2018 to 2019 ANNUAL REPORT OF SURVEILLANCE TOWED ARRAY SENSOR SYSEM LOW FREQUENCY ACTIVE (SURTASS LFA) SONAR ACTIVITIES

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS

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ACRONYMS AND ABBREVIATIONS

µ	micro
CLFA	Compact Low Frequency Active
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
EOG	Executive Oversight Group
HF	high frequency
HF/M3	High Frequency Marine Mammal Monitoring (sonar)
HLA	horizontal line array
hr	hour(s)
Hz	Hertz
IND	Indian
ITS	incidental take statement
km	kilometer(s)
LF	low frequency
LFA	Low Frequency Active
m	meter(s)
M3	Marine Mammal Monitoring
MMPA	Marine Mammal Protection Act
NDE	National Defense Exemption
NIND	North Indian
nmi	nautical mile(s)
NMFS	National Marine Fisheries Service
NP	North Pacific
OBIA	Offshore Biologically Important Area
OEIS	Overseas Environmental Impact Statement
Pa	Pascal
rms	root mean square
SAG	Scientific Advisory Group
SEIS/SOEIS	Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement
SL	source level
SURTASS	Surveillance Towed Array Sensor System
T-AGOS	Tactical Auxiliary General Ocean Surveillance
U.S.	United States of America
U.S.C.	United States Code
USNS	United States Naval Ship
WNP	Western North Pacific
yr	year(s)

1 INTRODUCTION

On August 10, 2017, after conferring with the Secretary of Commerce and pursuant to Title 16, Section 1371(f) United States Code (U.S.C.), the Secretary of Defense determined that it was necessary for the national defense to exempt all military readiness activities that employ Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) and Compact LFA sonar (CLFA) (collectively hereafter, SURTASS LFA) sonar from compliance with the requirements of the Marine Mammal Protection Act (MMPA) for two years from August 13, 2017 through August 13, 2019, or until such time when the National Marine Fisheries Service (NMFS) issues the required regulations and Letters of Authorization (LOAs) under Title 16, Section 1371, whichever is earlier. During this exemption period, all military readiness activities that involve the use of SURTASS LFA sonar are required to comply with all mitigation, monitoring, and reporting measures set forth in the 2017 National Defense Exemption (NDE) for SURTASS LFA sonar (hereafter, NDE) (Appendix A).

Under the 2017 NDE, the United States (U.S.) Navy is approved to conduct military readiness activities using SURTASS LFA sonar in the central and western North Pacific Ocean and eastern Indian Ocean (Figure 1) onboard four ocean surveillance ships: the U.S. Naval Ship (USNS) VICTORIOUS (Tactical Auxiliary General Ocean Surveillance [T-AGOS] 19), USNS ABLE (T-AGOS 20), USNS EFFECTIVE (T-AGOS 21), and USNS IMPECCABLE (T-AGOS 23). The sonar sound signals transmitted by the four SURTASS LFA sonar systems are to range between the frequencies of 100 and 500 Hertz (Hz) with the source level (SL) of each of the 18 LFA sonar array projectors transmitting no more than 215 decibels (dB) relative to 1 micro Pascal at 1 meter (m) (dB re 1 µPa @ 1 m) (root mean square [rms]) at the maximum duty cycle of 20 percent. During each annual period, LFA sonar transmissions from each of the four ocean surveillance ships may not exceed 255 hours (hr).

To provide greater geographic context for the marine mammals potentially occurring in the ocean area in which SURTASS LFA sonar may be operated under the NDE, the Navy has divided the western and central North Pacific Ocean and eastern Indian Ocean into 15 nominal geographic areas, which are also the areas used to model and assess potential acoustic impacts on marine mammals (Table 1; Figure 1). The Navy is approved to take marine mammals in these areas by Level B incidental harassment under the MMPA. However, during the annual period, Level B incidental harassment from exposure to all SURTASS LFA sonar transmissions cannot exceed 12 percent of any marine mammal stock. During LFA sonar transmissions, the Navy must conduct visual, passive acoustic (using the SURTASS array), and active acoustic (using the high frequency marine mammal monitoring [HF/M3] sonar) monitoring of the mitigation (extent of the 180-dB isopleth) and buffer (additional 1 kilometer [km] beyond the extent of the 180-dB isopleth) zones surrounding the LFA sonar array for the presence of protected marine mammals and sea turtles.

One of the NDE requirements for SURTASS LFA sonar activities is the submittal of an unclassified, annual report that at a minimum summarizes the quarterly unclassified mission reports and provides estimates of the percentage of marine mammal stocks affected by the transmissions of LFA sonar during the annual period, an analysis of the mitigation measures employed during the quarterly missions, the effectiveness of the mitigation to minimize or eliminate harassment to marine mammals, and an assessment of the long-term and cumulative effects of the military readiness activities using SURTASS LFA sonar. Accordingly, this annual report has been prepared to summarize the Navy's military readiness activities using SURTASS LFA sonar in the central and western North Pacific Ocean and eastern Indian Ocean from 14 August 2018 through 13 August 2019.

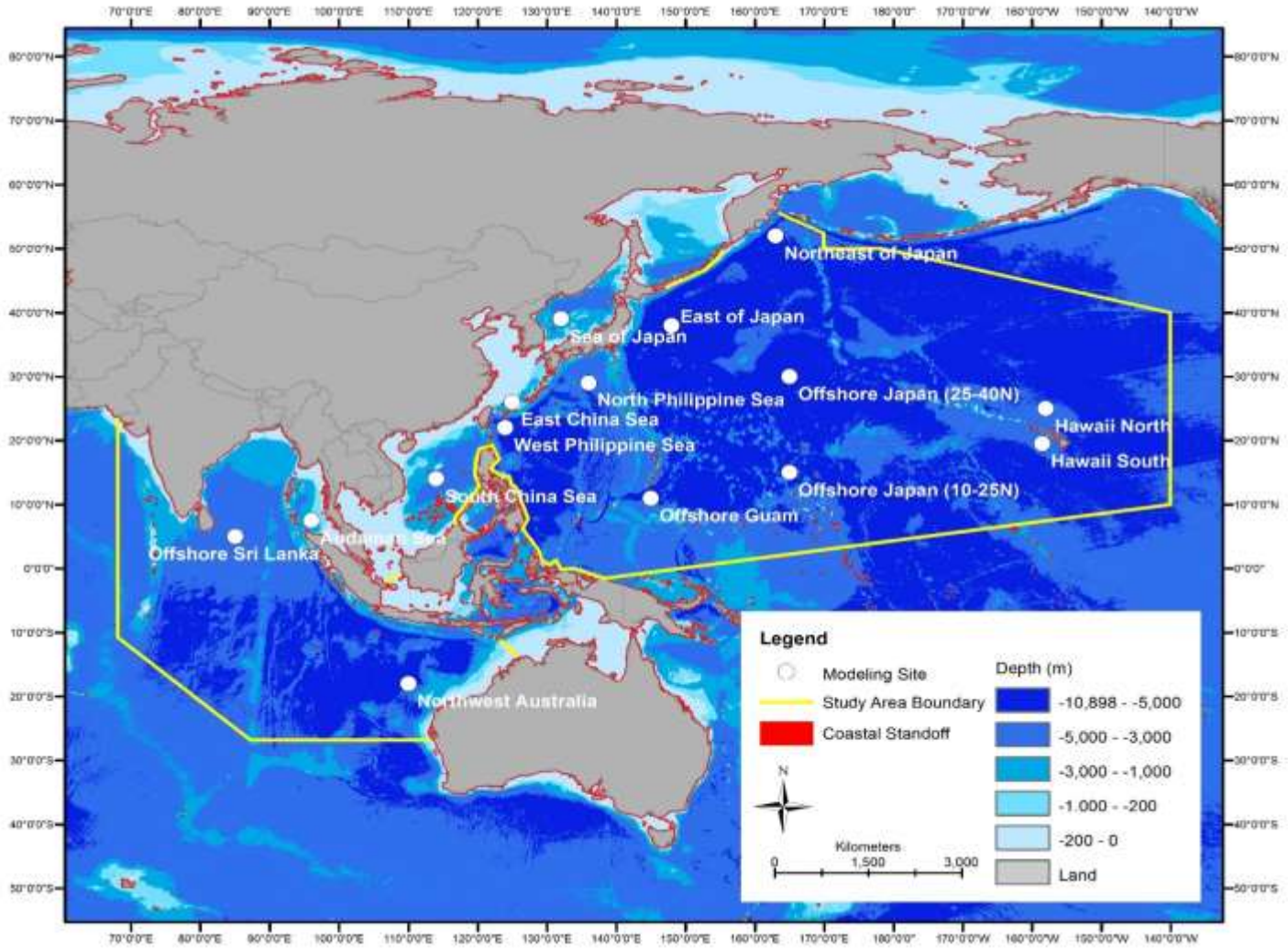

Figure 1. Location of Activity Area for SURTASS LFA Sonar in the Western and Central North Pacific and Eastern Indian Oceans. Nominal Representative Geographic and Model Areas within Overall Activity Area Shown.

Table 1. Fifteen Nominal Geographic Marine Areas Used for Acoustic Impact Modeling for SURTASS LFA Sonar Activities in the Central and Western North Pacific and Eastern Indian Oceans.

Model Area	*SURTASS LFA Mission/Model Area*
Western North Pacific Ocean	
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 Northwest Pacific (25° to 40° N)
9	Offshore Northwest Pacific (10° to 25° N)
15	Northeast of Japan
Central North Pacific Ocean	
10	Hawaii North
11	Hawaii South
Indian Ocean	
12	Arabian Sea
13	Andaman Sea
14	Northwest of Australia

2 2018 TO 2019 SUMMARY OF SURTASS LFA SONAR ACTIVITY AND MITIGATION MONITORING

This annual report is the unclassified summary of the Navy's SURTASS LFA sonar activities for the NDE period from 14 August 2018 through 13 August 2019 for the USNS VICTORIOUS, USNS ABLE, USNS EFFECTIVE, and USNS IMPECCABLE, as reported in the 16 quarterly mission summary reports submitted to NMFS. During the 2018 to 2019 NDE annual period, the Navy conducted a total of seven at-sea activity missions using LFA sonar in the central and western North Pacific Ocean and eastern Indian Ocean that had a combined duration of 9.7 days with LFA sonar transmissions totaling 25.86 hr (Table 2), which is less than the approved number of sonar transmit hours under the NDE.

Per mitigation NDE monitoring protocol for SURTASS LFA sonar, LFA sonar transmissions were suspended/delayed six times due to the detection by visual or active acoustic (HF/M3) monitoring of possible marine mammals or sea turtles within the LFA mitigation and buffer zones. No passive acoustic detections of marine animals in the mitigation/buffer zones for LFA sonar were made during the seven activity missions. Although no passive acoustic detections of vocalizing marine mammals were made

Table 2. Summary of the Military Readiness Activities Using SURTASS LFA Sonar, Mitigation Monitoring During LFA Sonar Activities, and Number of LFA Sonar Transmit Hours from August 2018 to August 2019.

SURTASS LFA Sonar Vessel	*Number of LFA Sonar Activity Missions*	*Mission Days*	*LFA Sonar Transmit Hours (hr)*	*Visual Monitoring Detections*	*Active Acoustic (HF/M3) Detections*	*Passive Acoustic Detections*	*LFA Sonar Shutdowns/ Suspensions*
USNS VICTORIOUS (T-AGOS 19)	0	0	0	0	0	0	0
USNS ABLE (T-AGOS 20)	1	3.7	11.93	1	4	0	4
USNS EFFECTIVE (T-AGOS 21)	1	2	2.71	0	0	0	0
USNS IMPECCABLE (T-AGOS 23)	5	4	11.22	2	0	0	2
Total	7	9.7	25.86	3	4	0	6

within the mitigation/buffer zones for LFA sonar, one passive acoustic detection of a vocalizing marine mammal was made but was evaluated to be located outside the mitigation/buffer zones. Accordingly, the passive acoustic detection of a marine mammal did not result in a suspension or delay of LFA sonar transmissions. In addition to detections of marine mammals or sea turtles in the LFA mitigation/buffer zones, during some activities using SURTASS LFA sonar, LFA sonar transmissions were suspended or delayed for reasons unrelated to mitigation monitoring.

2.1 USNS VICTORIOUS (T-AGOS 19)

The USNS VICTORIOUS conducted no at-sea LFA sonar activity missions and transmitted no LFA sonar during the annual period (Table 2; Appendix B, Table B-1). Four negative activity reports for the VICTORIOUS were submitted to NMFS during the annual 2018 to 2019 period.

