyon: June through September, annually
Abrolhos Bank	August through November

Note: See § 218.234(f)(2) and Attachment 1 for geographic coordinate information.

- (i) **Operational Exception for SURTASS LFA Sound Field in OBIA:** During military operations, SURTASS LFA sonar transmissions may exceed 180 dB re: 1 μ Pa (rms) within the boundaries of an OBIA, including operating within an OBIA, when the Holder of this Authorization determines that it is: 1) operationally necessary to continue tracking an existing underwater contact; or 2) operationally necessary to detect a new underwater contact within the OBIA. This exception does not apply to routine training and testing with the SURTASS LFA sonar systems.
- (j) **Mission Planning:** The Holder of this Authorization must maintain a running calculation/estimation of takes of each species and stocks over the effective period of these regulations. The Holder of this Authorization will plan all SURTASS LFA sonar missions to ensure that no more than 12 percent of any marine mammal stock listed in 50 CFR § 218.230(b)(1) through (3) would be taken by Level B harassment annually. This annual per-stock cap of 12 percent applies regardless of the number of SURTASS LFA sonar vessels operating. The Holder of this Authorization must coordinate with the Holders of the Authorizations issued to the USNS ABLE, USNS EFFECTIVE, and the USNS IMPECCABLE, to ensure that this condition is met for all vessels combined.

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MITIGATION MONITORING

9. The Holder of this Authorization, and any individuals operating under his authority, must:

- (a) Perform the following for visual mitigation monitoring:
 - (i) Marine mammal biologists qualified in conducting at-sea marine mammal visual monitoring from surface vessels will train and qualify designated ship personnel as lookouts to conduct at-sea visual monitoring.
 - (ii) Marine mammal biologists will train the lookouts in the most effective means to ensure quick and effective communication within the ship's command structure to facilitate implementation of protective measures if they observe marine mammals.
 - (iii) Conduct visual monitoring from the ship's bridge during daylight hours (30 minutes before sunrise until 30 minutes after sunset) during operations that employ SURTASS LFA sonar in the active mode. Maintain a topside watch with standard binoculars (7x) and with the naked eye.
- (b) Perform the following for passive acoustic mitigation monitoring:
 - (i) Use the low frequency, passive SURTASS sonar system to listen for vocalizing marine mammals.
- (c) Perform the following for active acoustic mitigation monitoring:
 - (i) Use the HF/M3 active sonar to locate and track marine mammals in relation to the SURTASS LFA sonar vessel and the sound field produced by the SURTASS LFA sonar source array, subject to the ramp-up requirements in § 218.234(e) and Condition 8(e).

10. Mitigation monitoring under Conditions 9(a), (b), and (c) must:

- (a) Commence at least 30 minutes before the first SURTASS LFA sonar transmission (30 minutes before sunrise for visual monitoring);
- (b) Continue between sonar transmissions (pings); and
- (c) Continue either at least 15 minutes after completion of SURTASS LFA sonar transmission operations (30 minutes after sunset for visual monitoring) or if marine mammals are showing abnormal behavioral patterns, for a period of time until behavior patterns return to normal or conditions prevent continued observations.

MONITORING

11. The Holder of this Authorization and any individuals operating under his authority for activities described in 50 CFR § 218.230 must:

- (a) Cooperate with NMFS and any other federal agency for monitoring the impacts of the activity on marine mammals; and
- (b) Designate qualified on-site individuals to conduct the mitigation, monitoring, and

reporting activities specified in this Letter of Authorization.

12. The Holder of this Authorization and any individuals operating under his authority will conduct all monitoring required under the Letter of Authorization to increase knowledge of the affected marine mammal species. The Holder of this Authorization must:
- (a) Consider recommendations on the different types of monitoring/research that could increase the understanding of the potential effects of SURTASS LFA sonar transmissions on beaked whales and/or harbor porpoises.
 - (b) Continue to assess data from the Navy Marine Mammal Monitoring (M3) program and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on these data that are determined to be unclassified after appropriate security reviews should be made publicly available.
 - (c) Continue to explore the feasibility of coordinating with other Navy fleet assets and/or range monitoring programs to include the use of SURTASS passive sonar (towed horizontal line array) to augment the collection of marine mammal vocalizations before, during, and after designated exercises.
 - (d) Continue to collect ambient noise data and explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise research efforts.

REPORTING

13. The Holder of this Authorization and any individuals operating under his authority must:
- (a) Draft a plan of action outlining a strategy for implementing recommendations on beaked whales and/or harbor porpoise research; or describe in writing why such research is not feasible/or is unlikely to increase the understanding of the potential effects of SURTASS LFA sonar transmissions on beaked whales and/or harbor porpoises, to be followed by a meeting with NMFS to discuss any other potential options.
 - (b) Provide a status update to NMFS when the Holder of this Authorization submits the next annual application for Authorizations on efforts to assess the data collected by the Marine Mammal Monitoring (M3) program and progress toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances.
 - (c) Systematically observe SURTASS LFA sonar operations for injured or disabled marine mammals and monitor the principal marine mammal stranding networks and other media to correlate analysis of any whale strandings that could potentially be associated with SURTASS LFA sonar operations. The Holder of this Authorization and any individuals operating under his authority shall:
 - (i) Ensure that NMFS is notified immediately, or as soon as clearance procedures allow, if an injured, stranded, or dead marine mammal is observed during or shortly after and in the vicinity of any SURTASS LFA sonar operations. The Holder of this Authorization will report the incident to the Chief, Permits and

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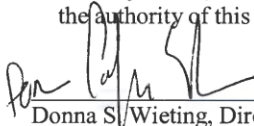
Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and Dale.Youngkin@noaa.gov.

- (ii) Provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).
 - (iii) In the event that an injured, stranded, or dead marine mammal is observed by the Holder of this Authorization and any individuals operating under his authority not in conjunction with SURTASS LFA sonar operations, the Holder of this Authorization and any individuals operating under his authority, will report the same information to NMFS as listed above as soon as operationally feasible and clearance procedures allow.
- (d) In the event of a ship strike by the SURTASS LFA sonar vessel, at any time or place, the Holder of this Authorization and any individuals operating under his authority, must:
- (i) Immediately, or as soon as clearance procedures allow, report to NMFS the species identification (if known), the size and length of the animal, location (lat/long) of the animal (or the strike if the animal has disappeared), whether the animal is alive or dead (or unknown), including an estimate of its injury status if alive (injured but alive, injured and moving, unknown, etc.).
 - (ii) Report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and Dale.Youngkin@noaa.gov.
 - (iii) Report as soon as feasible to the NMFS the vessel's name, class/type, and length, as well as operational status, speed and vessel heading.
 - (iv) Provide NMFS a photo or video of the struck animal, if equipment is available.
- (e) Submit classified and unclassified quarterly mission reports to the Director, Office of Protected Resources, NMFS no later than 30 days after the end of each quarter, beginning on the date of effectiveness of a Letter of Authorization. Each quarterly mission report will include summaries of all active-mode sonar missions completed during that quarter. At a minimum, each classified mission report must contain the following information:
- (i) Dates, times, and location of each vessel during each mission.
 - (ii) Information on sonar transmissions during each mission and records of any delays or suspensions.
 - (iii) Location of the SURTASS LFA sonar mitigation and buffer zones in relation to the LFA sonar array.
 - (iv) Marine mammal observations including 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 vessel, abnormal behavior (if any), and remarks/narrative (as necessary).

