Annual Report No. 4:

Operation of the Surveillance Towed Array Sensor System

Low Frequency Active (SURTASS LFA) Sonar

Onboard the R/V *Cory Chouest*
and
USNS IMPECCABLE (T-AGOS 23)

Under the National Marine Fisheries Service

Letters of Authorization

of 12 August 2005

May 2006

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1.0 INTRODUCTION

Under the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar Final Rule 50 CFR 216.186(b) and Condition 8(b) of the annual SURTASS LFA sonar Letters of Authorization (LOAs) for the USNS IMPECCABLE (T-AGOS 23) and Research Vessel (R/V) *Cory Chouest*, this report provides an unclassified summary of the classified quarterly reports of SURTASS LFA operations for the period 16 February 2005 through the quarter ending 15 February 2006.

1.1 Purpose of this Report

As a requirement of the Regulations for the Taking of Marine Mammals Incidental to Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar, 50 CFR 216 Subpart Q (67 *Federal Register* [FR] 46785-89), this annual report for operation of SURTASS LFA sonar onboard the USNS IMPECCABLE (T-AGOS 23) and R/V *Cory Chouest* has been prepared in accordance with the requirements of the Letters of Authorization (LOAs) issued by the United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) (Appendices A and B). The primary purpose of this annual report is to provide NMFS with unclassified SURTASS LFA sonar operations information to assist them in their evaluation of future Navy LOA applications.

Because there is a potential that operation of the SURTASS LFA sonar could result in incidental harassment of marine mammals, it was decided in consultation with NMFS that the employment of SURTASS LFA would require authorization by rule making for a five-year period with annual renewals through the issuance of LOAs for each SURTASS LFA vessel for areas of intended operation. On 1 April 1998, NMFS agreed to be a cooperating agency under the National Environmental Policy Act (NEPA) for the SURTASS LFA environmental impact statement (EIS). NMFS is the federal regulator for the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA).

1.2 SURTASS LFA Sonar Description

SURTASS LFA is a long-range, all-weather, sonar system that operates in the low frequency (LF) band (100-500 Hertz[Hz]). There are presently two SURTASS LFA sonar systems, one each onboard the USNS IMPECCABLE (T-AGOS 23) and R/V *Cory Chouest*, both operating in the northwestern Pacific Ocean. These systems have both passive and active components.

The active system component, LFA, is an augmentation to the passive detection system, and is planned for use when passive system performance proves inadequate. LFA is a set of acoustic transmitting source elements suspended by cable from underneath a ship. These elements, called projectors, are devices that produce the active sound pulse, or ping. The projectors transform electrical energy to mechanical energy that set up vibrations or pressure disturbances within the water to produce a ping. This is analogous to a stereo speaker or the earpiece in a telephone handset.

The characteristics and operating features of LFA are:

- The source is a vertical line array (VLA) of up to 18 source projectors suspended below the vessel. LFA's transmitted sonar beam is omnidirectional (i.e., a full 360 degrees) in the horizontal (nominal depth of the LFA array center is 122 m [400 ft]), with a narrow vertical beamwidth that can be steered above or below the horizontal.
- The source frequency is between 100 and 500 Hz (the LFA system's physical design does not allow for transmissions below 100 Hz). A variety of signal types can be used, including continuous wave (CW) and frequency-modulated (FM) signals. Signal bandwidth is approximately 30 Hz.
- The source level (SL) of an individual source projector is approximately 215 decibel (dB). The sound field of the LFA array can never be higher than the SL of an individual projector.
- The typical LFA transmitted sonar signal is not a constant tone, but a transmission of various waveforms that vary in frequency and duration. A complete sequence of transmissions is referred to as a ping and lasts from 6 to 100 seconds, although the duration of each continuous frequency transmission is never longer than 10 seconds.
- Duty cycles (ratio of sound "on" time to total time) are less than 20 percent—20 percent is the maximum physical limit of the LFA system. Typical duty cycles are approximately 7.5 to 10 percent.
- The time between pings is typically from 6 to 15 minutes.

The passive, or listening, part of the system is SURTASS, which detects returning echoes from submerged objects, such as submarines, through the use of hydrophones. These devices transform mechanical energy (received acoustic sound wave) to an electrical signal that can be analyzed by the signal processing system of the sonar. They are analogous to a microphone or the mouthpiece of a telephone handset. The SURTASS hydrophones are mounted on a receive array that is towed behind the vessel. The SURTASS LFA ship must maintain a minimum speed of approximately 5.6 kilometer per hour (kph)(3 knots) through the water in order to tow the hydrophone array in the horizontal plane. The return signals or echoes, which are usually below background or ambient noise level, are then processed and evaluated to identify and classify potential underwater targets.