2.2 USNS ABLE (T-AGOS 20)

One at-sea activity mission with a duration of 3.7 days was conducted by the USNS ABLE during the first quarter of the annual 2018 to 2019 NDE period, during which 11.93 hr of LFA sonar signals were transmitted (Table 2). During the ABLE's one mission, one visual and four active acoustic (HF/M3) detections of marine animals were reported within the LFA sonar mitigation and buffer zones, which resulted in four suspensions/delays of LFA sonar transmissions, per mitigation monitoring protocol. No passive acoustic detections were made during the ABLE's mission activities. The visual detection was reported to be a pod of dolphins and a pilot whale, all at a bearing of 246T and a range of 1,846 yards (1,688 meters [m]) from the ABLE.

The USNS ABLE conducted no at-sea LFA sonar activity missions and transmitted no LFA sonar during the remaining three quarters of the annual period (Appendix Table B-2). Consequently, the Navy submitted three reports of negative activity to NMFS for these quarters.

2.3 USNS EFFECTIVE (T-AGOS 21)

The USNS EFFECTIVE conducted one at-sea activity mission in the second quarter of the annual period, during which 2.71 hr of LFA sonar was transmitted over 2 mission days (Table 2). No visual, passive acoustic, or active acoustic detections of marine animals were made during the mission, with no suspension or delay of LFA sonar transmissions.

No SURTASS LFA sonar activities using LFA sonar were conducted by the EFFECTIVE during quarters 1, 3, or 4 of the 2018 to 2019 period (Appendix Table B-3). Three negative activity reports were submitted to NMFS for these quarters.

2.4 USNS IMPECCABLE (T-AGOS 23)

Five activity missions using LFA sonar were conducted during three quarters by the USNS IMPECCABLE (Table 2). In total, these missions spanned 4 days during which LFA sonar signals were transmitted for 11.22 hr. No active or passive acoustic detections of marine animals were made during any of the IMPECCABLE's five missions, although one passive acoustic detection of a vocalizing marine mammal was made during the IMPECCABLE's fifth mission but was judged to be located beyond the extent of the mitigation and buffer zones. Two visual observations of marine mammals were made during one of the IMPECCABLE's two Quarter 1 missions. Both visual detections were made prior to the commencement of LFA sonar transmissions in the period when visual monitoring commenced 30 minutes prior to the

initiation of LFA sonar transmissions. These visual detections resulted in the delay of LFA sonar transmissions until 15 minutes after no further marine mammals had been detected by any of the three monitoring methods. The first visual detection was of an unidentified marine mammal off the port bow while the second visual observation was reported to be a whale with a V-shaped tail, also located off the port bow of the IMPECCABLE. The IMPECCABLE conducted no activity missions nor transmitted LFA sonar during Quarter 3 of the 2018 to 2019 period (Appendix Table B-4).

3 SUMMARY OF 2018 TO 2019 MITIGATION, MONITORING, AND REPORTING

Per mitigation and monitoring protocols for SURTASS LFA sonar as detailed in the 2017 NDE, visual, passive acoustic, and active acoustic monitoring was conducted by civilian and military personnel onboard the USNS ABLE, EFFECTIVE, and IMPECCABLE during the 25.86 hr of LFA sonar transmissions in 2018 to 2019. The HF/M3 sonar systems were ramped up prior to use in active acoustic monitoring, per mitigation monitoring protocol. During the 2018 to 2019 annual period, three visual detections and four active acoustic (HF/M3) detections resulted in six suspensions or delays of LFA sonar transmissions (Table 2). No passive acoustic detections were made in the LFA mitigation/buffer zones.

The running total of the number of LFA sonar transmit hours for all SURTASS LFA sonar vessels and the total percentages of stocks taken by MMPA Level B incidental harassment were maintained throughout the annual period to ensure that no more than 1020 LFA sonar transmit hours were used and no more than 12 percent of any marine mammal stock was taken by MMPA Level B harassment. These running totals were reported quarterly to NMFS. For the August 2018 to 2019 annual period, the highest percentage of any marine mammal stock experiencing Level B harassment from exposure to the 25.86 hr of LFA sonar transmissions (Table 2) was 2.67 percent of the Western North Pacific (WNP) stock and distinct population segment (DPS) of humpback whales, which equates to 37 individual humpback whales (Table 3).

The Navy submitted unclassified reports or unclassified enclosures to classified reports for each SURTASS LFA sonar vessel during every quarter of the annual period, regardless of whether any military readiness activities using SURTASS LFA sonar were conducted that quarter. Eleven unclassified reports of no SURTASS LFA sonar activities (i.e., negative activity reports) and five classified reports that included unclassified enclosures and summarized the seven quarterly LFA sonar activity missions were submitted to NMFS.

3.1 MITIGATION EFFECTIVENESS

NDE Condition IV2(c) requires that the Navy analyze and report on the mitigation effectiveness for SURTASS LFA sonar with recommendations for improvement, where applicable. Although the hours of LFA sonar transmissions during the annual period were low, the implemented mitigation and monitoring measures were conducted according to the protocol outlined in the NDE and proved to be effective in detecting marine mammals, with seven detections of marine mammals that resulted in six suspensions or delays of LFA sonar transmissions to prevent exposure above 180 dB.

Visual monitoring of the sea surface surrounding the SURTASS LFA sonar vessels and LFA sonar array was conducted during daylight hours when LFA sonar was transmitting, culminating in three visual detections of marine mammals during two of the seven missions.

Table 3. Quarterly and Annual Percentages of Marine Mammal Stocks[1] Affected by MMPA Level B Incidental Harassment from Exposure to All SURTASS LFA Sonar Transmissions and the Number of Marine Mammals Affected in Those Stocks for the Annual Period of 2018 to 2019. ESA-listed Marine Mammals Highlighted.

All Affected Marine Mammal Species/Species Groups	Number Marine Mammals in Stock	Stock Name[1]	Level B Harassment									
			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	
			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	0.0004%	1	0.00317%	2					0.0036%	3
	3,432	NIND	0.0077%	1							0.0077%	1
Bryde's whale	20,501	WNP	0.0122%	3	0.02181%	6			0.0228%	5	0.0568%	14
	9,176	NIND	0.0513%	5							0.0513%	5
Common minke whale	25,049	WNP O	0.0677%	17	0.12363%	32					0.1913%	49
	257,500	IND	0.0000%	1							0.0000%	1
Fin whale	9,250	WNP			0.0668%	7					0.0668%	7
	1,716	IND	0.0061%	1							0.0061%	1
Humpback whale	1,328	WNP stock/DPS	0.2393%	4	2.4347%	33					2.6740%	37
North Pacific right whale	922	WNP			0.0031%	1					0.0031%	1
Omura's whale	1,800	WNP	0.0139%	1	0.0248%	2			0.0260%	1	0.0647%	4
	9,176	IND	0.0513%	5							0.0513%	5
Odontocetes												
Blainville's beaked whale	8,032	WNP	0.0302%	3	0.0320%	3			0.0496%	4	0.1118%	10
	16,867	IND	0.0464%	8							0.0464%	8
Common bottlenose dolphin	168,791	WNP	0.0271%	46	0.0414%	70			0.0035%	6	0.0720%	122
	785,585	IND	0.0512%	403							0.0512%	403
Cuvier's beaked whale	90,725	WNP	0.0289%	27	0.0218%	21			0.0235%	22	0.0741%	70
	27,272	IND	0.1372%	38							0.1372%	38
Deraniyagala's beaked whale	22,799	NP			0.0034%	1			0.0232%	6	0.0267%	7
	16,867	IND	0.0463%	8							0.0463%	8
Dwarf sperm whale	10,541	IND	0.0038%	1							0.0038%	1
	350,553	WNP							0.0099%	35	0.0099%	35
False killer whale	16,668	WNP	0.1298%	11	0.0862%	16			0.0300%	5	0.2460%	32
	144,188	IND	0.0011%	2							0.0011%	2
Fraser's dolphin	220,789	WNP	0.0173%	26	0.0151%	34					0.0324%	60
	16,992	CNP							0.1187%	21	0.1187%	21
	151,554	IND	0.0086%	14							0.0086%	14
Ginkgo-toothed beaked whale	22,799	NP	0.0373%	3	0.0113%	3			0.0232%	6	0.0718%	12
	16,867	IND	0.0463%	8							0.0463%	8
Indo-Pacific bottlenose dolphin	7,850	IND	0.0513%	5							0.0513%	5

No LFA Sonar Transmissions_Negative Activity All Vessels

1 WNP=Western North Pacific; NP=North Pacific; NIND=North Indian; IND=Indian; CNP=Central North Pacific; DPS=distinct population segment

Table 3. Quarterly and Annual Percentages of Marine Mammal Stocks Affected by MMPA Level B Incidental Harassment from Exposure to All SURTASS LFA Sonar Transmissions and the Number of Marine Mammals Affected in Those Stocks for the Annual Period of 2018 to 2019. ESA-listed Marine Mammals Highlighted (Continued).

All Affected Marine Mammal Species/Species Groups	Number Marine Mammals in Stock	Stock Name [1]	Level B Harassment									
			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	
			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
Killer whale	12,256	WNP	0.0108%	1	0.0038%	2			0.0065%	1	0.0211%	4
	12,593	IND	0.3844%	49							0.3844%	49
Kogia spp.	350,553	WNP	0.0053%	16	0.0043%	16					0.0097%	32
Long-beaked common dolphin	279,182	WNP	0.2202%	404	0.2026%	567					0.4228%	971
	1,819,882	IND	0.0000%	1							0.0000%	1
Longman's beaked whale	4,571	WNP	0.0662%	2	0.0281%	2			0.0311%	2	0.1255%	6
	16,867	IND	0.2063%	35							0.2063%	35
Melon-headed whale	36,770	WNP	0.1304%	16	0.0576%	22			0.0636%	24	0.2517%	62
	64,600	IND	0.0871%	57							0.0871%	57
Pacific white-sided dolphin	931,000	NP			0.0034%	32					0.0034%	32
Pantropical spotted dolphin	438,064	WNP	0.0361%	38	0.0129%	57			0.0215%	95	0.0705%	190
	736,575	IND	0.0049%	37							0.0049%	37
Pygmy killer whale	30,214	WNP	0.0416%	8	0.0344%	11			0.0017%	1	0.0778%	20
	22,029	IND	0.0396%	9							0.0396%	9
Pygmy sperm whale	10,541	IND	0.0006%	1							0.0006%	1
	350,553	WNP							0.0041%	15	0.0041%	15
Risso's dolphin	83,289	WNP	0.0901%	51	0.0726%	62			0.0043%	4	0.1671%	117
	452,125	IND	0.1619%	733							0.1619%	733
Rough-toothed dolphin	145,729	WNP	0.0363%	28	0.0229%	34			0.0094%	14	0.0686%	76
	156,690	IND	0.0035%	6							0.0035%	6
Short-beaked common dolphin	3,286,163	WNP	0.0060%	196	0.0052%	172					0.0112%	368
Short-finned pilot whale	53,608	WNP	0.1666%	57	0.1260%	68			0.0332%	18	0.3258%	143
	268,751	IND	0.0834%	225							0.0834%	225
Sperm whale	102,112	NP	0.0195%	5	0.0057%	7			0.0129%	14	0.0380%	26
	24,446	IND	0.0312%	8							0.0312%	8
Spinner dolphin	1,015,059	WNP	0.0019%	3	0.0003%	4			0.0015%	16	0.0038%	23
	634,108	IND	0.0047%	31							0.0047%	31
Striped dolphin	570,038	WNP	0.0299%	92	0.0183%	105			0.0085%	49	0.0568%	246
	674,578	IND	0.0883%	596							0.0883%	596

No LFA Sonar Transmissions_Negative Activity All Vessels

Visual monitoring of the LFA sonar mitigation and buffer zones is only effective during daylight hours, low sea states and sun glare, and during relatively good weather conditions (i.e., no precipitation or fog). Some behaviors, such as diving by marine mammals and sea turtles, especially to depth with long submergences, also affect the efficacy of visual monitoring. Visual monitoring for marine mammals and sea turtles is also subjective and relies on the experience of the observers. Parente et al. (2011) noted that the level of the visual observer's experience was a strong influence in the effectiveness of visual monitoring during seismic surveys. Given these factors, the mitigation effectiveness of visual monitoring for marine mammals or sea turtles during SURTASS LFA sonar activities has been estimated to have an effectiveness of about 9 percent (DoN, 2001). No subsequent data or information alters this effectiveness conclusion.