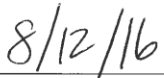
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- (v) The report will include the Navy's estimates of the percentages of marine mammal stocks affected (both for the quarter and cumulatively for the year covered by the Authorization) by SURTASS LFA sonar operations (both within and outside the LFA sonar mitigation and buffer zones), using predictive modeling based on mission locations, dates/times of operations, system characteristics, LFA sonar transmission durations, oceanographic environmental conditions, and animal demographics.
- (vi) If no SURTASS LFA sonar missions are completed during a quarter, a report of negative activity will be provided.
- (f) Submit an annual, unclassified report to the Director, Office of Protected Resources, NMFS, no later than 45 days after expiration of this Authorization. At a minimum, the annual report will contain the following:
 - (i) An unclassified summary of the year's quarterly reports.
 - (ii) The Navy's estimates of the percentages of marine mammal stocks affected by SURTASS LFA sonar operations (both within and outside the LFA sonar mitigation and buffer zones), using predictive modeling based on mission locations, dates/times of operations, system characteristics, LFA sonar transmission durations, oceanographic environmental conditions, and animal demographics.
 - (iii) An analysis of the effectiveness of the mitigation measures with recommendations for improvements, where applicable.
 - (iv) An assessment of any long-term effects from SURTASS LFA sonar operations.
 - (v) Any discernible or estimated cumulative impacts from SURTASS LFA sonar operations.
- 14. The Holder of this Authorization must comply with the Terms and Conditions of the Incidental Take Statement corresponding to the Endangered Species Act Biological Opinion issued to the Navy and the National Marine Fisheries Service's Office of Protected Resources, Permits and Conservation Division.
- 15. A copy of this Authorization must be in the possession of the Officer in Charge of the Military Crew (MILCREW) onboard the USNS VICTORIOUS to conduct the activity under the authority of this Letter of Authorization and Incidental Take Statement.



Donna S. Wieting, Director
Office of Protected Resources
National Marine Fisheries Service



Date

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Attachment 1 – Table 1. OBIA Coordinates and Periods of Effectiveness.

Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Georges Bank	40°00'N, 72°30'W 39°37' N, 72°09'W 39°54'N, 71°43'W 40°02' N, 71°20'W 40°08'N, 71°01'W 40°04'N, 70°44'W 40°00'N, 69°24'W 40°16'N, 68°27'W 40°34'N, 67°13'W 41°00'N, 66°24'W 41°52'N, 65°47'W 42°20'N, 66°06'W 42°18'N, 67°23'W	Year-round
Roseway Basin Right Whale Conservation Area	43°05'N, 65°40'W 43°05'N, 65°03'W 42°45'N, 65°40'W 42°45'N, 65°03'W	June through December, annually
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS)	41°00.000'N, 69°05.000'W 42°09.000'N, 67°08.400'W 42°53.436'N, 67°43.873'W 44°12.541'N, 67°16.847'W 44°14.911'N, 67°08.936'W 44°21.538'N, 67°03.663'W 44°26.736'N, 67°09.596'W 44°16.805'N, 67°27.394'W 44°11.118'N, 67°56.398'W 43°59.240'N, 68°08.263'W 43°36.800'N, 68°46.496'W 43°33.925'N, 69°19.455'W 43°32.008'N, 69°44.504'W 43°21.922'N, 70°06.257'W 43°04.084'N, 70°21.418'W 42°51.982'N, 70°31.965'W 42°45.187'N, 70°23.396'W 42°39.068'N, 70°30.188'W 42°32.892'N, 70°35.873'W 42°07.748'N, 70°28.257'W 42°05.592'N, 70°02.136'W 42°03.664'N, 69°44.000'W 41°40.000'N, 69°45.000'W	January 1 to November 14, annually
Southeastern U.S. Right Whale Seasonal Habitat	Critical Habitat Boundaries are coastal waters between 31°15' N and 30°15'N from the coast out 15 nautical miles (nmi); and the coastal waters between 30°15' N and 28°00'N from the coast out 5 nmi (50 CFR §226.13(c)). OBIA Boundaries are coastal waters between 31°15'N and 30°15'N from 12 to 15 nmi.	November 15 to April 15, annually
North Pacific Right Whale Critical Habitat	57°03'N, 153°00'W 57°18'N, 151°30'W 57°00'N, 151°30'W 56°45'N, 153°00'W (50 CFR §226.215)	March through August, annually

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Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Silver Bank and Navidad Bank	<p>Silver Bank: 20° 38.899'N, 69° 23.640'W 20° 55.706'N, 69° 57.984'W 20° 25.221'N, 70° 00.387'W 20° 12.833'N, 69° 40.604'W 20° 13.918'N, 69° 31.518'W 20° 28.680'N, 69° 31.900'W</p> <p>Navidad Bank: 20° 15.596'N, 68° 47.967'W 20° 11.971'N, 68° 54.810'W 19° 52.514'N, 69° 00.443'W 19° 54.957'N, 68° 51.430'W 19° 51.513'N, 68° 41.399'W</p>	December through April, annually
Coastal waters of Gabon, Congo and Equatorial Guinea	An exclusion zone following the 500-m isobath extending from 3°31.055'N, 9°12.226'E in the north offshore of Malabo southward to 8°57.470'S, 12°55.873'E offshore of Luanda.	June through October, annually
Patagonian Shelf Break	Between 200- and 2,000-m isobaths and the following latitudes: 35°00'S, 39°00'S, 40°40'S, 42°30'S, 46°00'S, 48°50'S.	Year-round
Southern Right Whale Seasonal Habitat	Coastal waters between 42°00'S and 43°00'S from 12 to 15 nmi including the enclosed bays of Golfo Nuevo, Golfo San Jose, and San Matias. Golfos San Jose and San Nuevo are within 22 km (14 mi; 12 nmi) coastal exclusion zone.	May through December, annually
Central California National Marine Sanctuaries	Single stratum boundary created from the Cordell Bank (15 CFR 922.10), Gulf of the Farallones (15 CFR 922.80), and Monterey Bay (15 CFR 922.30) NMS legal boundaries. Monterey Bay NMS includes the Davidson Seamount Management Zone.	June through November, annually
Antarctic Convergence Zone	30°E to 80°E, 45°S 80°E to 150°E, 55°S 150°E to 50°W, 60°S 50°W to 30°E, 50°S	October through March, annually