1.3 The Critical Need for SURTASS LFA

The original stated purpose for the SURTASS LFA sonar from the Final SURTASS LFA Sonar Overseas Environmental Impact Statement/Environmental Impact Statement (OEIS/EIS) was:

> "The purpose of the proposed action is to meet U.S. need for improved capability to detect quieter and harder-to-find foreign submarines at long range. This capability would provide U.S. forces with adequate time to react to, and defend against, potential submarine threats while remaining a safe distance beyond a submarine's effective weapons range." (DON, 2001)

This statement remains valid, and may be more compelling now than when it was presented in the FOEIS/EIS in January 2001. With the Cold War ending more than a decade ago, the Navy is faced with a smaller number of diesel-electric submarines with operations confined to smaller areas (Friedman, 2004). Maritime strategies rely heavily on quiet submarines to patrol the littorals, blockade strategic choke points, and stalk aircraft carrier battle groups (Goldstein and Murray, 2003).

The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas. The Secretary of the Navy and Chief of Naval Operations have continually validated that anti-submarine warfare (ASW) is a critical part of that mission—a mission that requires access to both the high seas and the littorals. In order to be prepared for all potential threats, the Navy must not only continue to test and train in the open ocean, but also in littoral environments[1].

Excerpts from Statement of Admiral William J. Fallon, U.S. Navy
Vice Chief of Naval Operations
before the
Subcommittee on Readiness and Management Support
United States Senate Armed Services Committee
on Environmental Sustainment
March 13, 2003

"……New ultra-quiet diesel-electric submarines armed with deadly torpedoes and cruise missiles are proliferating widely. New technologies such as these could significantly threaten our fleet as we deploy around the world to assure access for joint forces, project power from the sea, and maintain open sea-lanes for trade. To successfully defend against such threats, our Sailors must train realistically with the latest technology, including next-generation passive and active sonars."

"The Navy has immediate need for SURTASS LFA. The Chief of Naval Operations has stated that Anti-Submarine Warfare (ASW) is essential to sea control and maritime dominance. Many nations are capable of employing submarines to deny access or significantly delay execution of joint and coalition operations in support of our vital interests. The submarine threat today is real and in some ways has become more challenging than during the Cold War. Of the approximately 500 non-U.S. submarines in the world, almost half that number are operated by non-allied nations. Of greatest concern are the new ultra-quiet diesel-electric submarines armed with deadly torpedoes and cruise missiles being produced by the People's Republic of China, Iran, and North Korea."

"These diesel submarines are very difficult to detect outside the range at which they can launch attacks against U.S. and allied ships using passive sonar systems. Active systems like SURTASS LFA, when used in conjunction with other anti-submarine sensor and weapons systems, are necessary to detect, locate and destroy or avoid hostile submarines before they close within range of our forces. To ensure our Sailors are properly prepared to counter this growing submarine threat, we must make certain they train with the best systems available."

[1] Littoral Environment—The Navy defines littoral as the region that horizontally encompasses the land/watermass interface from fifty (50) statute miles ashore to two hundred (200) nautical miles at sea; extends vertically from the bottom of the ocean to the top of the atmosphere and from the land surface to the top of the atmosphere (Naval Oceanographic Office, 1999).

1.4 The Regulatory Process

SURTASS LFA sonar was the first Navy program for an operational system to have completed the NEPA process, a process that began on 18 July 1996, when the Navy published its Notice of Intent (NOI) in the *Federal Register* (67 FR 37452) to prepare an environmental impact statement (EIS) for SURTASS LFA Sonar under NEPA and Presidential Executive Order (EO) 12114. It culminated with the signing of the ROD on 16 July 2002 (67 FR 48145). The Navy's ESA Section 7 consultation with the NMFS and permitting requirements under the MMPA concluded with NMFS's issuance of the Biological Opinion and Incidental Take Statement (NMFS, 2002a; 2002b) and the issuance of a Letter of Authorization (LOA) (67 FR 55818) under the MMPA Final Rule (50 CFR Part 216 Subpart Q) (67 FR 46785) for the operation of SURTASS LFA Sonar on R/V *Cory Chouest*.