When LFA sonar was transmitting, the military sonar operators monitored the SURTASS passive sonar system for the detection of marine mammal vocalizations. No marine mammal vocalizations were detected on passive sonar within the mitigation/buffer zones during the seven at-sea missions conducted from August 2018 to August 2019. However, one detection of vocalizing marine mammals during a mission was made that was evaluated to beyond or outside the extent of the mitigation plus buffer zones. This passive acoustic detection of a marine mammal vocalization captured by the SURTASS passive sonar system demonstrated the efficacy of the monitoring method to detect vocalizing marine mammals, even when the marine mammals are located at a distance beyond which visual and active acoustic monitoring can detect their presence. The efficacy of mitigation monitoring is improved greatly when passive acoustic monitoring is used as an adjunct to visual monitoring. The major drawback of passive acoustic monitoring is that marine mammals have to be vocalizing for any detections to be made and determining the range to the vocalizing marine mammals is difficult.

The HF/M3 sonar system was operated continuously during LFA sonar transmissions in accordance with stipulations of the NDE to monitor for the presence of marine mammals or sea turtles within the mitigation/buffer zones. Four active acoustic (HF/M3 sonar) detections were reported during the ABLE's mission while no HF/M3 detections were made during the remaining six missions conducted during the 2018 to 2019 annual period. The HF/M3 sonar system is considered to be the most effective of the three mitigation monitoring methods used when LFA sonar is transmitting, as this method typically results in the greatest number of marine mammal or sea turtle detections as its effectiveness is not restricted by vocalizing marine mammals, weather, sea state, daylight, or the diving behavior of sea turtles or marine mammals.

The effectiveness of the HF/M3 sonar system to monitor and detect marine mammals using active acoustics has been described in the Navy's 2001 Final Overseas Environmental Impact Statement/Environmental Impact Statement (FOEIS/EIS) (Chapters 2 and 4) for SURTASS LFA sonar (DoN, 2001) and in 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 sonar system's capabilities indicated that it substantially increases the probability of detecting a marine mammal within the LFA mitigation zone and provides a superior monitoring capability, especially for detecting medium- to large-sized cetaceans at a distance of 1.1 to 1.3 nautical miles (nmi) (2 to 2.5 km) from the HF/M3 sonar system (DoN, 2001).

Additionally, qualitative and quantitative assessments of the HF/M3 sonar system's ability to detect marine mammals of various sizes were conducted in 170 hr of at-sea testing. The sea tests demonstrated that several detections of cetaceans by the HF/M3 sonar system would occur before the cetacean entered the LFA mitigation zone (DoN, 2001). Indeed, based on the scan rate of the HF/M3 sonar system, most marine mammals 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 LFA 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 feet [10 to 30 meters]) cetacean 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 with dolphins traveling more typically in pods rather than singly, the detection rate would be higher (Ellison and Stein, 2001).

To further protect marine mammals from exposure to SURTASS LFA sonar, the Navy implements the offshore biologically important area (OBIA) mitigation measure. OBIAs are marine areas where biologically important behaviors such as breeding, calving, foraging, and migration are conducted, sometimes seasonally. The Navy and NMFS designated 29 OBIAs globally (Table 4), four of which are in the ocean areas in which the Navy is authorized during the 2018 to 2019 annual period to transmit LFA sonar. This geographic mitigation measure specifies that LFA sonar must be transmitted such that the received sound field would not exceed 180 dB re 1 µPa @ 1 m (rms) at a distance of less than 0.54 nmi (1 km) seaward of the outer boundary of any OBIA. The OBIAs located in the SURTASS LFA sonar activity area are Penguin Bank (Hawaiian Islands Humpback National Marine Sanctuary), Northern Bay of Bengal and Head of Swatch-of-No-Ground, Offshore Sri Lanka, and Camden Sound/Kimberly Region.

In examining the results of the mitigation monitoring during the 2018 to 2019 annual reporting period, particularly given the low number of LFA sonar transmit hours (25.86 hr), which is the only time when mitigation monitoring would have been implemented, and the results of the previous seventeen years of SURTASS LFA sonar use, the Navy has concluded that the mitigation measures and monitoring have been implemented properly and have successfully minimized the potential adverse effects of SURTASS LFA sonar to marine mammals and sea turtles to the 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 the 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 but recommends no additional mitigation measures to be necessary. No revisions to the mitigation monitoring protocol or methodologies used for mitigation monitoring are recommended.

3.2 ANNUAL TRAINING

3.2.1 Visual Observer Training

Training of the civilian bridge crew that conduct visual monitoring whenever LFA sonar is transmitting is a requirement under the NDE. Although no in-person trainings of the civilian lookouts were conducted during this annual period, the training program and materials were available to all lookouts onboard the SURTASS LFA sonar vessels.

The visual observer training consists of two components: 1) an observation component that covers the visual monitoring requirements specified under the NDE and ESA permit for LFA sonar use as well as fundamentals of at-sea visual monitoring of marine mammals and sea turtles; and 2) an identification component that includes an overview of the types of marine mammals and sea turtles as well as the key

Table 4. Global Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar, Including Those Located Within the Annual Activity Area (Highlighted), and Their Annual Period of Effectiveness.

OBIA Number	OBIA Name	Water Body/Location	Relevant Low-Frequency or Other Marine Mammal Species	Annual Effective Seasonal Period
1	Georges Bank	Northwest Atlantic Ocean; east off Massachusetts	North Atlantic right and sei whales	Year-round
2	Roseway Basin Right Whale Conservation Area	Northwest Atlantic Ocean; south off Nova Scotia	North Atlantic right whale	June through December
3	Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS)	Northwest Atlantic Ocean/ Gulf of Maine; east off Massachusetts and Maine	North Atlantic right whale	January 1 to November 14; year-round for Stellwagen Bank NMS
4	Southeastern U.S. Right Whale Critical Habitat	Northwest Atlantic Ocean; east off North Carolina to Florida	North Atlantic right whale	November 15 to April 15
5	Gulf of Alaska	Gulf of Alaska; east off Kodiak Island	North Pacific right whale	March through September
6	Navidad Bank	Caribbean Sea/Northwest Atlantic Ocean; northeast off Dominican Republic	Humpback whale	December through April
7	Coastal Western Africa (Cameroon to Angola)	Southeastern Atlantic Ocean	Humpback and blue whales	June through October
8	Patagonian Shelf Break	Southwestern Atlantic Ocean	Southern elephant seal	Year-round
9	Argentina Coastal	Southwestern Atlantic Ocean	Southern right whale	May through December
10	Central California	Northeastern Pacific Ocean; west off Central California	Blue and humpback whales	June through November
11	Antarctic Convergence Zone	Southern Ocean	Blue, fin, sei, minke, humpback, and southern right whales	October through March
12	Offshore Piltun and Chayvo	Sea of Okhotsk; east off Sakhalin Island, Russia	Western Pacific gray whale	June through November

Table 4. Global Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar, Including Those Located Within the Annual Activity Area (Highlighted), and Their Annual Period of Effectiveness.

OBIA Number	*OBIA Name*	*Water Body/Location*	*Relevant Low-Frequency or Other Marine Mammal Species*	*Annual Effective Seasonal Period*
13	Eastern Madagascar Coastal	Western Indian Ocean	Humpback and blue whales	July through September, annually for humpback whale breeding; November through December for migrating blue whales
14	Southern Madagascar (Madagascar Plateau, Madagascar Ridge, and Walters Shoal)	Western Indian Ocean	Pygmy blue, humpback, and Bryde's whales	November through December
15	Ligurian-Corsican-Provençal Basin and Western Pelagos Sanctuary	Northern Mediterranean Sea; south off France and Italy	Fin whale	July to August
16	Penguin Bank (Hawaiian Islands NMS)	North Central Pacific Ocean; west off Maui, Hawaii	Humpback whale	November through April
17	Costa Rica Dome	Eastern Tropical Pacific Ocean	Blue and humpback whales	Year-round
18	Great Barrier Reef	Coral Sea/south-western Pacific Ocean; east off Queensland	Humpback and dwarf minke whales	May through September
19	Bonney Upwelling	Southern Ocean; south off South Australia	Blue, pygmy blue, and southern right whales	December through May
20	Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG)	Bay of Bengal, Northern Indian Ocean; south off Bangladesh	Bryde's whale	Year-round
21	Olympic Coast NMS, Barkley and Nitinat Canyons, and The Prairie	Northeastern Pacific Ocean; off Washington/northwest U.S. mainland	Humpback whale	Olympic NMS: December, January, March, April, and May; The Prairie, Barkley and Nitinat Canyons: June through September
22	Abrolhos Bank	Southwest Atlantic Ocean; east off Brazil	Humpback whale	August through November

Table 4. Global Offshore Biologically Important Areas (OBIAs) for SURTASS LFA Sonar, Including Those Located Within the Annual Activity Area (Highlighted), and Their Annual Period of Effectiveness.

OBIA Number	*OBIA Name*	*Water Body/Location*	*Relevant Low-Frequency or Other Marine Mammal Species*	*Annual Effective Seasonal Period*
23	Grand Manan North Atlantic Right Whale Critical Habitat	Southern Bay of Fundy, Canada	North Atlantic right whale	June through December
24	Eastern Gulf of Mexico	Eastern U.S. Gulf of Mexico	Bryde's whale	Year-round
25	Southern Coastal Chile	Gulf of Corcovado, Southeast Pacific Ocean; southwestern Chile	Blue whale	February to April
26	Offshore Sri Lanka	North Central Indian Ocean; south off Sri Lanka	Blue whale	December through April
27	Camden Sound/Kimberly Region	Southeast Indian Ocean; northwest off Western Australia	Humpback whale	June through September
28	Perth Canyon	Southeast Indian Ocean; southwest off Western Australia	Pygmy blue/blue and sperm whales	January through May
29	Southwest Australia Canyons	Southern Ocean; south off Western Australia	Sperm whale	Year-round

NMS=National Marine Sanctuary

observable features used to identify the potentially occurring marine mammal and sea turtle species that may be encountered in the ocean areas where SURTASS LFA sonar is used. A visual monitoring training manual that includes electronic versions of the LFA sonar-specific training as well as the Navy's Marine Species Awareness Training video and marine mammal field guides are provided and retained onboard all SURTASS LFA sonar vessels.

3.2.2 Passive Acoustic Training

A mitigation monitoring condition of the NDE and ESA permit requires the Navy to use the passive SURTASS array to monitor for vocalizing cetaceans. To ensure that the military crew sonar operators are capable of detecting and differentiating marine mammal vocalizations from other biological and natural sound signals received by the SURTASS array, the Navy authorized passive acoustic trainings to be conducted by marine acousticians experienced in identifying and classifying marine mammal vocalization signals. During the August 2018 to August 2019 annual period, two passive acoustic trainings were conducted in November 2018 and May 2019 by a Marine Mammal Monitoring (M3) Program acoustician for the military crews responsible for conducting passive acoustic monitoring as part of their duties as sonar operators onboard the USNS VICTORIOUS, ABLE, EFFECTIVE, and IMPECCABLE during SURTASS LFA sonar at-sea activities. Additionally, the military crew of the USNS LOYAL, an USNS T-AGOS vessel outfitted only with the SURTASS system, was also trained to increase their ability as sonar operators to distinguish biological sounds from mission-directed sounds. The military crew members were trained over two days in both November 2018 and May 2019 at the Naval Ocean Processing Facility (NOPF) Whidbey Island, Washington.

The passive acoustic trainings consist of classified components that cover the following: 1) the requirements of passive acoustic monitoring for marine mammals specified under permits or the NDE for SURTASS LFA sonar use; 2) marine mammal identification describing basic information about the primary marine mammal species that may detected with the SURTASS system 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. Reference materials of marine mammal acoustic signatures, including the 75-page manual *Tactical Identification Guide for SURTASS LFA Sonar Analysts,* and copies of the training components have been made available to the sonar operators.

3.3 Consideration of Monitoring or Research on the Potential 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 were independent scientific findings that are accessible to the public on the SURTASS LFA sonar website (http://www.surtass-lfa-eis.com). The Navy also convened an Executive Oversight Group (EOG) to evaluate the SAG recommendations in relation to existing Navy research programs and available Navy research funding and needs. 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.

The possible research-monitoring studies of potential effects of SURTASS LFA sonar 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.

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 the Intelligence, Surveillance and Reconnaissance Capabilities Division (OPNAV N974); 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 funded research programs. Although funding for this research has been requested in annual budgets, significant budgetary constraints throughout the Navy and NMFS have prevented those funds being allocated. Ongoing Navy and NMFS discussions are planned with the goal of determining the most efficient and cost-effective way forward for Navy environmental compliance research efforts on possible effects of LFA sonar exposure to these taxa.