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Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Piltun and Chayvo offshore feeding grounds in the Sea of Okhotsk	54°09.436'N, 143°47.408'E 54°09.436'N, 143°17.354'E 54°01.161'N, 143°17.354'E 53°53.580'N, 143°13.398'E 53°26.963'N, 143°28.230'E 53°07.013'N, 143°35.481'E 52°48.705'N, 143°38.447'E 52°32.077'N, 143°37.788'E 52°21.605'N, 143°34.163'E 52°09.470'N, 143°26.582'E 51°57.686'N, 143°30.208'E 51°36.033'N, 143°42.794'E 51°08.082'N, 143°51.301'E 51°08.082'N, 144°16.742'E 51°24.514'N, 144°11.139'E 51°48.116'N, 144°10.809'E 52°03.194'N, 144°20.363'E 52°23.235'N, 144°10.150'E 52°28.674'N, 144°12.787'E 52°42.523'N, 144°10.150'E 53°12.972'N, 143°55.648'E 53°18.505'N, 143°56.637'E 53°23.041'N, 143°53.011'E 53°28.250'N, 143°53.341'E 53°44.039'N, 143°49.056'E 53°53.207'N, 143°50.045'E 53°59.819'N, 143°48.067'E	June through November, annually
Coastal waters off Madagascar	16°03'55.04"S, 50°27'12.59"E 16°12'23.03"S, 51°03'37.38"E 24°30'45.06"S, 48°26'00.94"E 24°15'28.07"S, 47°46'51.16"E 22°18'00.74"S, 48°14'13.52"E 20°52'24.12"S, 48°43'13.49"E 19°22'33.24"S, 49°15'45.47"E 18°29'46.08"S, 49°37'32.25"E 17°38'27.89"S, 49°44'27.17"E 17°24'39.12"S, 49°39'17.03"E 17°19'35.34"S, 49°54'23.82"E 16°45'41.71"S, 50°15'56.35"E	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales.
Madagascar Plateau, Madagascar Ridge, and Walters Shoal	25°55'20.00"S, 44°05'15.45"E 25°46'31.36"S, 47°22'35.90"E 27°02'37.71"S, 48°03'31.08"E 35°13'51.37"S, 46°26'19.98"E 35°14'28.59"S, 42°35'49.20"E 31°36'57.96"S, 42°37'49.35"E 27°41'11.21"S, 44°30'11.01"E	November through December, annually

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Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Ligurian-Corsican-Provençal Basin and Western Pelagos Sanctuary in the Mediterranean Sea	42°50.271'N, 06°31.883'E 42°55.603'N, 06°43.418'E 43°04.374'N, 06°52.165'E 43°12.600'N, 07°10.440'E 43°21.720'N, 07°19.380'E 43°30.600'N, 07°32.220'E 43°33.900'N, 07°49.920'E 43°36.420'N, 08°05.580'E 43°42.600'N, 08°22.140'E 43°50.880'N, 08°34.500'E 43°58.560'N, 08°47.700'E 43°59.040'N, 08°56.040'E 43°57.047'N, 09°03.540'E 43°52.260'N, 09°08.520'E 43°47.580'N, 09°13.500'E 43°36.060'N, 09°16.620'E 43°28.440'N, 09°05.820'E 43°21.360'N, 09°02.100'E 43°16.020'N, 08°57.240'E 43°04.440'N, 08°47.580'E 42°54.900'N, 08°35.400'E 42°45.900'N, 08°27.540'E 42°36.060'N, 08°22.020'E 42°22.620'N, 08°15.849'E 42°07.202'N, 08°17.174'E 41°52.800'N, 08°15.720'E 41°39.780'N, 08°05.280'E 41°28.200'N, 08°51.600'E 42°57.060'N, 06°19.860'E	July to August, annually
Hawaiian Islands Humpback Whale NMS and Penguin Bank	21°10'02.179"N, 157°30'58.217"W 21°09'46.815"N, 157°30'22.367"W 21°06'39.882"N, 157°31'00.778"W 21°02'51.976"N, 157°30'30.049"W 20°59'52.725"N, 157°29'28.591"W 20°58'05.174"N, 157°27'35.919"W 20°55'49.456"N, 157°30'58.217"W 20°50'44.729"N, 157°42'42.418"W 20°51'02.654"N, 157°44'45.333"W 20°53'56.784"N, 157°46'04.716"W 20°56'32.988"N, 157°45'33.987"W 21°01'27.472"N, 157°43'10.586"W 21°05'20.499"N, 157°39'27.802"W 21°10'02.179"N, 157°30'58.217"W	November through April, annually
Costa Rica Dome	Centered at 9°N and 88°W	Year-round

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Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Great Barrier Reef Between 16° S and 21° S	16°01.829'S, 145°38.783'E 15°52.215'S, 146°20.936'E 17°28.354'S, 146°59.392'E 20°16.228'S, 151°39.674'E 20°58.381'S, 150°30.897'E 20°17.007'S, 149°38.247'E 20°10.941'S, 149°18.247'E 20°02.403'S, 149°12.623'E 19°53.287'S, 149°03.986'E 19°49.866'S, 148°52.135'E 19°53.287'S, 148°44.302'E 19°47.965'S, 148°36.870'E 19°47.205'S, 148°26.024'E 19°19.978'S, 147°39.626'E 19°14.065'S, 147°37.014'E 19°08.913'S, 147°31.993'E 19°05.667'S, 147°24.160'E 19°07.576'S, 147°18.134'E 18°51.718'S, 146°51.219'E 18°44.258'S, 146°54.031'E 18°37.175'S, 146°51.420'E 18°31.620'S, 146°43.385'E 18°27.595'S, 146°40.573'E 17°36.676'S, 146°20.488'E 17°20.484'S, 146°16.671'E 17°07.745'S, 146°13.056'E 16°49.769'S, 146°11.047'E 16°41.835'S, 146°03.817'E 16°39.706'S, 145°54.979'E	May through September, annually
Bonney Upwelling on the west coast of Australia	37°12'20.036"S, 139°31'17.703"E 37°37'33.815"S, 139°42'42.508"E 38°10'36.144"S, 140°22'57.345"E 38°44'50.558"S, 141°33'50.342"E 39°07'04.125"S, 141°11'00.733"E 37°28'33.179"S, 139°10'52.263"E	December through May, annually
Northern Bay of Bengal and Head of Swatch-of-No-Ground	20°59.735'N, 89°07.675'E 20°55.494'N, 89°09.484'E 20°52.883'N, 89°12.704'E 20°55.275'N, 89°18.133'E 21°04.558'N, 89°25.294'E 21°12.655'N, 89°25.354'E 21°13.279'N, 89°16.833'E 21°06.347'N, 89°15.011'E	Year-round
Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon	Boundaries within 23 nmi (26.5 m; 42.6 km) of the coast from 47°07' N to 48°30' N latitude 48°30'01.995"N, 125°58'38.786"W 48°16'55.605"N, 125°38'52.052"W 48°23'07.353"N, 125°17'10.935"W 48°12'38.241"N, 125°16'42.339"W 47°58'20.361"N, 125°31'14.517"W 47°58'20.361"N, 126°06'16.322"W 48°09'46.665"N, 126°25'48.758"W	Olympic NMS: December, January, March, and May, annually The Prairie, Barkley Canyon, and Nitnat Canyon: June through September, annually