Based on the scientific analyses detailed in the Navy application and further supported by information and data contained in the Navy's Final EIS for SURTASS LFA sonar operations, NMFS concurred with the Navy that the incidental harassment of marine mammals resulting from SURTASS LFA sonar operations would result in the incidental harassment of only small numbers of marine mammals, have no more than a negligible impact on the affected marine mammal stocks or habitats, and not have an unmitigable adverse impact on Arctic subsistence uses of marine mammals (67 FR 46783). This determination was supported by the highly effective mitigation measures; the interim operating restrictions implemented by NMFS under the LOA for SURTASS LFA sonar operations; and the Long Term Monitoring (LTM) program, including the research to be conducted therein. These included geographic operational restrictions, mitigation measures to minimize any potential for injury to marine mammals, monitoring and reporting of estimated risk to marine mammals, and supplemental research that will result in increased knowledge of marine mammal species, and the potential impacts of LF sound on these species. These latter measures offer the means for learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing the incidental harassment of marine mammals from anthropogenic underwater sound, and evaluating the possible long-term effects from exposing marine mammals to anthropogenic underwater sound.

On November 24, 2003 the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2004 (NDAA FY04) (Public Law 108-136) was passed by Congress. Included in this law were amendments to the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 *et seq.*) that apply where a "military readiness activity" is concerned. Of special importance for SURTASS LFA sonar take authorization, the NDAA amended Section 101(a)(5) of the MMPA, which governs the taking of marine mammals incidental to otherwise lawful activities. The term "military readiness activity" is defined in Public Law 107-314 (16 U.S.C. § 703 note) to include all training and operations of the Armed Forces that relate to combat; and the adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use. NMFS and the Navy have determined that the Navy's SURTASS LFA sonar testing and training operations that are the subject of NMFS's July 16, 2002, Final Rule constitute a military readiness activity because those activities constitute "training and operations of the Armed Forces that relate to combat" and constitute "adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use."

1.5 Litigation

On 7 August 2002, several non-governmental organizations (NGOs) filed suit against the Navy and NMFS over SURTASS LFA sonar use and permitting. The Court recognized the Navy's National Security requirements for operations to continue as the case proceeded. On 15 November 2002, the Court issued a tailored Preliminary Injunction for operations of LFA in a stipulated area in the northwest Pacific Ocean/Philippine Sea, and south and east of Japan. On 25 January 2003, the R/V *Cory Chouest*, having met all environmental compliance requirements, commenced testing and training in the northwest Pacific Ocean under this tailored Preliminary Injunction.

The Court issued a ruling on the parties' motions for summary judgment in the SURTASS LFA litigation on 26 August 2003. The Court found deficiencies in the Navy's and NMFS' compliance under NEPA, ESA, and MMPA. The Court, however, indicated that a total ban of employment of LFA would pose a hardship on the Navy's ability to protect National Security by ensuring military preparedness and the safety of those serving in the military from hostile submarines. Based on mediation the Court issued a tailored Permanent Injunction on 14 October 2003, allowing SURTASS LFA operations from both R/V *Cory Chouest* and USNS IMPECCABLE (T-AGOS 23) in stipulated areas in the northwest Pacific Ocean/Philippine Sea, Sea of Japan, East China Sea, and South China Sea with certain year-round and seasonal restrictions. On 7 July 2005, the Court amended the injunction to expand the potential areas of operation based on real world contingencies, as shown in Figure 1.

Since then the R/V *Cory Chouest* and USNS IMPECCABLE have successfully completed numerous training missions. These operations were conducted within the areas stipulated by the Court and under the mitigation requirements of the Final Rule and LOA issued by NMFS.

1.6 Supplemental Environmental Impact Statement

In response to U.S. District Court ruling on the motion for preliminary injunction, the Deputy Assistant Secretary of the Navy for Environment (DASN(E)) decided that the purposes of NEPA would be served by supplemental analysis of employing SURTASS LFA sonar systems. On 11 April 2003, the DASN(E) directed the Navy to prepare a supplemental EIS to address concerns identified by the Court to provide additional information regarding the environment that could potentially be affected by the SURTASS LFA sonar systems and additional information related to mitigation.