One of the first efforts the EOG recommended was to bound the problem of harbor porpoise exposure to SURTASS LFA sonar transmissions. Since the harbor porpoise is primarily a coastal species and SURTASS LFA sonar does not principally operate in coastal waters, a low-cost desktop study was funded by the Navy to investigate the potential spatial overlap of harbor porpoise habitat with SURTASS LFA sonar use. The Navy completed the study and submitted a report to NMFS in February 2019 that described the areas of harbor porpoise habitat within the SURTASS LFA sonar activity areas wherein harbor porpoises could potentially be exposed to LFA sonar transmissions and the likely effects on harbor porpoises due to exposure. The Navy estimated in its report that the likelihood of harbor porpoises being exposed to SURTASS LFA sonar transmissions was very low since the distribution of harbor porpoises only overlapped with SURTASS LFA sonar activities in two of 15 representative activity and model areas (DoN, 2019). This low potential for harbor porpoise exposure to LFA sonar transmissions is due to the shallow water occurrence of harbor porpoises, where LFA sonar is typically not operated, and wherein only limited acoustic energy would be transmitted from LFA sonar transmissions in activities occurring further offshore. The Navy's conclusion was that although some harbor porpoises could potentially be exposed to SURTASS LFA sonar transmissions, likely exposure would only be at reduced received sound levels that have limited potential for behavioral responses and no potential for exposures inducing injury. Accordingly, given the very unlikely potential for harbor porpoises to be exposed to SURTASS LFA sonar, additional studies focusing on LFA sonar effects on harbor porpoises are not a high research priority for the Navy.

3.4 Status of Marine Mammal Monitoring (M3) Program and Data

The Navy's M3 program is a monitoring component of the SURTASS LFA sonar program that uses acoustic data collected from 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, and to use the collected data to further the overall understanding of anthropogenic noise effects on the marine environment. The M3 program has evolved to become a valuable tool by which the Navy can quantitatively document acoustic activity levels of baleen whales and measure ambient noise level trends over ecologically meaningful ocean scales and time periods under varying ocean noise conditions.

M3 program analysts have identified baleen whale calls and assembled a catalog of vocalizations from blue, fin, humpback, minke, Bryde's, gray, sei, Omura's, and sperm whales. Additionally, the M3 program has quantified the annual and inter-annual variation in baleen whale singing behavior. Based on over 18 years of data, M3 program analysts can describe the typical seasonal patterns of acoustic activities for blue, fin, humpback, and minke whales. Acoustic data from over seven years now provide insights into the seasonal acoustic and behavior patterns of three additional species of baleen whales (Bryde's, gray, and sei whales) and one odontocete species (sperm whale). A large-scale collection of sounds, acoustic occurrence counts, and tracks at both individual and species levels for baleen whale and sperm whale is being assembled, which will include increasingly detailed whale movement patterns that likely reflect migrations and possibly foraging.

The M3 program analysts provide considerable expertise to the Navy in classifying oceanic sounds. M3 analysts have resolved the compiled acoustic historical data to identify weather phenomena (i.e., lightning and rain squalls), weapons detonation, earthquakes, hydrothermal venting, known and previously undescribed biologics, and semi-submersible oil and gas drilling rigs.

Details of the M3 Program accomplishments for fiscal year 2018 to 2019 are provided in the M3 annual report (Appendix C) but several highlights are described here. During the annual fiscal year, M3 analysts generated 3,327 marine mammal tracks[2] of eight large whale species and one species of hybrid whale that contained over 18,565 positions of acoustically-active marine mammals. Additionally, during the annual fiscal period, the M3 program counted 9,360 acoustic whale occurrences (four counts per day of seven species) over 36 total days on eight Navy sensors. Using declassified M3 acoustic data, a scientific paper on fin whale singing and swim speed associations was published in a peer-reviewed, scientific journal in 2019 (Clark et al., 2019), while a similar paper on humpback whale sing-swim speed associations is being prepared for internal review. Continuing the declassification and release of data to appropriate researchers on the distribution of western Pacific gray whales that began in 2016, in 2018, the M3 Program released a memorandum that included acoustic displays and detailed shallow water detection areas of western Pacific gray whales to Dr. Brandon Southall, who used the information and data to inform the advisory committee of the International Union for Conservation of Nature. In 2019, a wavefile of the western gray whale's acoustic signature was released to Dr. Southall, who distributed it to his peers for not only review and discussion but to foster cooperative strategies for conducting field work in the region to definitively identify the location and source of the recorded signals.

At present, the M3 program's data are classified, as are the data reports and products created by M3 analysts, due to the inclusion of sensitive national security information. The Navy assesses and analyzes M3 data collected from Navy passive acoustic monitoring systems and continues working to make some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances, and ultimately to the public. Significant progress in making M3 data available to the scientific community has been accomplished over the last several years as evidenced by the publication of one scientific, peer-reviewed paper with a second in preparation and release of information to researchers such as Dr. Southall.

2 The term "track" refers to a time series of successive acoustic locations for the same acoustically-active whale (i.e., an acoustic track).

3.5 Status of Ambient Noise Data

The Navy collects ambient noise data from the marine environment when the SURTASS passive towed horizontal line array is deployed. However, because the collected ambient noise data may also contain sensitive acoustic military information, the Navy classifies the data, making them unavailable to the public. 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) for the world's oceans.

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 with the goal of ultimately making it available to scientists with the appropriate credentials. The Navy continues to study the feasibility of declassifying portions of its ambient noise 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. M3 Program analysts have identified sources of incoherent sound in their collection of ambient noise data.

3.6 Marine Mammal Ship Strike Reporting

Per condition of the NDE and ESA permit for SURTASS LFA sonar, the Navy is responsible for systematically observing SURTASS LFA sonar activities for the presence of injured or disabled marine mammals. During the 2018 to 2019 annual period, no struck, injured, or disabled marine mammals or sea turtles were observed prior, during, or after the execution of SURTASS LFA sonar activities or during normal shipboard operations or transit. Accordingly, no reports were submitted to NMFS.

3.7 Marine Mammal Stranding Reporting

The NDE and ESA permit for SURTASS LFA sonar also call for the Navy to monitor the principal marine mammal stranding networks and media to temporally and spatially correlate any marine mammal strandings with SURTASS LFA sonar activities. The Navy monitors not only its SURTASS LFA sonar activities for the presence of injured or disabled marine mammals but also monitors the principal marine mammal stranding networks and other media for marine mammal strandings in the activities area for SURTASS LFA sonar. The Navy then correlates SURTASS LFA sonar activities spatially and temporally with marine mammal stranding events. The Navy compiled marine mammal stranding information from all parts of the activity area for SURTASS LFA sonar from e-news alerts, via social media for domestic and international stranding organizations, and by searching available stranding networks for relevant regional information. The majority of the stranding data for the western North Pacific and eastern Indian oceans was reported by the International Dolphin and Whale Stranding Network (https://www.facebook.com/Stranding Network/), which is an informal group of scientists, advocates, and concerned individuals that maintains a thorough compilation of all strandings of marine mammals reported throughout the world. No new Philippines' stranding data have been made available since 2016 by the Philippines Marine Mammal Stranding Network (Aragones et al. 2017), and marine mammal stranding data for Hawaii, Guam, and CNMI were compiled.

The Navy has evaluated the spatial and temporal overlap of the compiled strandings with SURTASS LFA sonar activities, and no overlap exists. No mass or individual strandings of marine mammals occurred in the vicinity of SURTASS LFA sonar activities during or directly following the periods when LFA sonar transmissions were conducted. As such, no reports of stranding correlations were submitted to NMFS during the annual period.

4 AFFECTED MARINE MAMMAL STOCKS

In its 2017 to 2018 LOAs application, the Navy provided estimates of the percentage of marine mammal stocks potentially affected during a proposed 20 nominal missions in the 15 activity/modeling areas where SURTASS LFA sonar might be deployed from August 2017 through August 2018 (DoN, 2017). The same analysis methodology and population data (densities and abundances) were utilized to compute the post-mission take estimates of marine mammals using the actual number of LFA sonar hours transmitted during each of the seven missions completed during the 2018 to 2019 NDE period. These take estimates were included in the 16 quarterly mission reports submitted to NMFS. The Navy maintained a running total of the number of transmitted LFA sonar hours and the percentages of affected marine mammal stocks to ensure that no more than 1020 hr of LFA sonar were transmitted or no more than 12 percent of any marine mammal stock were taken incidentally to the execution of SURTASS LFA sonar activities.

In this annual report, the Navy provides the compiled quarterly and annual post-mission summaries of the estimated percentages of the marine mammal stocks and number of marine mammals in each stock incidentally harassed by the LFA sonar transmissions both for each SURTASS LFA sonar vessel (Appendix B) and all combined vessels (Table 3). 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 SEIS/SOEIS, Appendix B (DoN, 2017a).

4.1 POST-MISSION ESTIMATES OF POTENTIALLY AFFECTED MARINE MAMMAL STOCKS

Overall mission planning during the annual period was fundamentally based on national security and anti-submarine warfare requirements, although consideration was also given to the need for MMPA Level B incidental harassment of any one stock of marine mammals to remain under 12 percent annually. Thus, mission planning for each quarter of the annual NDE 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. Due to the effectiveness of mitigation monitoring for SURTASS LFA sonar, no MMPA Level A incidental harassment was approved nor estimated.

During the August 2018 through August 2019 NDE period, the highest percentage of any marine mammal stock taken by MMPA Level B incidental harassment from exposure to the 25.86 total hr of LFA sonar transmissions was 2.67 percent of the WNP stock and DPS of humpback whales (Table 3), which is well below the approved maximum limit of 12 percent. The endangered WNP humpback whale stock/DPS is small and is represented by a population estimated as only 1,328 individuals. The WNP stock/DPS of humpback whales occurs in many of the western North Pacific activity/modeling areas for SURTASS LFA sonar. The second highest Level B take percentage for the annual period was 0.42 percent of the WNP stock of long-beaked common dolphins, which also had the highest number of individuals in

any stock affected by Level B harassment, at 971 individuals (Table 3). The WNP long-beaked common dolphin stock has a population estimated at 272,189 individuals.

5 ASSESSMENT OF LONG-TERM EFFECTS AND CUMULATIVE IMPACTS

As part of the annual report on SURTASS LFA sonar activities, the Navy is to report on its assessment of long-term effects and any discernible or estimated cumulative impacts associated with activities using SURTASS LFA sonar. The Navy's conclusion remains unchanged following its assessment of the available information on long-term effects and cumulative impacts potentially associated with SURTASS LFA sonar activities. The Navy has concluded that no significant long-term effects nor discernible, significant cumulative impacts will reasonably result from the execution of SURTASS LFA sonar activities.

Short-term rather than long-term effects are expected in association with SURTASS LFA sonar activities. Short-term effects such as behavioral responses in marine mammals or sea turtles are most likely but would be temporary, infrequent, and comparatively short in duration due to the nature of the LFA sonar transmissions, with transmissions of 60 sec durations at a typical duty cycle of 10 percent (i.e., the source transmits for 60 sec every 10 minutes), and the duty cycle not exceeding 20 percent. Such short-term effects on the biological environment are not expected to be additive for the very small portion (no more than 2.67 percent of any marine mammal stock in 2018 to 2019) of any stock or species affected annually by the intermittent LFA sonar signals. These same characteristics of LFA sonar transmissions also means that effects to the ambient noise environment are transitory and intermittent with no permanent overall effect on the long-term level in oceanic ambient noise. No evidence is known to exist on long-term effects resulting from use of SURTASS LFA sonar.

Many types of activities and processes, both natural and human-related, could possibly contribute to the cumulative impact of SURTASS LFA sonar activities. Climate change, marine pollution, commercial fishing, seismic exploration, commercial shipping, whaling, and scientific research could all potentially occur in areas of the marine environment where SURTASS LFA sonar activities are conducted. The greatest possible cumulative impact associated with SURTASS LFA sonar activities in combination with other known current or planned maritime activities is the increase in the ambient noise environment, whether on a transitory basis from sonar and seismic sound transmissions or a more persistent basis from ship traffic.

The use of four SURTASS LFA sonar systems does not add appreciably to the underwater ambient noise environment in the 100 to 500 Hz frequency band at which transmissions are limited. This very small number of potential sound sources only add to the ambient noise environment when LFA sonar systems are active or transmitting, which is a infinitesimally small amount of an annual period (i.e., no more than a 20 percent duty cycle, where the sonar is off and not transmitting for 80 percent of the time; all LFA sonar systems only transmitted for a combined total of 25.86 hr in the entire 2018 to 2019 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), with ship noise centered in the 20 to 200 Hz frequency band (Ross, 2005). 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). The overall increasing ambient noise trends in both the Pacific and Indian oceans have primarily been attributed to increasing shipping noises (Miksis-Olds and Nichols, 2016). Although seismic exploration is not extensive in the central or western North Pacific Ocean or eastern Indian Ocean, commercial maritime traffic in these regions is extensive.

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 approved level of 1,020 hr per year and a 20 percent duty cycle, the contribution to the LF ambient noise environment from the transmissions 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 if LFA sonar operated at 1,020 hr/yr, the contribution from SURTASS LFA sonar would be 1.0×10^{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, as previously concluded, the potential for accumulation of noise due to the intermittent transmission of SURTASS LFA sonar is considered negligible.