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Name of Area	Location of Area	Months of Importance/ Periods of Effectiveness
Abrolhos Bank	16°35'34.909"S, 38°52'30.455"W 16°35'31.619"S, 38°43'41.069"W 16°40'00.131"S, 37°23'52.492"W 19°30'59.069"S, 37°23'52.446"W 19°30'59.974"S, 39°33'38.351"W 19°20'24.752"S, 39°30'33.03"W 18°52'16.884"S, 39°32'31.789"W 18°45'09.937"S, 39°32'27.709"W 18°30'59.345"S, 39°30'59.669"W 18°27'28.985"S, 39°30'13.453"W 18°17'30.429"S, 39°26'21.073"W 18°07'43.518"S, 39°19'52.924"W 18°09'24.931"S, 39°16'24.913"W 18°10'04.585"S, 39°12'30.425"W 18°10'20.682"S, 38°39'06.185"W 18°08'50.404"S, 38°35'00.059"W 18°06'05.466"S, 38°31'41.385"W 18°02'09.399"S, 38°29'26.179"W 17°58'01.372"S, 38°28'45.409"W 17°53'58.883"S, 38°29'34.612"W 16°48'58.768"S, 38°55'23.768"W 16°43'15.682"S, 38°53'40.007"W	August through November, annually

Attachment 2 – Authorized Take Estimates by Mission Area

The Holder of this Authorization must maintain a running calculation/estimation of takes of each species/stock over the effective period of this Authorization. The take, by Level B harassment, that occurs during the year covered by this Authorization may not exceed 12 percent of any marine mammal stock listed in the following tables.

The Holder of this Authorization must also coordinate with the Holders of the Authorizations issued to the USNS ABLE, the USNS EFFECTIVE, and the USNS IMPECCABLE, to ensure that these conditions are met for all vessels combined.

Table 1. Number of cetaceans and pinnipeds authorized to be taken by Level A harassment for all SURTASS LFA sonar operations over the 5-year rulemaking period.

Category	Requested Take Authorization Level A harassment
Mysticetes	No more than 6 over the course of the regulations.
Odontocetes	No more than 25 over the course of the regulations.
Pinnipeds	No more than 25 over the course of the regulations.

Tables 2-12. Number of marine mammals estimated to be taken by Level B harassment for all SURTASS LFA sonar operations during the annual LOA effective period in each of the Navy's requested mission areas.

The number of marine mammals authorized to be taken is based on the estimated percentage of the species' stock affected by a nominal number of SURTASS LFA sonar missions per mission area.

Table 2. Mission Area 1 - East of Japan	
Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	2
Bryde's whale	17
Common minke whale	63
Fin whale	3
Humpback whale	6
North Pacific right whale	1
Sei whale	17
Baird's beaked whale	47
Common bottlenose dolphin	237
Cuvier's beaked whale	65
False killer whale	60
Ginkgo-toothed beaked whale	11
Harbor porpoise	338
Hubbs' beaked whale	11
Killer whale	2
<i>Kogia</i> spp.	67
Pacific white-sided dolphin	74
Pantropical spotted dolphin	117
Pygmy killer whale	35
Risso's dolphin	207
Rough-toothed dolphin	118
Short-beaked common dolphin	1,617
Short-finned pilot whale	210
Sperm whale	20
Spinner dolphin	4

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Stejneger's beaked whale	11
Striped dolphin	84

Table 3. Mission Area 2 – North Philippine Sea	
Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	2
Bryde's whale	46
Common minke whale	321
Fin whale	11
Humpback whale	45
North Pacific right whale	2
Blainville's beaked whale	22
Common bottlenose dolphin	662
Cuvier's beaked whale	221
False killer whale	135
Fraser's dolphin	305
Ginkgo-toothed beaked whale	22
Killer whale	6
<i>Kogia</i> spp.	146
Long-beaked common dolphin	4,962
Longman's beaked whale	11
Melon-headed whale	198
Pacific white-sided dolphin	358
Pantropical spotted dolphin	569
Pygmy killer whale	98
Risso's dolphin	491
Rough-toothed dolphin	274
Short-beaked common dolphin	2,409
Short-finned pilot whale	692
Sperm whale	48
Spinner dolphin	36
Striped dolphin	1,366

Table 4. Mission Area 3 – West Philippine Sea	
Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	3
Bryde's whale	44
Common minke whale	234
Fin whale	11
Humpback whale	67
Blainville's beaked whale	20
Common bottlenose dolphin	652
Cuvier's beaked whale	12
Deraniyagala's beaked whale	20
False killer whale	131
Fraser's dolphin	293
Ginkgo-toothed beaked whale	20
Killer whale	6
<i>Kogia</i> spp.	83
Long-beaked common dolphin	4,559

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Longman's beaked whale	11
Melon-headed whale	193
Omura's whale	6
Pantropical spotted dolphin	498
Pygmy killer whale	95
Risso's dolphin	504
Rough-toothed dolphin	269
Short-finned pilot whale	329
Sperm whale	46
Spinner dolphin	31
Striped dolphin	597

Table 5. Mission Area 4 - Offshore Guam

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	2
Bryde's whale	12
Common minke whale	5
Fin whale	2
Humpback whale	11
Sei whale	6
Blainville's beaked whale	39
Common bottlenose dolphin	53
Cuvier's beaked whale	31
Deraniyagala beaked whale	37
Dwarf sperm whale	226
False killer whale	25
Fraser's dolphin	167
Ginkgo-toothed beaked whale	37
Killer whale	5
Longman's beaked whale	73
Melon-headed whale	96
Omura's whale	3
Pantropical spotted dolphin	289
Pygmy killer whale	5
Pygmy sperm whale	93
Risso's dolphin	100
Rough-toothed dolphin	82
Short-finned pilot whale	122
Sperm whale	36
Spinner dolphin	11
Striped dolphin	80