This Draft Supplemental Environmental Impact Statement (Draft SEIS) was completed in November 2005 (DON, 2005a). The Draft SEIS proposed action was the U.S. Navy employment of up to four SURTASS LFA sonar systems in the oceanic areas as presented in Figure 1-1 (SURTASS LFA Sonar Systems Potential Areas of Operations) of the Final Overseas Environmental Impact Statement/Environmental Impact Statement (FOEIS/EIS) for SURTASS LFA Sonar (DON, 2001). Based on current operational requirements, exercises using these sonar systems would occur in the Pacific, Atlantic, and Indian oceans, and the Mediterranean Sea. To reduce adverse effects on the marine environment, areas would be excluded as necessary to prevent 180-decibel (dB) sound pressure level (SPL) or greater within specific geographic range

of land, in offshore biologically important areas during biologically important seasons, and in areas necessary to prevent greater than 145-dB SPL at known recreational and commercial dive sites.

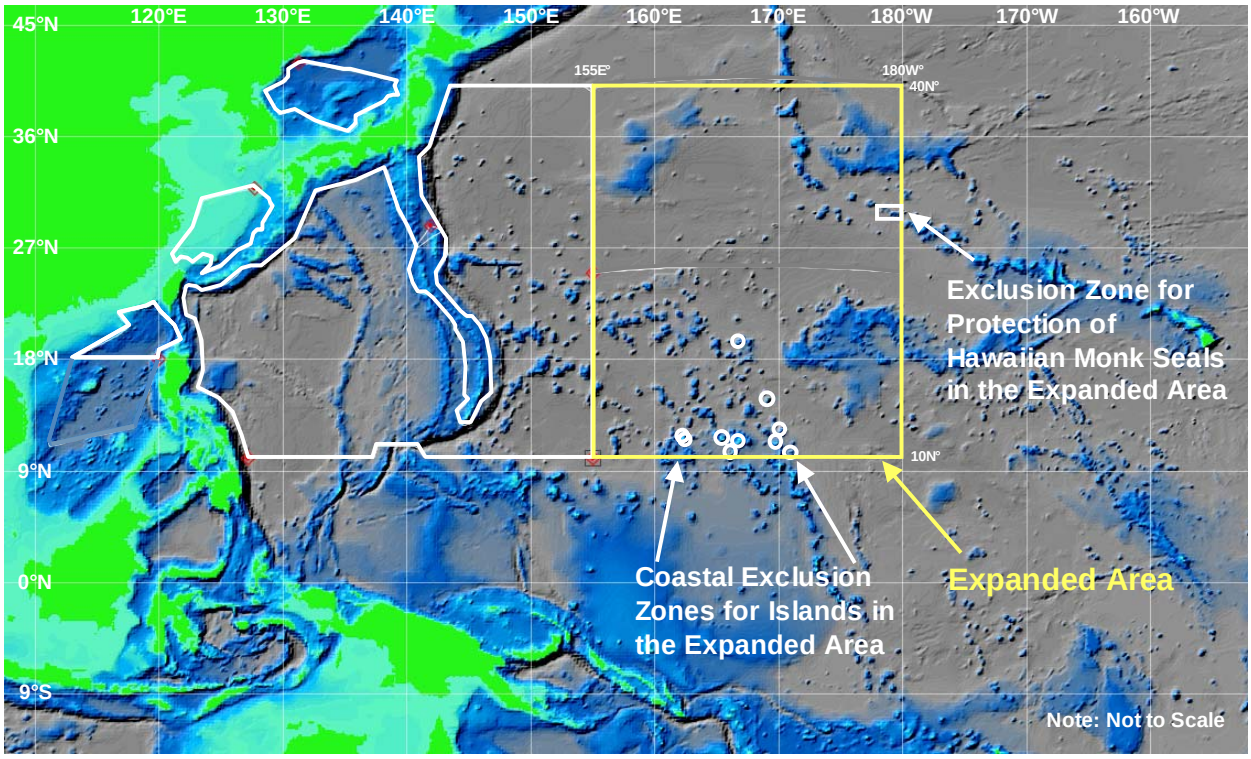

Figure 1. SURTASS LFA Sonar Operations Areas Permitted under Stipulation Regarding Permanent Injunction as Amended

The purpose of the Draft SEIS was to:

- Address deficiencies in NEPA, ESA, and MMPA[2] compliance found by the U.S. District Court for the Northern District of California in its 26 August 2003 Opinion and Order;
- Provide information necessary to apply for a new five-year Rule that would provide for incidental takes under the MMPA when the current rule expires in 2007, taking into account legislative changes to the MMPA and the need to employ two additional SURTASS LFA sonar systems;
- Analyze potential impacts for LFA system upgrades; and
- Provide additional information and analyses pertinent to the proposed action.