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 that are comparatively short in duration and occur infrequently. These combined effects are not of the type or severity that would be expected to be cumulative for the small portion of any marine mammal or sea turtle stock or species likely to be exposed either annually or in the reasonably foreseeable future.

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APPENDIX A: 2017 NATIONAL DEFENSE EXEMPTION FROM REQUIREMENTS OF THE MARINE MAMMAL PROTECTION ACT FOR DEPARTMENT OF DEFENSE SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE SONAR MILITARY READINESS ACTIVITIES

DEPUTY SECRETARY OF DEFENSE
1010 DEFENSE PENTAGON
WASHINGTON, DC 20301-1010

AUG 1 0 2017

MEMORANDUM FOR SECRETARY OF THE NAVY

SUBJECT: National Defense Exemption from Requirements of the Marine Mammal Protection Act for Department of Defense Surveillance Towed Array Sensor System Low Frequency Active Sonar Military Readiness Activities

Pursuant to Title 16, Section 1371(f), of the United States Code, and having conferred with the Secretary of Commerce, I have determined that it is necessary for the national defense to exempt all military readiness activities that employ Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar from compliance with the requirements of the Marine Mammal Protection Act, Title 16, Sections 1361-1421h, of the United States Code. A military readiness activity is defined in Section 315(f) of Public Law 107-314.

This exemption is effective August 13, 2017, and shall remain in force for a period of two years from that date or until such time as the National Marine Fisheries Service issues Regulations and Letters of Authorization under Title 16, Section 1371 for SURTASS LFA sonar military readiness activities, whichever is earlier. During the exemption period, all military readiness activities that involve the use of SURTASS LFA sonar shall comply with the parameters and mitigation, monitoring, and reporting measures set forth in Attachment 1.

Attachment:
As stated

Attachment 1

Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) Sonar Mitigation, Monitoring and Reporting Measures

I. PARAMETERS

1. This exemption covers use of SURTASS LFA sonar onboard the USNS VICTORIOUS (T-AGOS 19), the USNS ABLE (T-AGOS 20), the USNS EFFECTIVE (T-AGOS 21), and USNS IMPECCABLE (T-AGOS 23). 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 at 1 meter (m) root mean square (rms) and a maximum duty cycle of 20 percent.

2. The Navy will carry out an estimated total of 20 nominal active sonar missions annually among these four vessels (or equivalent number of shorter missions), but shall not exceed a total of 255 hours of sonar transmit time per vessel per year during the period of this exemption within the following areas:

   (a) Up to 16 nominal missions annually 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 annually in the central North Pacific Ocean that include the Hawaii North and Hawaii South mission areas.

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

II. MITIGATION

1. SURTASS LFA sonar military readiness activities must be conducted 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 the military readiness activities, the following mitigation measures must be implemented:

   (a) **Personnel Training—Lookouts**:
      (1) The Navy shall train the lookouts in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if they spot marine mammals.
      (2) The Navy will employ one or more marine mammal biologists qualified in conducting at-sea marine mammal visual monitoring from surface vessels to train and qualify designated ship personnel to conduct at-sea visual monitoring. This training may be accomplished either in-person, or via video training.

   (b) **General Operating Procedures**:
      (1) Prior to SURTASS LFA sonar operations, the Navy will promulgate executive guidance for the administration, execution, and compliance with this exemption.
      (2) SURTASS LFA sonar signals must not be transmitted at a frequency greater than 500 Hertz (Hz).
      (3) The Navy must ensure, to the greatest extent practicable, that no marine mammal is subjected to a sound pressure level of 180 dB re: 1 μPa (rms) or greater from SURTASS LFA sonar operations.

   (c) **Commercial and Recreational SCUBA Diving Mitigation Zone**

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(1) The Navy will establish a mitigation zone for human divers at 145 dB re: 1 µPa at 1 m around all known human commercial and recreational diving sites. Although this geographic restriction is intended to protect human divers, it will also reduce the LFA sound levels received by marine mammals located in the vicinity of known dive sites

(d) **LFA Sonar Mitigation Zone and Additional 1-Kilometer (km) Buffer Zone:**

(1) Prior to commencing and during SURTASS LFA sonar transmissions, the Navy 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 and the distance from the SURTASS LFA sonar source to the 180-decibel (dB) re: 1 µPa isopleth (*i.e.*, the LFA sonar mitigation zone).

(2) The Navy will establish a180-dB LFA sonar mitigation zone around the surveillance vessel that is equal in size to the 180-dB re: 1 µPa isopleth (i.e., the volume subjected to sound pressure levels of 180 dB or greater) as well as establish a one-kilometer (1-km) buffer zone around the LFA sonar mitigation zone.

(3) The Navy will update these sound field estimates every 12 hours or more frequently depending upon changing meteorological or oceanographic conditions; and at least 30 minutes prior to any SURTASS LFA sonar transmission.

(e) **Ramp-Up Procedures for the HF/M3 System:**

(1) The Navy will ramp up the High Frequency/Marine Mammal Monitoring (HF/M3) active sonar from a power level beginning at a maximum source sound pressure level of 180 dB re: 1 µPa @ 1 m (rms) in 10-dB increments to operating levels over a period of no less than five minutes:

(A) At least 30 minutes prior to any SURTASS LFA sonar transmission,

(B) Prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmissions; and

(C) Any time after individuals have powered down the HF/M3 active sonar source for more than two minutes.

(2) The Navy will not increase the HF /M3 active sonar system's sound pressure level once HF /M3 operators detect a marine mammal. 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.

(f) **Suspension/Delay for SURTASS LFA Sonar Transmissions:**

If a marine mammal is detected through monitoring within either the LFA sonar mitigation zone or the 1-km buffer zone, the Navy will immediately suspend or delay SURTASS LFA sonar transmissions.

(g) **Resumption of SURTASS LFA Sonar Transmissions:**

The Navy may resume/commence SURTASS LFA sonar transmissions 15 minutes after:

(1) All marine mammals have left the area of the LFA sonar mitigation zone and the 1- km buffer zone; and/or

(2) 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.

(h) **Geographic Restrictions:**

(1) The Navy will not operate SURTASS LFA sonar such that: the SURTASS LFA sonar sound field exceeds 180 dB re: 1 µPa (rms):

(A) At a distance of less than or equal to 12 nautical miles (nmi) (22 km (14 miles (mi)), from any coastline, including offshore islands; and

(B) 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 the table below ,or

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identified through the Adaptive Management Process, specified herein, within the period of the NDE's effectiveness.

(2) The OBIAs for marine mammals (with specified periods of effectiveness) for SURTASS LFA sonar routine training, testing, and military operations are:

Name of Area	Location of Area	Months of Importance
Georges Bank	Northwest Atlantic Ocean	Year-round
Roseway Basin Right Whale Conservation Area	Northwest Atlantic Ocean	June through December, annually
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS)	Northwest Atlantic Ocean/ Gulf of Maine	January 1 to November 14, annually Year-round for Stellwagen Bank NMS
Southeastern U.S. Right Whale Habitat	Northwest Atlantic Ocean	November 15 to January 15, annually
Gulf of Alaska	Gulf of Alaska	March through September, annually
Navidad Bank	Caribbean Sea/ Northwest Atlantic Ocean	December through April, annually
Coastal waters of Gabon, Congo and Equatorial Guinea	Southeastern Atlantic Ocean	June through October, annually
Patagonian Shelf Break	Southwestern Atlantic Ocean	Year-round
Southern Right Whale Seasonal Habitat	Southwestern Atlantic Ocean	May through December, annually
Central California	Northeastern Pacific Ocean	June through November, annually
Antarctic Convergence Zone	Southern Ocean	October through March, annually
Piltun and Chayvo offshore feeding grounds	Sea of Okhotsk	June through November, annually
Coastal waters off Madagascar	Western Indian Ocean	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales.
Madagascar Plateau, Madagascar Ridge, and Walters Shoal	Western Indian Ocean	November through December, annually
Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary	Northern Mediterranean Sea	July to August, annually
Penguin Bank, Hawaiian Islands Humpback Whale NMS	North-Central Pacific Ocean	November through April, annually
Costa Rica Dome	Eastern Tropical Pacific Ocean	Year-round
Great Barrier Reef	Coral Sea/ Southwestern Pacific Ocean	May through September, annually
Bonney Upwelling	Southern Ocean	December through May, annually
Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG)	Bay of Bengal/ Northern Indian Ocean	Year-round

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Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon	Northeastern Pacific Ocean	Olympic NMS: December, January, March, and May annually. Prairie, Barkley Canyon, and Nitnat Canyon: June through September annually
Abrolhos Bank	Southwest Atlantic Ocean	August through November, annually
Grand Manan North Atlantic Right Whale Critical Habitat	Bay of Fundy, Canada	June through December, annually
Eastern Gulf of Mexico	Eastern Gulf of Mexico	Year-round
Southern Chile Coastal Waters	Gulf of Corcovado, Southeast Pacific Ocean; Southwestern Chile	February to April, annually
Offshore Sri Lanka	North-Central Indian Ocean	December through April, annually
Camden Sound/Kimberly Region	Southeast Indian Ocean; northwestern Australia	June through September, annually
Perth Canyon	Southeast Indian Ocean; southwestern Australia	January through May, annually
Southwest Australia Canyons	Southeast Indian Ocean; southwestern Australia	Year-round

Note: The boundaries and periods of OBIAs will be kept on file in NMFS' Office of Protected Resources and its website at http://www/nmfs.noaa.gov/pr/permits/incidental/military.htm.

(i) **Operational Exception for SURTASS LFA Sound Field in OBIAs.** During military operations, SURTASS LFA sonar transmissions may exceed 180 dB re: 1 µPa (rms) within the boundaries of an OBIA, including operating within an OBIA, when the Navy 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 Navy must maintain a running calculation/estimation of takes of each species and stocks over the effective period of these regulations. The Navy will plan all SURTASS LFA sonar missions to ensure that no more than 12 percent of any marine mammal species or stock 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 Navy must coordinate to ensure that this condition is met for all vessels combined.

III. MONITORING

1. The Navy must perform:

(a) **Visual Mitigation Monitoring:**

(1) 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. This training may be accomplished either in-person, or via video training.

(2) 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.

(3) Conduct visual monitoring from the ship's bridge during all daylight hours (30 minutes before sunrise until 30 minutes after sunset). During activities that employ SURTASS LFA sonar in the active mode,

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the SURTASS vessels shall have lookouts to maintain a topside watch with standard binoculars (7x) and with the naked eye.

(b) **Passive Acoustic Mitigation Monitoring:**
(1) Use the low frequency, passive SURTASS sonar system to listen for vocalizing marine mammals.

(c) **Active Acoustic Mitigation Monitoring:**
(1) 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.

2. Mitigation monitoring under Conditions III.1(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);
(a) Continue between sonar transmissions (pings); and
(a) Continue either at least 15 minutes after completion of SURTASS LFA sonar transmissions (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.

3. The Navy 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 NDE.

4. The Navy will conduct all monitoring required under this NDE to increase knowledge of the affected marine mammal species. The Navy 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 collect ambient noise data and explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise research efforts.

IV. REPORTING

1. **Classified and Unclassified Quarterly Reports.** The Navy must submit classified and unclassified quarterly mission reports to the Director, Office of Protected Resources, NMFS no later than 45 days after the end of each quarter, beginning on the date of effectiveness of this NDE. 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:

(a) Dates, times, and location of each vessel during each mission.
(b) Information on sonar transmissions during each mission and records of any delays or suspensions.
(c) Location of the SURTASS LFA sonar mitigation and buffer zones in relation to the LFA sonar array.

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(d) 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).
(e) 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) by SURTASS LFA sonar military readiness activities (both within and outside the LFA sonar mitigation and buffer zones), using predictive modeling based on mission locations, dates/times of operations, system characteristics, LF A sonar transmission durations, oceanographic environmental conditions, and animal demographics.
(f) If no SURTASS LFA sonar missions are completed during a quarter, a report of negative activity will be provided.

2. **Annual Unclassified Report.** The Navy must submit an annual, unclassified report to the Director, Office of Protected Resources, NMFS, no later than 60 days after the annual anniversary of the execution of this NDE. At a minimum, the annual report will contain the following:

(a) An unclassified summary of the year's quarterly reports.
(b) The Navy's estimates of the percentages of marine mammal stocks affected by SURTASS LFA sonar military readiness activities (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.
(c) An analysis of the effectiveness of the mitigation measures with recommendations for improvements, where applicable.
(d) An assessment of any long-term effects from SURTASS LFA sonar military readiness activities a.
(e) Any discernible or estimated cumulative impacts from SURTASS LFA sonar military readiness activities.