Table 6. Mission Area 5 - Sea of Japan

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Bryde's whale	3
Common minke whale	8
Fin whale	31
North Pacific right whale	-
Western North Pacific gray whale	1

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Baird's beaked whale	6
Common bottlenose dolphin	9
Cuvier's beaked whale	54
Dall's porpoise	597
False killer whale	33
Harbor porpoise	63
Killer whale	2
<i>Kogia</i> spp.	21
Long-beaked common dolphin	1,531
Omura's whale	1
Pacific white-sided dolphin	-
Risso's dolphin	84
Rough-toothed dolphin	30
Short-beaked common dolphin	1,137
Short-finned pilot whale	19
Sperm whale	31
Spinner dolphin	5
Stejneger's beaked whale	9
Striped dolphin	31
Spotted seal	1

Table 7. Mission Area 6 - East China Sea

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Bryde's whale	8
Common minke whale	92
Fin whale	4
North Pacific right whale	1
Western North Pacific gray whale	1
Omura's whale	1
Blainville's beaked whale	8
Common bottlenose dolphin	32
Cuvier's beaked whale	5
False killer whale	19
Fraser's dolphin	133
Ginkgo-toothed beaked whale	8
Killer whale	2
<i>Kogia</i> spp.	29
Long-beaked common dolphin	1,749
Longman's beaked whale	4
Melon-headed whale	72
Pacific white-sided dolphin	39
Pantropical spotted dolphin	198
Pygmy killer whale	3
Risso's dolphin	176
Rough-toothed dolphin	45
Short-beaked common dolphin	697
Short-finned pilot whale	25
Sperm whale	15
Spinner dolphin	12
Striped dolphin	84
Spotted seal	1

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Table 8. Mission Area 7 - South China Sea

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Bryde's whale	10
Common minke whale	53
Fin whale	4
Humpback whale	6
North Pacific right whale	1
Western North Pacific gray whale	1
Omura's whale	1
Blainville's beaked whale	5
Common bottlenose dolphin	7
Cuvier's beaked whale	3
Deraniyagala beaked whale	5
False killer whale	11
Fraser's dolphin	60
Ginkgo-toothed beaked whale	5
Killer whale	1
<i>Kogia</i> spp.	21
Long-beaked common dolphin	1,135
Longman's beaked whale	3
Melon-headed whale	39
Pantropical spotted dolphin	74
Pygmy killer whale	2
Risso's dolphin	116
Rough-toothed dolphin	14
Short-finned pilot whale	14
Sperm whale	11
Spinner dolphin	5
Striped dolphin	32

Table 9. Mission Area 8 - Offshore Japan (25-40° N)

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	9
Common minke whale	2
Fin whale	1
Humpback whale	2
Sei whale	7
Baird's beaked whale	2
Blainville's beaked whale	12
Common bottlenose dolphin	9
Cuvier's beaked whale	60
Dwarf sperm whale	80
False killer whale	48
Hubbs' beaked whale	8
Killer whale	2
Longman's beaked whale	5
Melon-headed whale	36
<i>Mesoplodon</i> spp.	8
Pacific white-sided dolphin	13

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Pantropical spotted dolphin	33
Pygmy killer whale	2
Pygmy sperm whale	34
Risso's dolphin	10
Rough-toothed dolphin	34
Short-beaked common dolphin	869
Short-finned pilot whale	23
Sperm whale	26
Spinner dolphin	6
Stejneger's beaked whales	8
Striped dolphin	17
Hawaiian monk seal	4
Northern fur seal	-

Table 10. Mission Area 9 - Offshore Japan (10-25° N)

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	8
Fin whale	1
Humpback whale	9
Sei whale	69
Omura's whale	1
Blainville's beaked whale	7
Common bottlenose dolphin	11
Cuvier's beaked whale	35
Deraniyagala beaked whale	9
Dwarf sperm whale	56
False killer whale	8
Fraser's dolphin	33
Ginkgo-toothed beaked whale	9
Killer whale	2
Longman's beaked whale	3
Melon-headed whale	36
Pantropical spotted dolphin	144
Pygmy killer whale	1
Pygmy sperm whale	23
Risso's dolphin	6
Rough-toothed dolphin	26
Short-finned pilot whale	27
Sperm whale	24
Spinner dolphin	24
Striped dolphin	74

Table 11. Mission Area 10 - Hawaii North	
Animal	Estimated Number of Animals Estimated Take by Level B Management
Blue whale	1
Bryde's whale	7
Common minke whale	6
Fin whale	1
Humpback whale	13
Sei whale	3
Blainville's beaked whale	12
Common bottlenose dolphin-Inshore Archipelago	30
Common bottlenose dolphin-Hawaii Pelagic	1
Common bottlenose dolphin-Kauai/Niihau	1
Common bottlenose dolphin-Oahu	1
Common bottlenose dolphin-4 Islands	1
Cuvier's beaked whale	10
Dwarf sperm whale	108
False killer whale-Hawaii Pelagic	9
False killer whale-Main Hawaiian Islands Insular	2
False killer whale-Northwestern Hawaiian Islands	3
Fraser's dolphin	115
Killer whale	1
Longman's beaked whale	23
Melon-headed whale-Northern Mariana Islands	1
Melon-headed whale-Kohala Resident	18
Pantropical spotted dolphin-Western North Pacific	61
Pantropical spotted dolphin- Hawaii Pelagic	4
Pantropical spotted dolphin- Hawaii Island	5
Pantropical spotted dolphin- Oahu	7
Pygmy killer whale	21
Pygmy sperm whale	10
Risso's dolphin	46
Rough-toothed dolphin	47
Short-finned pilot whale	72
Sperm whale	17
Spinner dolphin-Western North Pacific Stock	8
Spinner dolphin- Hawaii Pelagic	1
Spinner dolphin- Hawaii Island	12
Spinner dolphin- Oahu/4-Islands	1
Spinner dolphin- Kauai/Niihau	1
Spinner dolphin- Kure/Midway Atoll	1
Striped dolphin	76
Hawaiian monk seal	2