[2] On 2 December 2004, the Court vacated and dismissed the MMPA claims based on the NDAA FY04 amendments to the MMPA.

2.0 MITIGATION MEASURES

Under the current rule, NMFS has issued one-year LOAs to the Navy for the USNS IMPECCABLE and R/V *Cory Chouest* for an estimated 12 to 16 active sonar missions for the annual period of each LOA between the two ships (or equivalent shorter missions not to exceed 432 hours of transmit time between the two ships) during the annual period of effectiveness of each of these LOAs. Further, NMFS required that, under these LOAs, the Navy must minimize to the greatest extent practicable any adverse impacts on marine mammals, their habitats, and the availability of marine mammals for subsistence.

Mitigation protocols were initially set forth in the Final SURTASS LFA EIS, and modified by NMFS in their Final Rule and by the tailored Permanent Injunction issued by the Court in 14 October 2003, as amended on 7 July 2005 (see Section 3.0). Under the conditions of the Final Rule and the LOAs, the mitigation measures discussed below have been implemented. Mitigation protocols set forth in the Record of Decision, NOAA/NFMS Final Rule and LOAs, and Court orders have been promulgated by the Chief of Naval Operations (N774) through executive direction messages of 12 August 2002, 31 October 2003, 13 August 2004, and 16 August 2005.

2.1 Interim Operational Restrictions Under NMFS Final Rule and LOAs

In the SURTASS LFA Final Rule under the MMPA (67 FR 46785), NMFS added interim operational restrictions in the Final Rule to preclude the potential for injury to marine mammals by resonance effects. These include: 1) establishment of a 1-km (0.54-nm) buffer shutdown zone outside of the 180-dB LFA mitigation zone; and 2) limiting the operational frequency of SURTASS LFA sonar to 330 Hz and below. The first restriction included a SURTASS LFA sonar system shutdown within a buffer zone that extends 1 km (0.54 nm) from the outer limit of the 180-dB safety zone (SURTASS LFA mitigation zone). This may extend up to 2 km (1.1 nm) from the vessel, depending on oceanographic conditions. At this distance, SPLs will be significantly less intense than 180 dB. Second, NMFS imposed an operational restriction on the frequency of the SURTASS LFA sonar sound to 330 Hz and below. The intentions of these measures were to ensure, to the greatest extent practicable, that marine mammals would not be injured by the SURTASS LFA sonar signal. These protective measures would be retained until scientific documentation could be provided which indicated that they could be modified while still providing sufficient protection for marine mammals.

2.2 Mitigation and Monitoring Requirements

The objective of these mitigation measures is to avoid risk of injury to marine mammals, sea turtles, and human divers. This objective is met by:

- Ensuring that coastal waters within 22 km (12 nm) of shore are not exposed to SURTASS LFA sonar signal levels $\geq$ 180 dB received level (RL);
- Ensuring that no offshore biologically important areas are exposed to SURTASS LFA sonar signal levels $\geq$ 180 dB RL during critical seasons;

- Minimizing exposure of marine mammals and sea turtles to SURTASS LFA sonar signal levels below 180 dB RL by monitoring for their presence and suspending transmissions when one of these organisms approached the SURTASS LFA mitigation (safety) and buffer zones as shown in Figure 2; and
- Ensuring that no known recreational or commercial dive sites are subjected to LF sound pressure levels greater than 145 dB RL.