3. **Status on Marine Mammal Monitoring (M3) Program.** The Navy must provide a status update to NMFS, in proximity to the annual anniversary of the execution of this NDE, 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. 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. The status update may be submitted with the Navy's annual unclassified report.

4. **Marine Mammal Ship Strike Reporting**. In the event of a ship strike by the SURTASS LFA sonar vessel, at any time or place, the Navy must:

(a) 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.).
(b) 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.
(c) 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.
(d) Provide NMFS a photo or video of the struck animal, if equipment is available.

5. **Marine Mammal Stranding Reporting.** During SURTASS LFA sonar military readiness activities personnel onboard a SURTASS LFA vessel shall systematically observe for injured or disabled marine mammals and

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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 activities, the Navy shall:

(a) 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 (within 24 hours) and in the vicinity of any SURTASS LFA sonar activities. The Navy will 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.

(b) 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).

(c) In the event that personnel onboard a SURTASS LFA vessel observe an injured, stranded, or dead marine mammal during transit, or that is not in the vicinity of, or found during or shortly after SURTASS LFA sonar military readiness activities, the Navy will report the same information to NMFS as listed above as soon as operationally feasible and clearance procedures allow.

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APPENDIX B: SUMMARIES OF 2018 TO 2019 MARINE MAMMAL LEVEL B INCIDENTAL HARASSMENT BY SURTASS LFA SONAR VESSEL

Table B-1. Summary of the Quarterly and Annual MMPA Level B Incidental Harassment Associated with Exposure to the USNS VICTORIOUS' (T-AGOS 19) SURTASS LFA Sonar Transmissions During the August 2018 to August 2019 NDE Period; No SURTASS LFA Sonar Actvities nor LFA Sonar Transmissions Were Conducted by the USNS VICTORIOUS during 2018 to 2019.

Marine Mammal Species/Species Groups	*Number Animals in Stock*	*Stock Name*	*Level B Harassment*									
			Quarter 1 (August to November)		*Quarter 2 (November to February)*		*Quarter 3 (February to May)*		*Quarter 4 (May to August)*		*Total Annual*	
			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												
Bryde's whale												
Common minke whale												
Fin whale												
Omura's whale												
Odontocetes												
Blainville's beaked												
Common bottlenose dolphin												
Cuvier's beaked whale												
False killer whale												
Fraser's dolphin												
Gingko-toothed beaked whale												
Killer whale												
Pygmy killer whale												
Risso's dolphin												
Rough-toothed dolphin												
Short-beaked common dolphin												
Short-finned pilot whale												
Sperm whale												
Spinner dolphin												
Striped dolphin												
			No LFA Sonar Missions—Negative Activity Report		**No LFA Sonar Missions—Negative Activity Report**		**No LFA Sonar Missions—Negative Activity Report**		**No LFA Sonar Missions—Negative Activity Report**			

Table B-2. Summary of the Quarterly and Annual MMPA Level B Incidental Harassment Associated with Exposure to the USNS ABLE's (T-AGOS 20) 11.93 Hours of SURTASS LFA Sonar Transmissions During the August 2018 to August 2019 NDE Period.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name [1]	Level B Harassment									
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual	
			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	3,432	NIND	0.0077%	1							0.0077%	1
Bryde's whale	9,176	NIND	0.0513%	5							0.0513%	5
Common minke whale	257,500	IND	0.0000%	1							0.0000%	1
Fin whale	1,716	IND	0.0061%	1							0.0061%	1
Omura's whale	9,176	IND	0.0513%	5							0.0513%	5
Odontocetes												
Blainville's beaked	16,867	IND	0.0464%	8							0.0464%	8
Common bottlenose dolphin	785,585	IND	0.0512%	403							0.0512%	403
Cuvier's beaked whale	27,272	IND	0.1372%	38							0.1372%	38
Deraniyagala's beaked whale	16,867	IND	0.0463%	8							0.0463%	8
Dwarf sperm whale	10,541	IND	0.0038%	1							0.0038%	1
False killer whale	144,188	IND	0.0011%	2							0.0011%	2
Fraser's dolphin	151,554	IND	0.0086%	14							0.0086%	14
Gingko-toothed beaked whale	16,867	IND	0.0463%	8							0.0463%	8
Indo-Pacific bottlenose dolphin	7,850	IND	0.0513%	5							0.0513%	5
Killer whale	12,593	IND	0.3844%	49							0.3844%	49
Long-beaked common dolphin	1,819,882	IND	0.0000%	1							0.0000%	1
Longman's beaked whale	16,867	IND	0.2063%	35							0.2063%	35
Melon-headed whale	64,600	IND	0.0871%	57							0.0871%	57
Pantropical spotted dolphin	736,575	IND	0.0049%	37							0.0049%	37
Pygmy killer whale	22,029	IND	0.0396%	9							0.0396%	9
Pygmy sperm whale	10,541	IND	0.0006%	1							0.0006%	1
Risso's dolphin	452,125	IND	0.1619%	733							0.1619%	733
Rough-toothed dolphin	156,690	IND	0.0035%	6							0.0035%	6
Short-finned pilot whale	268,751	IND	0.0834%	225							0.0834%	225
Sperm whale	24,446	NIND	0.0312%	8							0.0312%	8
Spinner dolphin	634,108	IND	0.0047%	31							0.0047%	31
Striped dolphin	674,578	IND	0.0883%	596							0.0883%	596
					No LFA Sonar Missions—Negative Activity Report		No LFA Sonar Missions—Negative Activity Report		No LFA Sonar Missions—Negative Activity Report			

1 NIND= North Indian; IND=Indian

Table B-3. Summary of the Quarterly and Annual MMPA Level B Incidental Harassment Associated with Exposure to the USNS EFFECTIVE's (T-AGOS 21) 2.71 Hours of SURTASS LFA Sonar Transmissions During the August 2018 to August 2019 NDE Period.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name [2]	Level B Harassment									
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual	
			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			0.0027%	1					0.0027%	1
Bryde's whale	20,501	WNP			0.0110%	3					0.0110%	3
Common minke whale	25,049	WNP O			0.0688%	18					0.0688%	18
Fin whale	9,250	WNP			0.0577%	6					0.0577%	6
Humpback whale	1,328	WNP stock and DPS			2.1610%	29					2.1610%	29
North Pacific right whale	922	WNP			0.0031%	1					0.0031%	1
Omura's whale	1,800	WNP			0.0125%	1					0.0125%	1
Odontocetes												
Blainville's beaked whale	8,032	WNP			0.0222%	2					0.0222%	2
Common bottlenose dolphin	168,791	WNP			0.0230%	39					0.0230%	39
Cuvier's beaked whale	90,725	WNP			0.0212%	20					0.0212%	20
False killer whale	16,668	WNP			0.0488%	9					0.0488%	9
Fraser's dolphin	220,789	WNP			0.0093%	21					0.0093%	21
Gingko-toothed beaked whale	22,799	NP			0.0078%	2					0.0078%	2
Killer whale	12,256	WNP			0.0023%	1					0.0023%	1
Kogia spp.	350,553	WNP			0.0033%	12					0.0033%	12
Long-beaked common dolphin	279,182	WNP			0.1269%	355					0.1269%	355
Longman's beaked whale	4,571	WNP			0.0195%	1					0.0195%	1
Melon-headed whale	36,770	WNP			0.0326%	12					0.0326%	12
Pacific white-sided dolphin	931,000	NP			0.0034%	32					0.0034%	32
Pantropical spotted dolphin	438,064	WNP			0.0070%	31					0.0070%	31
Pygmy killer whale	30,214	WNP			0.0195%	6					0.0195%	6
Risso's dolphin	83,289	WNP			0.0470%	40					0.0470%	40
Rough-toothed dolphin	145,729	WNP			0.0151%	22					0.0151%	22
Short-beaked common dolphin	3,286,163	WNP			0.0052%	172					0.0052%	172
Short-finned pilot whale	53,608	WNP			0.0981%	53					0.0981%	53
Sperm whale	102,112	NP			0.0037%	4					0.0037%	4
Spinner dolphin	1,015,059	WNP			0.0002%	2					0.0002%	2
Striped dolphin	570,038	WNP			0.0129%	74					0.0129%	74
			No LFA Sonar Missions—Negative Activity Report				No LFA Sonar Missions—Negative Activity Report		No LFA Sonar Missions—Negative Activity Report			

2 WNP=Western North Pacific; NP=North Pacific; CNP=Central North Pacific; DPS=distinct population segment

Table B-4. Summary of the Quarterly and Annual MMPA Level B Incidental Harassment Associated with Exposure to the USNS IMPECCABLE's (T-AGOS 23) 11.22 Hours of SURTASS LFA Sonar Transmissions During the August 2018 to August 2019 NDE Period.

Marine Mammal Species/Species Groups	Number Animals in Stock	Stock Name [2]	Level B Harassment									
			Quarter 1 (August to November)		Quarter 2 (November to February)		Quarter 3 (February to May)		Quarter 4 (May to August)		Total Annual	
			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	0.0004%	1	0.0004%	1					0.0008%	2
Bryde's whale	20,501	WNP	0.0122%	3	0.0108%	3			0.0228%	5	0.0458%	11
Common minke whale	25,049	WNP O	0.0677%	17	0.0549%	14					0.1225%	31
Fin whale	9,250	WNP			0.0092%	1					0.0092%	1
Humpback whale	1,328	WNP stock and DPS	0.2393%	4	0.27%	4					0.5130%	8
Omura's whale	1,800	WNP	0.0139%	1	0.0123%	1			0.0260%	1	0.0522%	3
Odontocetes												
Blainville's beaked whale	8,032	WNP	0.0302%	3	0.0097%	1			0.0496%	4	0.0896%	8
Common bottlenose dolphin	168,791	WNP	0.0271%	46	0.0184%	31			0.0035%	6	0.0490%	83
Cuvier's beaked whale	90,725	WNP	0.0289%	27	0.0005%	1			0.0235%	22	0.0529%	50
Deraniyagala's beaked whale	22,799	NP			0.0034%	1			0.0232%	6	0.0267%	7
Dwarf sperm whale	350,553	WNP							0.0099%	35	0.0099%	35
False killer whale	16,668	WNP	0.0625%	11	0.0374%	7			0.0300%	5	0.1298%	23
Fraser's dolphin	220,789	WNP	0.0115%	26	0.0058%	13					0.0173%	39
	16,992	CNP							0.1187%	21	0.1187%	21
Ginkgo-toothed beaked whale	22,799	NP	0.0106%	3	0.0034%	1			0.0232%	6	0.0373%	10
Killer whale	12,256	WNP	0.0028%	1	0.0015%	1			0.0065%	1	0.0108%	3
Kogia spp.	350,553	WNP	0.0043%	16	0.0010%	4					0.0053%	20
Long-beaked common dolphin	279,182	WNP	0.1445%	404	0.0757%	212					0.2202%	616
Longman's beaked whale	4,571	WNP	0.0265%	2	0.0086%	1			0.0311%	2	0.0662%	5
Melon-headed whale	36,770	WNP	0.0418%	16	0.0250%	10			0.0636%	24	0.1304%	50
Pantropical spotted dolphin	438,064	WNP	0.0087%	38	0.0059%	26			0.0215%	95	0.0361%	159
Pygmy killer whale	30,214	WNP	0.0250%	8	0.0149%	5			0.0017%	1	0.0416%	14
Pygmy sperm whale	350,553	WNP							0.0041%	15	0.0041%	15
Risso's dolphin	83,289	WNP	0.0602%	51	0.0256%	22			0.0043%	4	0.0901%	77
Rough-toothed dolphin	145,729	WNP	0.0190%	28	0.0078%	12			0.0094%	14	0.0363%	54
Short-beaked common dolphin	3,286,163	WNP	0.0060%	196							0.0060%	196
Short-finned pilot whale	53,608	WNP	0.1055%	57	0.0279%	15			0.0332%	18	0.1666%	90
Sperm whale	102,112	NP	0.0046%	5	0.0020%	3			0.0129%	14	0.0195%	22
Spinner dolphin	1,015,059	WNP	0.0002%	3	0.0002%	2			0.0015%	16	0.0019%	21
Striped dolphin	570,038	WNP	0.0160%	92	0.0054%	31			0.0085%	49	0.0299%	172
							No LFA Sonar Missions—Negative Activity Report					

APPENDIX C: MARINE MAMMAL MONITORING (M3) ANNUAL 2018 TO 2019 REPORT

ANNUAL REPORT OF THE MARINE MAMMAL MONITORING (M3) PROGRAM

24 SEPTEMBER 2019

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1 PURPOSE

The purpose of the Marine Mammal Monitoring (M3) program, a monitoring component of the Surveillance Towed Array Senor System Low Frequency Active (SURTASS LFA) sonar program, is to utilize the Navy's fixed and mobile passive acoustic monitoring systems to enhance the Navy's collection of long-term data on individual and populations of acoustically-active marine mammals, principally baleen whales. The M3 program collects acoustic data on the behavioral range of vocalizing (calling and singing) whales and on the influences of anthropogenic activities on whale behaviors. The acoustic data the M3 program observes, collects, and analyzes are electronically archived in a form that can be used for exercise planning, naval operations, system tests, and preparation of environmental compliance documents. The purpose of this Annual Report is to provide a description of the current M3 program, its benefits, products, actions, and accomplishments, as well as future M3 program goals. Overall, in FY2019, the M3 program generated more than 3,327 marine mammal tracks[1] containing over 18,565 positions of acoustically-active marine mammals.