Table 12. Mission Area 11 - Hawaii South

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	5
Common minke whale	4
Fin whale	1
Humpback whale	14
Sei whale	2
Blainville's beaked whale	12
Common bottlenose dolphin-Inshore Archipelago	28
Common bottlenose dolphin-Hawaii Pelagic	1
Common bottlenose dolphin-Kauai/Nihau	1
Common bottlenose dolphin-Oahu	1
Common bottlenose dolphin-4-Islands	1
Cuvier's beaked whale	9
Deraniyagala beaked whale	11
Dwarf sperm whale	92
Ginkgo-toothed beaked whale	22
False killer whale-Hawaii Pelagic	8
False killer whale-Main Hawaiian Island Insular	1
Fraser's dolphin	86
Killer whale	1
Longman's beaked whale	22
Melon-headed whale-Mariana Islands	1
Melon-headed whale-Kohala Resident	15
Pantropical spotted dolphin-Western North Pacific	68
Pantropical spotted dolphin- Hawaii Pelagic	1
Pantropical spotted dolphin- Hawaii Island	1
Pantropical spotted dolphin- Oahu	1
Pygmy killer whale	18
Pygmy sperm whale	38
Risso's dolphin	36
Rough-toothed dolphin	31
Short-finned pilot whale	57
Sperm whale	15
Spinner dolphin-Western North Pacific	9
Spinner dolphin- Hawaii Pelagic	1
Spinner dolphin- Hawaii Island	1
Spinner dolphin- Oahu/4-Islands	1
Striped dolphin	85
Hawaiian monk seal	2

Table 13. Mission Area 12 – Arabian Sea

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	2
Common minke whale	24
Fin whale	2
Humpback whale	1

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Blainville's beaked whale	5
Common bottlenose dolphin-Hawaiian Island	70
Cuvier's beaked whale	6
Deraniyagala beaked whale	6
False killer whale-Hawaiian Islands	1
Fraser's dolphin	4
Ginkgo-toothed beaked whale	6
Indo-Pacific bottlenose dolphin	1
Killer whale	16
Longman's beaked whale	22
Long-beaked common dolphin	1
Dwarf sperm whale	1
Melon-headed whale-Hawaiian Islands	15
Pantropical spotted dolphin-4-Islands	6
Pygmy killer whale	3
Pygmy sperm whale	1
Risso's dolphin	163
Rough-toothed dolphin	2
Short-finned pilot whale	43
Sperm whale	13
Spinner dolphin-Pearl and Hermes Reef	5
Striped dolphin	97

Table 14. Mission Area 13 – Andaman Sea	
Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	5
Common minke whale	1
Fin whale	1
Omura's whale	5
Blainville's beaked whale	13
Common bottlenose dolphin-Hawaiian Islands	636
Cuvier's beaked whale	67
Deraniyagala beaked whale	13
Dwarf sperm whale	1
Ginkgo-toothed beaked whale	13
False killer whale-Northwestern Hawaiian Islands	3
Fraser's dolphin	25
Indo-Pacific bottlenose dolphin	7
Killer whale	24
Long-beaked common dolphin	2
Longman's beaked whale	60
Melon-headed whale-Hawaiian Islands	95
Pantropical spotted dolphin-4-Islands	49
Pygmy killer whale	13
Pygmy sperm whale	1
Risso's dolphin	1,183
Rough-toothed dolphin	10
Short-finned pilot whale	379
Sperm whale	12
Spinner dolphin-Pearl and Hermes reef	41
Striped dolphin	814

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**Table 15. Mission Area 14 – Northwest
Australia**

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Blue whale	1
Bryde's whale	4
Common minke whale	207
Fin whale	13
Humpback whale	1
Omura's whale	4
Blainville's beaked whale	6
Common bottlenose dolphin-Hawaiian Islands	222
Cuvier's beaked whale	26
Dwarf sperm whale	1
False killer whale-Northwestern Hawaiian Islands	2
Fraser's dolphin	10
Killer whale	42
Longman's beaked whale	26
Melon-headed whale-Hawaiian Islands	39
Pantropical spotted dolphin-4-Islands	37
Pygmy killer whale	7
Risso's dolphin	496
Rough-toothed dolphin	5
Short-finned pilot whale	154
Southern bottlenose whale	7
Spade-toothed whale	6
Sperm whale	6
Spinner dolphin-Pearl and Hermes reef	29
Striped dolphin	590

**Table 16. Mission Area 15 – Northeast of
Japan**

Animal	Estimated Number of Animals Estimated Take by Level B Harassment
Fin whale - WNP	21
North Pacific right whale	2
Sei whale - NP	32
Western Pacific gray whale	1
Baird's whale	163
Dall's porpoise	2,539
Pacific white-sided dolphin	267
Short-beaked common dolphin	5,555
Sperm whale	72
Stejneger's beaked whale	19
Northern fur seal	641
Ribbon seal	1,808
Spotted seal	11,076
Steller sea lion	1

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APPENDIX B:
MARINE MAMMAL DENSITIES AND ABUNDANCES BY
MISSION AREA

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Appendix Table B. Density and Abundance Estimates for the Marine Mammal Stocks and Distinct Population Segments (DPSs) Occurring in the Three Northwestern Pacific Ocean Mission Areas in Which SURTASS LFA Sonar was Operated During the August 2016 Through August 2017 Effective Period. These Same Density and Abundance Estimates Were Used to Estimate the Pre-Mission (DoN, 2016) and Post-Mission Affected Marine Mammals. ESA-Listed Species Highlighted. Abundance and Density References are Provided after the Table.

Marine Mammal Species Name	Stock Name ³	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km ²)				Density Reference(s)
				Winter	Spring	Summer	Fall	
Blue whale	WNP	9,250	1, 2, 3	0.00001	0.00001		0.00001	1, 4, 5, 18
Bryde's whale	WNP	20,501	6	0.0006	0.0006	0.0006	0.0006	7
				0.0004	0.0004	0.0004	0.0004	18
Common minke whale	WNP O	25,049	8	0.0044	0.0044	0.0044	0.0044	8
				0.0003	0.0003		0.0003	4
				0.0033	0.0033	0.0033	0.0033	8
Common minke whale	WNP J	893	25	0.0018	0.0018	0.0018	0.0018	8
Fin whale	WNP	9,250	1, 9	0.0002	0.0002			1
				0.00001	0.00001		0.00001	4
				0.0002	0.0002		0.0002	1
Humpback whale	WNP stock/DPS	1,328	10	0.00089	0.00089		0.00089	5, 11, 22
				0.00036	0.00036		0.00036	5, 22
North Pacific right whale	WNP	922	26	0.00001	0.00001			
Omura's whale	WNP	1,800	12, 13	0.00006	0.00006	0.00006	0.00006	13
				0.00004	0.00004	0.00004	0.00004	
Sei whale	NP	7,000	1, 23	0.00029	0.00029		0.00029	18
Western North Pacific gray whale	WNP stock/DPS	140	2	0.00001	0.00001		0.00001	
Blainville's beaked whale	WNP	8,032	4	0.0005	0.0005	0.0005	0.0005	4
				0.00096	0.00096	0.00096	0.00096	15
Common bottlenose dolphin	WNP	168,791	14	0.0146	0.0146	0.0146	0.0146	14
				0.00245	0.00245	0.00245	0.00245	15
	IA	105,138	27	0.00077	0.00077	0.00077	0.00077	16

³ NP=North Pacific; WNP=Western North Pacific; CNP=Central North Pacific; IA=Inshore Archipelago; NMI=Northern Mariana Islands; DPS=distinct population segment

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Appendix Table B. Density and Abundance Estimates for the Marine Mammal Stocks and Distinct Population Segments (DPSS) Occurring in the Three Northwestern Pacific Ocean Mission Areas in Which SURTASS LFA Sonar was Operated During the August 2016 Through August 2017 Effective Period. These Same Density and Abundance Estimates Were Used to Estimate the Pre-Mission (DoN, 2016) and Post-Mission Affected Marine Mammals. ESA-Listed Species Highlighted. Abundance and Density References are Provided after the Table.