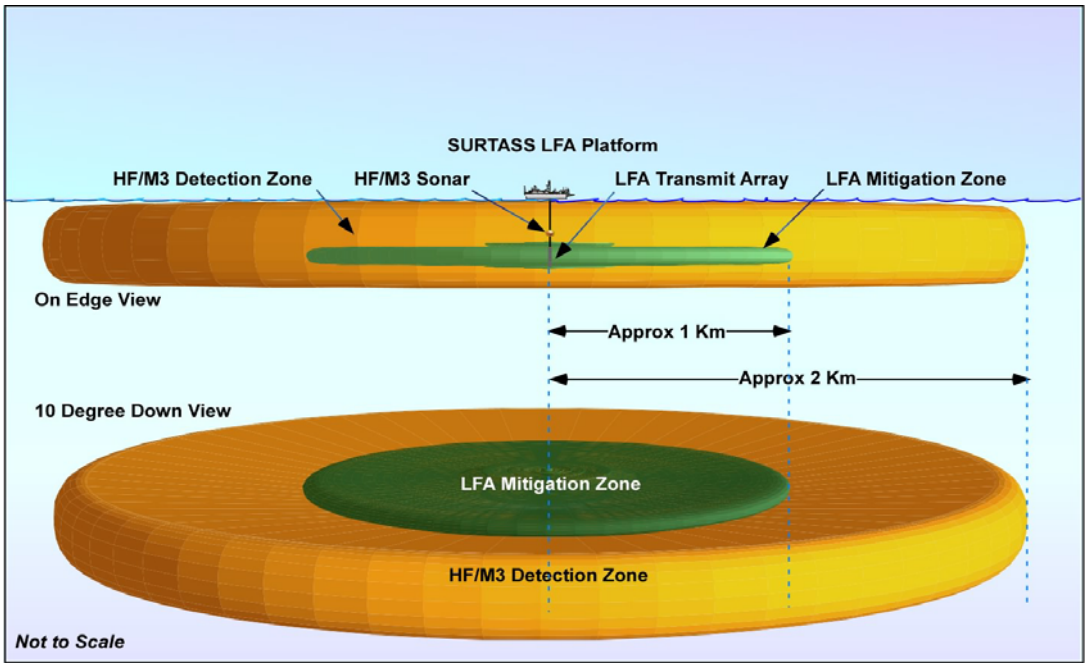

Figure 2. HF/M3 Sonar Detection and LFA Mitigation/Buffer Zones

Strict adherence to these measures should ensure that there will be no significant impact on marine mammal stocks, sea turtle stocks, and recreational or commercial divers. Table 1 is a summary of the proposed mitigation, the criteria for each, and the actions required.

2.2.1 Geographic Restrictions

The following geographic restrictions apply to the employment of SURTASS LFA sonar:

- SURTASS LFA sonar-generated sound field will be below 180 dB RL within 22 km (12 nm) of any coastlines and in offshore areas outside this zone that have been determined by NMFS and the Navy to be biologically important;
- When in the vicinity of known recreational or commercial dive sites, SURTASS LFA sonar will be operated such that the sound fields at those sites will not exceed 145 dB RL; and
- SURTASS LFA sonar operators will estimate sound pressure levels (SPL) prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, in order not to exceed the 180-dB and 145-dB RL sound field criteria cited previously.

Table 1. Summary of Mitigation

Mitigation	Criteria	Actions
Geographic Restrictions		
22 km (12 nm) from coastline and offshore biologically important areas during biologically important seasons outside of 22 km (12 nm)	Sound field below 180 dB RL, based on SPL modeling.	Delay/suspend SURTASS LFA sonar operations.
Recreational and commercial dive sites (known)	Sound field not to exceed 145 dB RL, based on SPL modeling.	Delay/suspend SURTASS LFA sonar operations.
Monitoring to Prevent Injury to Marine Mammals and Sea Turtles		
Visual Monitoring	Potentially affected species sighted near the vessel but outside of the LFA mitigation and/or buffer zones.	Notify OIC.
	Potentially affected species sighted within the LFA mitigation or buffer zones.	Delay/suspend SURTASS LFA sonar operations.
Passive Acoustic Monitoring	Potentially affected species detected.	Notify OIC.
Active Acoustic Monitoring	Contact detected and determined to have a track that would pass within the LFA mitigation or buffer zones.	Notify OIC.
	Potentially affected species detected inside of the LFA mitigation or buffer zones.	Delay/suspend SURTASS LFA sonar operations.

2.2.1.1 Offshore Biologically Important Areas

Offshore Biologically Important Areas (OBIAs) are areas of the world's oceans outside of 22 km (12 nm) of a coastline where marine animals of concern (those animals listed under the Endangered Species Act and/or marine mammals) congregate in high densities to carry out biologically important activities. These areas include:

- Migration corridors;
- Breeding and calving grounds; and
- Feeding grounds.