2 M3 PROGRAM

2.1 Background

The M3 program was initiated in the fall of 1992 as an independent scientific research effort to make use of the acoustic data on oceanic and biological sounds available through the U.S. Navy's Integrated Undersea Surveillance System (IUSS). The primary goal of the M3 program is to use IUSS data to fill data gaps and to further the overall understanding of anthropogenic noise effects on the marine environment. The M3 program was identified as part of the Long Term Monitoring program in the Navy's SURTASS LFA Sonar Final Overseas Environmental Impact Statement/Environmental Impact Statements (DoN, 2001). The M3 program has evolved into a valuable tool by which the acoustic activity levels of whales are quantitatively documented and ambient noise level trends are measured over ecologically meaningful ocean scales and time periods under varying ocean noise conditions.

M3 data are collected to: 1) document occurrence, distribution, and behaviors of acoustically active whale species over ocean basin and decadal scales; 2) objectively assess changes in marine mammal activity levels under normal conditions (e.g., weather, wind, time of year, or time of day) relative to acoustic conditions with varying levels of anthropogenic sources (e.g., seismic profiler[2], naval sonar, shipping, or fishing activities); 3) uniquely inform environmental assessments of current and future anti-submarine warfare systems; and 4) assemble a long-term database of ocean environmental data to enable scientifically-based evaluations of potential influences on cetaceans or other marine species.

2.2 M3 Program History

In the fall of 1992, the U.S. Navy initiated the Whales '93 program to evaluate the potential of the IUSS for detecting, locating, and tracking whales, as well as determining their seasonal distributions and movements. The Whales '93 team collected data at Naval Ocean Processing Facilities (NOPFs) for the

[1] For the M3 program, the term "track" refers to a time series of successive acoustic locations for the same acoustically-active whale (i.e., an acoustic track).
[2] The term "seismic profiler" refers to a vessel operating a seismic airgun array or arrays as part of a geological and geophysical survey, usually to explore for sub-bottom oil and gas but also to conduct basic research.

North Atlantic and North Pacific oceans. The data collection efforts in this three-year Whales '93 program yielded unprecedented amounts of new information on acoustically-active marine mammals in the North Atlantic and North Pacific oceans (Costa, 1993; Watkins et al., 2000, 2004; Clark and Gagnon, 2002). The Whales '93 effort continued through 1996 and included a second experiment, Whales '95. The objective of the Whales '95 experiment was to contribute to the Navy's overall knowledge of marine mammal distributions and movements, which would inform Navy operational and research planning. Data were collected via the disestablished San Nicholas Island Sound Surveillance System (SOSUS) arrays during Whales '95, which were correlated with data from a ship-based bioacoustics, passive towed horizontal line array (Clark and Fristrup, 1997; Fristrup and Clark, 1997). The success of these initial research efforts led to the evolution of the M3 program, which in 2002 became part of the NOAA/NMFS (National Marine Fisheries Service) permit requirements during the first Marine Mammal Protection Act (MMPA) rulemaking for SURTASS LFA sonar (NOAA, 2002).

2.3 Current M3 Program

Since 2002, fixed passive acoustic monitoring systems in the North Atlantic and North Pacific oceans have been used to monitor for the sounds of several baleen whale species and one odontocetes species. Initially, songs from blue, fin, humpback, and minke whales were detected during reproductive seasons. However, as the acoustic expertise of the M3 program team increased and software tools improved, M3 program analysts expanded their research efforts into seasons when these whale species were not singing (Clark and Gagnon, 2002). Subsequently, M3 program analysts identified calls, which are transient signals, from blue, fin, humpback, and minke whales, as well as sounds from Bryde's, gray, sei, Omura's, and sperm whales.

This growing proficiency also allowed M3 program analysts to expand their catalog of marine biological sounds that have not yet been identified to species. This collection of unknown biologic sounds includes some signal types that are clearly from large whales, some that are most likely echolocation clicks from diving odontocetes (e.g., sperm whales), some that are from fishes, and some that are from invertebrates (e.g., diurnal vertical plankton migrations, sea urchins). By authenticating that a sound source is of biological origin, the M3 program has significantly contributed to the proper identification of marine sounds and sound sources that are not of biological origin.

Another example of insights emerging from the large-scale, long-term data set of the M3 program is the quantification of annual and inter-annual variation in large whale singing behavior. Based on over 17 years of data, M3 program analysts can describe the typical seasonal patterns of acoustic activities for four species of baleen whales (blue, fin, humpback, and minke whales). Additionally, data from over seven years now provide insights into the seasonal patterns of an additional three species of baleen whales (Bryde's, gray, and sei whales) and at least one odontocete (sperm whale). A large-scale collection of sounds, acoustic occurrence counts, and tracks at both individual animal and species levels for baleen whale and sperm whale is being assembled. This collection includes increasingly detailed whale movement patterns that likely reflect migrations and possibly feeding.

The Navy is continuing to sponsor the collection of cross-spectral matrix (CSM) data from their passive acoustic arrays. Over 17 years of CSM data are now available. When merged with the M3 program's reports, the combined CSM and M3 information can be used to estimate the total number of singing blue, fin, minke, and humpback whales per unit area. Observations of CSM data over time can also show the interactions and influences of anthropogenic and ambient noise sources on large whale behavior. These collected data and reports provide the Navy with the necessary baseline information to quantify

statistically how baleen whale behavior is affected by various factors, such as ocean basin features, water conditions, seasons, time of day, weather conditions, and ambient noise conditions, as well as specific anthropogenic noise conditions (e.g., seismic profiler, shipping, fishing, naval sonar activities). These baseline data and resultant statistics can be of immense value to the Navy and other Federal agencies to address the issue of potential behavioral effects on marine mammals from Navy sonar and other anthropogenic noise sources (e.g., seismic surveys). IUSS is committed to continuing to sponsor multi-year acoustic monitoring studies of marine mammals using their fixed passive acoustic monitoring systems.

2.4 Regulatory Compliance Requirements

The requirement to collect and assess M3 program data and resulting analyses was instituted in the first MMPA rulemaking for the employment of SURTASS LFA sonar (NOAA, 2002). In the 2017 National Defense Exemption (NDE), data collection by the M3 program was included as a monitoring requirement (DoD, 2017), specifying that the Navy continue to assess data from the M3 program and work toward making some portion of those data, after appropriate security review, available to scientists with clearances; if the analyses produced by the scientists with clearances are deemed to be unclassified, they are to be made publicly available. Furthermore, the Navy is to 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. These requirements are continued in the recently approved MMPA regulations that authorize SURTASS LFA sonar training and testing activities through August 2026 (NOAA, 2019).

A science paper on fin whale sing-swim speed associations has been declassified and published in a peer-reviewed, scientific journal (Clark et al., 2019), while a similar paper on humpback whale sing-swim speed associations is being prepared for internal review.

Information on the distribution of western gray whales has also been declassified and released to scientists. In 2016, a memorandum was released to Dr. Brandon Southall, who serves on an advisory committee of the International Union for Conservation of Nature (IUCN), after approval by CUS and OPNAV N2N6F24, that discusses SURTASS-derived detections of acoustic signatures believed to be originating from western gray whales. These sounds are detected in shallow water of the South China Sea, East China Sea, and Sea of Japan, and indicate an area of wintering for these highly-endangered marine mammals. An updated 2018 memorandum contained acoustic displays and added another shallow water area of detection. During FY2019, a wavefile of the acoustic signature was released to Dr. Brandon Southall, who distributed it to experts to review and discuss, as well as to foster cooperative strategies for conducting field work in the region to definitively identify the source of the recorded signals.

3 M3 PROGRAM BENEFITS AND PRODUCTS

The M3 program provides the Navy, and potentially other government agencies, with long-term sets of acoustic data and analysis reports, as well as various tools for analysis of cetacean vocalizations. These include analysis and visualization tools to document and quantify seasonal occurrences and movements, as well as acoustic behaviors of at least seven large whale species (as well as other marine animals, as feasible) over large ocean areas and multiple annual periods. The analysis report products from the M3 program could be used to rigorously and scientifically compare and evaluate changes in marine mammal metrics as a function of various oceanic environmental conditions, especially pertaining to the acoustic

environment, and the sources of changes in that acoustic environment. Importantly, such an evaluation could be conducted for single or cumulative (multiple) acoustic sources, thereby providing an exceptional mechanism for comparatively evaluating the relative contributions from different types and numbers of anthropogenic sound-generating activities.

An invaluable benefit is the considerable expertise the M3 program provides the Navy regarding the classification of ocean sounds. For instance, odd LOFARgram[3] signatures that have been resolved by M3 analysts include various weather phenomena (i.e., lightning and rain squalls), weapons detonation, earthquakes, hydrothermal venting, known and previously undescribed biologics, and semi-submersible drilling rigs. Additionally, the experience and knowledge of the M3 program team have been instrumental in the identification of IUSS equipment casualties, software and hardware issues, and station performance irregularities.

4 M3 PROGRAM ACTIONS AND ACCOMPLISHMENTS IN FY2019

The following is a list of the principle M3 program actions and accomplishments from 1 October 2018 through 30 September 2019.

Health Checks: Conducted daily M3 sensor health checks using the Integrated Common Processor (ICP)[4] LOFARgrams and Raven software[5] spectrograms of single-hydrophone data. These displays were used to assist in identifying various IUSS equipment casualties that were not recognized by NOPF operations or maintenance personnel. Assisted with the generation of casualty reports (CASREPTs) for IUSS equipment casualties identified by the M3 program.

Acoustic Display Review: Reviewed multiple acoustic displays on a daily basis (hundreds of thousands over the 12-month period) to determine the acoustic occurrences and identifications of marine mammals and unique acoustic phenomena.

Marine Mammal Counts: In FY2019, M3 completed 9,360 counts of whale acoustic occurrences (seven species, four counts per day), for one day out of every 10 days (36 total days) on eight IUSS sensors. For the first nine months of FY2019, a special count was conducted in the Pacific on two sensors.

Acoustic Recordings: Identified and archived numerous recordings and developed thousands of tracks for blue, Bryde's, fin, humpback, minke, sei, and sperm whales using the ICP program TAPP (Tactical Acoustic Intelligence Products Program). These recordings from TAPP and tracks include: 1) songs (blue, fin, humpback, and minke whales); 2) calls (blue, Bryde's, fin, humpback, minke, and sei whales); and 3) foraging clicks (from sperm whales) recorded throughout the year. The recordings and tracks are from a wide variety of locations and under a range of behavioral contexts (e.g., summer foraging in areas of high prey productivity, migratory movements, or meandering travel throughout an area for weeks at a time).

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[3] LOFARgram is a term referring to a graphic display, similar to a sound spectrograph/spectrogram, which was generated by the Low Frequency Analysis and Recording (LOFAR) device designed in the late 1950s to analyze LF underwater signals in near-real-time.

[4] The Integrated Common Processor (ICP) has the capability to process and display data from all IUSS fixed and mobile underwater systems, taking advantage of automation advancement, array technology improvements, hardware insertions, and the common software components of the Navy's submarine and surface undersea warfare systems.

[5] Raven is a software program for the acquisition, visualization, measurement, and analysis of acoustics signals.

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SURTASS Analyst Training Sessions: Conducted two days of acoustic training sessions for SURTASS ship-riding personnel at NOPF Whidbey Island, WA. Some students were from the fixed IUSS community; approximately 100 students attended. An additional two days of training will be conducted at NOPF Whidbey Island, WA, on 9-10 October, 2019.

Humpback Whales: In the 12 months covered by this report, M3 generated 1,270 tracks with 6,047 positions of humpback whales, focusing on the variability of swimming speeds while the whales were singing and while not singing. This report covers the humpback whale migration from November 2018 to April 2019. The humpback whale tracks from this acoustic season will be compared with previous years of humpback tracks and combined into a science paper for submission to a peer-reviewed scientific journal. In preparation for this scientific paper, 438 tracks from the last ten years were selected and entered into an Excel spreadsheet database. This database contains 6,939 positions in which humpback whales swam a total of 54,768 nautical miles (nm) and reveals a wide range of singing and non-singing swim speeds.