Marine Mammal Species Name	Stock Name ³	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km ²)				Density Reference(s)
				Winter	Spring	Summer	Fall	
Cuvier's beaked whale	WNP	90,725	4	0.0054	0.0054	0.0054	0.0054	4
				0.00079	0.00079	0.00079	0.00079	15
				0.0003	0.0003	0.0003	0.0003	4
Deraniyagala's beaked whale	NP	22,799	4, 24	0.00093	0.00093	0.00093	0.00093	4
				0.0005	0.0005	0.0005	0.0005	
Dwarf sperm whale	WNP	350,553	4	0.00714	0.00714	0.00714	0.00714	21
False killer whale	WNP Pelagic	16,668	14	0.0029	0.0029	0.0029	0.0029	14
				0.00111	0.00111	0.00111	0.00111	18
	IA	9,777	27	0.00111	0.00111	0.00111	0.00111	
Fraser's dolphin	WNP	220,789	4	0.00694	0.00694	0.00694	0.00694	15
	CNP	16,992	15	0.00694	0.00694	0.00694	0.00694	
Ginkgo-toothed beaked whale	NP	22,799	4	0.0005	0.0005	0.0005	0.0005	4
				0.00093	0.00093	0.00093	0.00093	
Killer whale	WNP	12,256	4	0.00009	0.00009	0.00009	0.00009	16
				0.00014	0.00014	0.00014	0.00014	15
<i>Kogia</i> spp.	WNP	350,553	4	0.0031	0.0031	0.0031	0.0031	4
				0.0017	0.0017	0.0017	0.0017	
Long-beaked common dolphin	WNP	279,182	17	0.1158	0.1158	0.1158	0.1158	17
Longman's beaked whale	WNP	4,571	15	0.00025	0.00025	0.00025	0.00025	16
				0.00187	0.00187	0.00187	0.00187	15
Melon-headed whale	WNP	36,770	4	0.00428	0.00428	0.00428	0.00428	18
	NMI	2,455	18	0.00428	0.00428	0.00428	0.00428	
Pantropical spotted dolphin	WNP	438,064	14	0.0137	0.0137	0.0137	0.0137	14
				0.0226	0.0226	0.0226	0.0226	18
Pygmy killer whale	WNP	30,214	4	0.0021	0.0021	0.0021	0.0021	4
				0.00014	0.00014	0.00014	0.00014	18

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Appendix Table B. Density and Abundance Estimates for the Marine Mammal Stocks and Distinct Population Segments (DPSS) Occurring in the Three Northwestern Pacific Ocean Mission Areas in Which SURTASS LFA Sonar was Operated During the August 2016 Through August 2017 Effective Period. These Same Density and Abundance Estimates Were Used to Estimate the Pre-Mission (DoN, 2016) and Post-Mission Affected Marine Mammals. ESA-Listed Species Highlighted. Abundance and Density References are Provided after the Table.

Marine Mammal Species Name	Stock Name ³	Stock / Abundance (animals)	Stock / Abundance Reference(s)	Density (animals per km ²)				Density Reference(s)
				Winter	Spring	Summer	Fall	
Pygmy sperm whale	WNP	350,553	4	0.00291	0.00291	0.00291	0.00291	21
Risso's dolphin	WNP	83,289	14	0.0106	0.0106	0.0106	0.0106	14
				0.00296	0.00296	0.00296	0.00296	15
	IA	83,289	14	0.0106	0.0106	0.0106	0.0106	14
Rough-toothed dolphin	WNP	145,729	4	0.0059	0.0059	0.0059	0.0059	4
				0.00257	0.00257	0.00257	0.00257	15
Short-beaked common dolphin	WNP	3,286,163	4	0.0562	0.0562	0.0562	0.0562	4
Short-finned pilot whale	WNP	53,608	14	0.0153	0.0153	0.0153	0.0153	14
				0.00508	0.00508	0.00508	0.00508	15
Sperm whale	NP	102,112	19, 20	0.00123	0.00123	0.00123	0.00123	18
Spinner dolphin	WNP	1,015,059	4	0.00083	0.00083	0.00083	0.00083	21
Striped dolphin	WNP	570,038	14	0.0329	0.0329	0.0329	0.0329	14
				0.00616	0.00616	0.00616	0.00616	18

APPENDIX B LITERATURE CITED

1. Tillman, M. F. (1977). Estimates of population size for the North Pacific sei whale. *Report of the International Whaling Commission Special Issue, 1*, 98-106.
2. Carretta, J. V., Oleson, E. M., Weller, D. W., Lang, A. R., Forney, K. A., Baker, J., Muto, M. M., Hanson, B., Orr, A. J., Huber, H., Lowry, M. S., Barlow, J., Moore, J. E., Lynch, D., Carswell, L., & Brownell, Jr., R. L. (2015). *U.S. Pacific Marine Mammal Stock Assessments: 2014*. (NOAA-TM-NMFS-SWFSC-549). LaJolla, CA: Southwest Fisheries Science Center, National Marine Fisheries Service. doi:10.7289/V5/TM-SWFSC-549.