There are four areas designated by the Navy and NMFS as offshore areas of critical biological importance for marine mammals in the Final SURTASS LFA EIS and Final Rule. These are:

- Shoreward of the 200-meter isobath off the North American East Coast, from 28 to 50 degrees North latitude, west of 40 degrees West longitude—year-round.
- Antarctic Convergence Zone, delimited by the following: 1) 30 to 80 degrees East longitude along the 45-degree South latitude; 2) 80 to 150 degrees East longitude along the 55-degree South latitude; 3) 150 degree East to 50 degree West longitude along the

60-degree South latitude; and 4) 50 degree West to 30 degree East longitude along the 50-deg South latitude—October through March (IUCN, 1995).

- Costa Rica Dome, centered at 9 degrees N latitude and 88 degrees W longitude—year round (Longhurst, 1998; Chandler et al., 1999).
- Penguin Bank, Hawaiian Archipelago, centered at 21 degrees North latitude and 157 degrees 30 minutes West longitude—November 1 through May 1.

None of these areas were within the authorized operational areas for LFA during the period of this report.

2.2.1.2 Recreational and Commercial Dive Sites

SURTASS LFA sonar operations are constrained in the vicinity of known recreational and commercial dive sites to ensure that the sound field at such sites does not exceed 145 dB RL. Recreational dive sites are generally defined as coastal areas from the shoreline out to the 40-m (130-ft) depth contour, which are frequented by recreational divers; but it is recognized that there are other sites that may be outside this boundary.

2.2.1.3 Sound Field Modeling

SURTASS LFA sonar operators will estimate SPL prior to and during operations to provide the information necessary to modify operations, including the delay or suspension of transmissions, in order not to exceed the 180-dB and 145-dB RL sound field criteria cited above. Sound field limits are estimated using near-real-time environmental data and underwater acoustic performance prediction models. These models are an integral part of the SURTASS LFA sonar processing system. The acoustic models help determine the sound field by predicting the SPLs, or RLs, at various distances from the SURTASS LFA sonar source location. Acoustic model updates are nominally made every 12 hours, or more frequently when meteorological or oceanographic conditions change.

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

2.2.2 Monitoring to Prevent Injury to Marine Animals

The following monitoring to prevent injury to marine animals is required under the conditions of the LOAs when employing SURTASS LFA sonar:

- **Visual monitoring** for marine mammals and sea turtles from the vessel during daylight hours by personnel trained to detect and identify marine mammals and sea turtles;
- **Passive acoustic monitoring** using the passive (low frequency) SURTASS array to listen for sounds generated by marine mammals as an indicator of their presence; and
- **Active acoustic monitoring** using the High Frequency Marine Mammal Monitoring (HF/M3) sonar, which is a Navy-developed, enhanced HF commercial sonar, to detect,

locate, and track marine mammals and, to some extent, sea turtles, that may pass close enough to the SURTASS LFA sonar's transmit array to enter the LFA mitigation and buffer zones.

2.2.2.1 Visual Monitoring

Visual monitoring includes daytime observations for marine mammals and sea turtles from the vessel. Daytime is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring begins 30 min before sunrise or 30 min before the SURTASS LFA sonar is deployed. Monitoring continues until 30 min after sunset or until the SURTASS LFA sonar is recovered. Observations are made by personnel trained in detecting and identifying marine mammals and sea turtles. The objective of these observations is to maintain a track of marine mammals and/or sea turtles observed and to ensure that none approach the source close enough to enter the LFA mitigation zone.

These personnel maintain a topside watch and marine mammal/sea turtle observation log during operations that employ SURTASS LFA sonar in the active mode. The numbers and identification of marine mammals/sea turtles sighted, as well as any unusual behavior, is entered into the log. A designated ship's officer monitors the conduct of the visual watches and periodically reviews the log entries. There are two potential visual monitoring scenarios.

First, if a potentially affected marine mammal or sea turtle is sighted outside of the LFA mitigation zone, the observer notifies the OIC. The OIC then notifies the HF/M3 sonar operator to determine the range and projected track of the animal. If it is determined that the animal will pass within the LFA mitigation zone, the OIC orders the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation zone. If the animal is visually observed within 1-km buffer zone outside of the LFA mitigation zone, the OIC orders the immediate delay or suspension of SURTASS LFA sonar transmissions. The observer continues visual monitoring/recording until the animal is no longer seen.

Second, if the potentially affected animal is sighted anywhere within the LFA mitigation or buffer zones, the observer notifies the OIC who orders the immediate delay or suspension of SURTASS LFA sonar transmissions.