Sei Whales: Generated 278 tracks with 1,235 positions of sei whales. These tracking reports provide valuable information on annual movements, behaviors, vocalizations, and distribution of a rarely-observed, largely oceanic marine mammal. The distribution of the sei whale is poorly understood because they are visually difficult to differentiate from either Bryde's or fin whales at sea, exhibit unpredictable occurrence patterns, and occur principally in oceanic regions with only rare occurrence in neritic[6] waters (Jefferson et al., 2008). M3 has refined the process where sei whales can be distinguished from other baleen whales which emit very similar song.

Blue Whale: Generated 502 tracks with 4,245 positions of Atlantic blue whales. The capability to acoustically track individual blue whales over long distances provides valuable information on individual whale movement, reproductive behavior, and song variability. Individual Atlantic blue whale singers sometimes include such a unique set of song features that the singer can be recognized in a different basin after being lost for days. Blue whales are known to produce regionally distinct songs. At least 13 blue whale songs have been documented in the world. To date, M3 has identified regionally distinct blue whale songs from the North Atlantic, Western North Pacific, Eastern North Pacific, Antarctic, North Indian Ocean (Sri Lanka), and pygmy blue whale. M3 also has two blue whale song forms (referred to as Namibia and Cape Verde dialects) that have yet to be associated with documented blues.

Western Pacific Blue Whale: Two individual Western Pacific blue whale singers were detected and tracked during the acoustic season. Since 2016, these two Western Pacific blue whales were successfully identified from other blue whales due to their unique acoustic signatures. Referred to as "Gap" and "No-Gap," these two whales display strong mid-spectrum frequency modulation and weak mating song. On 15 August 2018, Gap was regained as whale number WPAC-Blue-02-Aug18 in the Northwest Pacific. In 2017, Gap was held as whale number WPAC-Blue-03-Aug17 and tracked for 129 days. In 2016, Gap was detected as whale number WPAC-Blue-13-Aug16 and tracked for 197 days. On 25 July 2018, No-Gap was detected with a very strong mid-spectrum song in the Northwest Pacific. It is being tracked as whale number WPAC-Blue-01-Jul18. In 2017, No-Gap was gained on 20 August 2017, and tracked as whale number WPAC-Blue-04-Aug17 for 84 days. In 2016, No-Gap was detected on 24 July and tracked as whale number WPAC-Blue-11-Jul16 for 152 days. These two whales, Gap and No-Gap, provide a unique insight into the mating area, habit, and possible feeding areas of Western blue whales. In 2019, Gap and

[6] The neritic zone is the shallow marine environment extending from mean low water down to 200-meter (660-foot) depths, generally corresponding to the continental shelf.

No-Gap have been tracked since 02Aug19 and 31Jul19 respectfully and are both singing in the same area as in prior years.

Atlantic Hybrid Whale: In the 12 months covered by this report, detected and tracked a unique acoustic signature believed to be a hybrid of a blue and fin whale, which the M3 program refers to as "Bluefin" because the acoustic features of its song are a combination of both blue and fin whale song features. The Bluefin's migration tracks during 2019 resembled that of 2010, 2014, 2015, 2016, 2017, and 2018. In the North Atlantic Ocean, this Bluefin whale has been recorded and tracked annually for at least a decade, typically following a similar pattern of movements each year. In 2018 and again in 2019, Bluefin came very close to multiple sensors, providing the best acoustic signature of the last several years. This unique collection of data and analysis reports has added to the growing understanding of the movement patterns and behaviors of large baleen whales acoustically, spatially and temporally. Bluefin is being tracked in September, 2019 as this report closes.

Fin Whale: Generated 920 tracks with 4,096 positions of fin whales. Several singing fin whales, whose songs had very distinctive features, were detected and tracked over many days. Preliminary analysis of this large amount of data and resultant analysis reports on fin whale singers in the Atlantic Ocean suggest that no specific breeding area exists in the Atlantic Ocean for fin whales, and that they may breed opportunistically both temporally and spatially.

Sperm Whale: Generated 346 tracks of sperm whales with 2,408 positions. Sperm whale clicks were originally thought to be too high in frequency to be detected by IUSS assets. It has been determined, however, that sufficient energy on the lower-frequency side of the click frequency band makes these whales very detectable when they are relatively close to an IUSS sensor.

Western Gray Whale: No Western Gray Whales (WGW) were detected during FY2019 due to the deployment areas and deployment timeframes of SURTASS. During FY2019, a WGW wavefile was released to Dr. Brandon Southall who served on an advisory committee of the International Union for Conservation of Nature (IUCN). Dr. Southall distributed this wavefile to WGW experts to review and discuss the source of the signal referred to as WGW by M3 personnel, as well as to foster cooperative strategies for conducting field work in the region to definitively identify the source of the recorded signals.

Omura's Whale: For years, M3 had monitored an unknown whale vocalization at 20 Hertz (Hz) in both the South China Sea and East China Sea. In 2017 with the help of Dr. Cerchio, M3 identified these vocalizations as those from the Omura's whale (Cerchio et al. 2015). During this reporting timeframe Omura's whales were detected in every month of FY2019.

Bryde's Whale: Detected several Bryde's whales in near-equatorial waters in August and September in 2017, 2018, and 2019. These whales emit a low source level song and fixed or SURTASS arrays must be close aboard to detect them. Bryde's whales were detected in both the Pacific Ocean and Atlantic Ocean up to latitude 30° N. As is the case with blue and fin whales, Bryde's whale song frequency (Hz) has been noted decreasing in pitch every year.

Incoherent Ambient Noise: M3 personnel have identified sources of incoherent sound. A short brief was developed and provided to interested parties. The briefing material is available as ICP slides.

Artifacts: As new equipment is brought on line, M3 personnel review it for signal processing accuracy. Several unique artifacts were identified by M3 personnel and briefed to various staff, PMS 485, and Lockheed Martin personnel.

Equipment Issues: New shore processing equipment and processors are reviewed for accuracy and utility to the M3 program. Daily processing health checks are conducted and frequently reveal signal processing errors that are identified to operations and maintenance for resolution. Additionally, bearing accuracy problems have been identified by M3 personnel while tracking various marine mammals.

SURTASS Marine Mammal Detections: In FY2019, daily monitoring of SURTASS arrays when deployed revealed thousands of hours of marine mammal detection for at least nine different species. Since 2018, M3 has monitored SURTASS missions to document mission, mission area, wet array time, whale holding hours[7], and species held. A total of 9,658.8 SURTASS array wet hours were observed on M3 ICP consoles during which a total of 18,008.3 whale hours were detected.

The following was gathered for FY2019:

X911

Deployed to four different geographic areas. M3 detected 353 whales from six different species (blue, fin, humpback, sperm, Bryde's, and Omura's). X911 had 1,549.52 hours of array wet time on ICP. M3 detected 6,884.57 whale hours on array X911 in 2019.

X011

Deployed to four different geographic areas. M3 detected 175 whales from nine different species (minke, humpback, sperm, Bryde's, Omura's, 26 Hz blue, True Blue, 23 Hz blue, and Sri Lanka Blue). X011 had 1,279.32 hours of array wet time on ICP. M3 detected 2,933.28 whale hours on X011 in 2019.

X111

Deployed to three different geographic areas. M3 detected 167 whales from three different species (sperm, Bryde's, and Omura's). X111 had 2,674.42 hours of array wet time on ICP. M3 detected 1,923.81 whale hours on X111 in 2019.

X211

Deployed to four different geographic areas. M3 detected 270 whales from four different species (sperm, humpback, Bryde's, and Omura's). X211 had 1,968.02 hours of array wet time on ICP. M3 detected 2,325.59 whale hours on X211 in 2019.

X311

Deployed to two different geographic areas. M3 detected 315 whales from five different species (sperm, humpback, Bryde's, blue and Omura's). X311 had 2,187.52 hours of array wet time on ICP. M3 detected 3,941.09 whale hours on X211 in 2019.

5 SURTASS LFA SONAR TRAINING IN FY2019

From 15 through 16 November 2018 and 01 through 02 May 2019, senior marine acoustician, Dorene Stevenson, from MAI, conducted passive acoustic training for the USNS VICTORIOUS, USNS ABLE, USNS EFFECTIVE, USNS LOYAL, and USNS IMPECCABLE at NOPF Whidbey Island, WA. The passive acoustic trainings consisted of a classified Microsoft PowerPoint presentation. The presentation included: 1) an

[7] "Whale-holding hours" or "whale hours" equals the number of whales held (detected) times the number of hours held. For example, if two fin whales were held for three hours, that equates to six whale hours held.

introductory component that covered the requirements of passive acoustic monitoring for marine mammal species specified under permits and/or the NDE for LFA sonar employment; 2) a marine mammal identification component that described basic information about the primary marine mammal species that may be detected on SURTASS, and species-specific acoustic characteristics for visual identification on spectrograms during passive acoustic monitoring; and 3) recommended sonar display parameters to facilitate the detection and identification of acoustically active marine mammal species.

The introductory component included an overview of the reasons why monitoring mitigation of marine species is conducted during SURTASS LFA sonar transmissions, the monitoring requirements and procedures per the LOAs/NDE and Endangered Species Act (ESA) Incidental Take Statement (ITS) permits, and the importance of this task to the Navy's continued ability to use SURTASS LFA sonar. The other types of monitoring mitigation required during SURTASS LFA sonar transmissions, visual monitoring and active acoustic monitoring with the High-Frequency Marine Mammal Monitoring (HF/M3) sonar, were also discussed. Passive acoustic reporting procedures were discussed, with the explanation of how the information the MILCREW collects is reported to other Navy organizations and ultimately to the federal regulator, NMFS, which authorizes the Navy to use SURTASS LFA sonar.

The marine mammal identification component of the training included basic information about the species of marine mammals they could detect on the SURTASS passive array. The migratory and vocalization behavior of each marine mammal species was described, as well as key features on exemplar spectrograms that can be used to identify each species. The parameters of the sonar display were discussed, with recommended settings to aid with classifying detected biological signals to a specific marine mammal species. Many of the settings that are used by sonar operators at NOPF Dam Neck for review of SOSUS and SURTASS data for marine mammals are different from those typically used for mission-directed sonar operations.

6 FUTURE GOALS OF M3 PROGRAM

Several of the future plans for the M3 program are infra-structure related with hardware and software upgrades, an extension of the NOPF building, and the acquisition of additional equipment being top priorities. An expansion and augmentation of the M3 program are highly desirable, as an expanded capability would facilitate the transition into the public domain of vitally important reports and information on marine mammal movements, distributions, and bioacoustic behaviors that the M3 program has derived.

The following are immediate and long-term goals of the M3 Program

- Increase the number of single-hydrophone inputs and upgrade the Raven software acquisition system to enable recording from one hydrophone for every available IUSS sensor, with the capability of adding additional sensors. This software and hardware upgrade was developed by Lockheed Martin, the primary Raven software engineer at Cornell and M3 scientists. This upgrade was delivered to site and is not currently acquiring the single-phone data due to an unknown software problem. M3 personnel are coordinating efforts to resolve this.
- Expand the collection of movement information on sperm whales. M3 has recently noted that individual sperm whale tracks can be refined to a degree where each whale within a group can be plotted showing the spatial needs of each whale for feeding during migration.

- Use the upgraded NOPF APADS for storage of all CSM data. NOPF APADS was being developed by ARL:UT and Lockheed Martin. NOPF APADS has not been delivered to M3 as of September, 2019. NOPF APADS uses Linux and has hardware compatible to ICP. NOPF APADS is to replace AANA, which failed last year.
- Expand data collection and analysis to include calibrated measurements of received levels of species-specific sounds and calculations of source levels of marine animal sounds and detection ranges. These data are part of the input needed to derive probability of detection (PoD) functions for passive acoustic data for different marine mammal species. These metrics are essential inputs for estimating acoustic population densities, as well as data that document species-specific sound production rates. Marine mammal density estimates are critical for quantifying the impact of anthropogenic sound on individual species or population stocks.
- Expand data collection and analysis to include calibrated measurements of anthropogenic noise sources (e.g., surface vessels and seismic airgun surveys). This expansion would include calculations of received levels, source levels, and spatial-temporal dynamics of the resultant acoustic environments (i.e., acoustic footprints) generated by different anthropogenic sources under various oceanographic conditions.
- Complete relocation and refurbishment of M3 in its new, larger space.
- Complete upgrade of the old single-hydrophone Raven acquisition system into the new M3 program space.
- Work within Navy security classification guidelines to generate reports of scientific findings and submit the reports for declassification and ultimate publication in peer-reviewed scientific journals.

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