ANNUAL REPORT 5: SURTASS LFA SONAR OPERATIONS 2016 TO 2017

3. Stafford, K. M., Nieukirk, S. L., & Fox, C. G. (2001). Geographic and seasonal variation of blue whale calls in the North Pacific. *Journal of Cetacean Research and Management*, 3(1), 65-76.
4. Ferguson, M. C., & Barlow, J. (2001). *Spatial distribution and density of cetaceans in the eastern Pacific Ocean based on summer/fall research vessel surveys in 1986-96*. NOAA Administrative Report LJ-01-04. La Jolla, CA: National Marine Fisheries Service, Southwest Fisheries Science Center

Ferguson, M. C., & Barlow, J. (2003). Addendum: Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. NMFS-SWFSC Administrative Report LJ-01-04, Addendum. La Jolla, CA: Southwest Fisheries Science Center, National Marine Fisheries Service.
5. LGL Limited, Environmental Research Associates (LGL). (2008). *Environmental assessment of a marine geophysical survey by the R/V Marcus G. Langseth in Southeast Asia, March–July 2009*.
6. International Whaling Commission (IWC). (2009). Population estimates. Retrieved from <<http://www.iwcoffice.org/conservation/estimate.htm>>.
7. Ohsumi, S. (1977). Bryde's whales in the pelagic whaling ground of the North Pacific. *Report of the International Whaling Commission Special Issue*, 1, 140-149.
8. Buckland, S. T., Cattanach, K. L., & Miyashita, T. (1992). Minke whale abundance in the northwest Pacific and the Okhotsk Sea, estimated from 1989 and 1990 sighting surveys. *Report of the International Whaling Commission*, 42, 387-392.
9. Mizroch, S. A., Rice, D. W., Zwiefelhofer, D., Waite, J. M., & Perryman, W. L. (2009). Distribution and movements of fin whales in the North Pacific Ocean. *Mammal Review*, 39(3), 193-227.
10. Bettridge, S., Baker, C. S., Barlow, J., Clapham, P. J., Ford, M., Gouveia, D., Mattila, D. K., Pace, III, R. M., Rosel, P. E., Silber, G. K., & Wade, P. R. (2015). *Status review of the humpback whale (Megaptera novaeangliae) under the Endangered Species Act*. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-540. La Jolla, CA: Southwest Fisheries Service, National Marine Fisheries Service.
11. Calambokidis, J., Falcone, E. A., Quinn, T. J., Burdin, A. M., Clapham, P. J., Ford, J.K.B., Gabriele, C.M., Leduc, R., Mattila, D., Rojas-Bracho, L., Straley, J. M., Taylor, B.L., Urbán R., J., Weller, D., Witteveen, B.H., Yamaguchi, M., Bendlin, A., Camacho, D., Flynn, K., Havron, A., Huggins, J., & Maloney, N. (2008). *SPLASH: Structure of populations, levels of abundance and status of humpback whales in the North Pacific*. (Final report for Contract AB133F-03-RP-00078, Report prepared for U.S. Department of Commerce, Western Administrative Center, Seattle, WA). Olympia, WA: Cascadia Research.
12. Ohsumi, S. (1980). Population study of the Bryde's whale in the Southern Hemisphere under scientific permit in the three seasons, 1976/77-1978/79. *Reports of the International Whaling Commission*, 30, 319-331.
13. Department of the Navy (DoN). (2013). Request for letter of authorization for the incidental harassment of marine mammals resulting from Navy training activities in the Mariana Islands training and testing areas. Pearl Harbor, HI: Pacific Fleet. 228 pages.
14. Miyashita, T. (1993). Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. *Report of the International Whaling Commission*, 43, 417-437.

ANNUAL REPORT 5: SURTASS LFA SONAR OPERATIONS 2016 TO 2017

15. Bradford, A. L., Forney, K. A., Oleson, E. M., & Barlow, J. (2013). *Line-transect abundance estimates of cetaceans in the Hawaiian EEZ*. (PIFSC Working Paper WP-13-004; PSRG-2013-18). Honolulu, HI: Pacific Islands Fishery Science Center, National Marine Fisheries Service.
16. LGL Limited, Environmental Research Associates (LGL). (2011). *Environmental assessment of a low-energy marine geophysical survey by the R/V Thompson in the western tropical Pacific Ocean, November–December 2011*.
17. Carretta, J. V., Forney, K. A., Oleson, E., Martien, K., Muto, M. M., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., Lynch, D., Carswell, L., Brownell, Jr., R. L., Robbins, R., Mattila, D. K., Ralls, K., & Hill, M. C. (2011). *U.S. Pacific marine mammal stock assessments: 2010*. NOAA-TM-NMFS-SWFSC-476. La Jolla, CA: Southwest Fisheries Science Center, National Marine Fisheries.
18. Fulling, G. L., Thorson, P. H., & Rivers, J. (2011). Distribution and abundance estimates for cetaceans in the waters off Guam and the Commonwealth of the Northern Mariana Islands. *Pacific Science*, 65(3), 321-343.
19. Kato, H., & Miyashita, T. (1998). *Current status of North Pacific sperm whales and its preliminary abundance estimates*. Report submitted to the International Whaling Commission (SC/50/CAWS/52). 6 pages.
20. Allen, B. M., & Angliss, R. P. (2015). *Alaska marine mammal stock assessments, 2014*. NOAA Technical Memorandum NMFS-AFSC-301. Seattle, WA: Alaska Fisheries Science Center, National Marine Fisheries Service.
21. Barlow, J. (2006). Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. *Marine Mammal Science*, 22(2), 446-464.
22. Acebes, J. M. V., Darling, J. D., & Yamaguchi, M. (2007). Status and distribution of humpback whales (*Megaptera novaeangliae*) in northern Luzon, Philippines. *Journal of Cetacean Research and Management*, 9(1), 37-43.
23. Mizroch, S.A., Conn, P.B., & Rice, D.W. (2015). The mysterious sei whale: Its distribution, movements and population decline in the North Pacific revealed by whaling data and recoveries of Discovery-type marks. *Paper SC/66a/IA/14 presented at the 66a IWC Scientific Committee Meeting in San Diego, CA, 22 May to 3 June 2015*.
24. Dalebout, M. L., Scott Baker, C., Steel, D., Thompson, K., Robertson, K. M., Chivers, S. J., Perrin, W. F., Goonatilake, M., Charles Anderson, R., Mead, J. G., Potter, C. W., Thompson, L., Jupiter, D., & Yamada, T. K. (2014). Resurrection of *Mesoplodon hotaula* Deraniyagala 1963: A new species of beaked whale in the tropical Indo-Pacific. *Marine Mammal Science*, 30(3), 1081-1108.
25. Pastene, L. A., & Goto, M. (1998). An estimate of the mixing proportion of 'J' and 'O' stocks minke whales in subarea 11 based on mitochondrial DNA haplotype data. *Report of the International Whaling Commission*, 48, 471-474.
26. Best, P. B., Bannister, J. L., Brownell, Jr., R. L., & Donovan, G. P., (Eds). (2001). Right whales: Worldwide status. *Journal of Cetacean Research and Management*, (Special Issue 2), 1-309.
27. Miyashita, T. (1986). Population estimates of dolphins using research vessels data. Pages 202-213 in T. Tamura, S. Ohsumi, & S. Arai (Eds). *Report of the investigation in search of resolution of the dolphin-fishery conflict in the Iki Island area*. Tokyo, Japan: The Investigating Committee.