All sightings are recorded in the log and provided as part of the Long Term Monitoring (LTM) Program as discussed in FOEIS/EIS Subchapter 2.4.2 to monitor for potential long-term environmental effects.

2.2.2.2 Passive Acoustic Monitoring

Passive acoustic monitoring is conducted when SURTASS is deployed, using the SURTASS towed horizontal line array (HLA) to listen for vocalizing marine mammals as an indicator of their presence. If the sound is estimated to be from a marine mammal that may be potentially affected by SURTASS LFA sonar, the technician notifies the OIC who alerts the HF/M3 sonar operator and visual observers. If prior to or during transmissions, the OIC then orders the delay

or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation and buffer zones.

All contacts are recorded in the log and provided as part of the LTM Program to monitor for potential long-term environmental effects.

2.2.2.3 Active Acoustic Monitoring

HF active acoustic monitoring uses the HF/M3 sonar to detect, locate, and track marine mammals (and possibly sea turtles) that could pass close enough to the SURTASS LFA sonar array to enter the LFA mitigation zone. HF acoustic monitoring begins 30 min before the first SURTASS LFA sonar transmission of a given mission is scheduled to commence and continues until transmissions are terminated. Prior to full-power operations, the HF/M3 sonar power level is ramped up over a period of 5 min from 180 dB SL in 10-dB increments until full power (if required) is attained to ensure that there are no inadvertent exposures of local animals to RLs $\geq$ 180 dB from the HF/M3 sonar. There are two potential scenarios for mitigation via active acoustic monitoring.

First, if a contact is detected outside the LFA mitigation and buffer zones, the HF/M3 sonar operator determines the range and projected track of the animal. If it is determined that the animal will pass within the LFA mitigation and buffer zones, the sonar operator notifies the OIC. The OIC then orders the delay or suspension of transmissions when the animal is predicted to enter the LFA mitigation and buffer zones.

Second, if a contact is detected by the HF/M3 sonar within the LFA mitigation or buffer zones, the observer notifies the OIC who orders the immediate delay or suspension of transmissions.

All contacts are recorded in the log and provided as part of the LTM Program.

2.2.2.4 Resumption of SURTASS LFA Transmissions

SURTASS LFA sonar transmissions can commence/resume 15 minutes after there is no further detection by the HF/M3 sonar and there is no further visual observation of the animal within the LFA mitigation and buffer zones.

3.0 PERMANENT INJUNCTION FOR SURTASS LFA OPERATIONS

During the period of this report, both SURTASS LFA sonar systems were operated under the tailored Permanent Injunction issued on 14 October 2003, as amended on 7 July 2005. Details of the authorized areas of operation are provided in two Letters of Authorization (APPENDICES A and B) and shown in Figure 1. The associated charts provided in APPENDICES A and B reflect the coastal exclusion zones wherein received sound pressure levels will not exceed 180 dB.

4.0 SUMMARY OF SURTASS LFA OPERATIONS FOR FOURTH YEAR ANNUAL REPORT

Under 50 CFR 216.186(b) and LOA Condition 8(b), this annual report consists of an unclassified summary of the quarterly reports as of 90 days prior to the expiration of the current LOAs. Therefore, this annual report will cover only those quarterly reports submitted subsequent to the due date of the last annual report in May 2004. This annual report will include the third and fourth quarterly reports under the third year LOAs and first and second quarterly reports under the fourth year LOAs for the USNS IMPECCABLE and R/V *Cory Chouest*, for the period of 16 February 2005 through 15 February 2006. The third and fourth quarters for the fourth year LOAs, along with the first and second quarters of the fifth year LOAs, will be reported in the subsequent annual report in 2007.

4.1 SURTASS LFA Operations for Fourth Annual Report

Under the conditions of the Court's tailored Permanent Injunction, two SURTASS LFA sonar systems are currently operating under LOAs issued by NMFS for the period 16 August 2005 to 15 August 2006. The LFA system onboard R/V *Cory Chouest* commenced reintroduction to the Fleet in January 2003 and is presently operating in the western North Pacific. The second system onboard USNS IMPECCABLE (T-AGOS 23) commenced sea trials in late February 2004 and full Fleet operations in FY 05. This report includes ten training missions from the R/V *Cory Chouest* and six training mission for the USNS IMPECCABLE.

The purposes of the training missions are to provide fully functional hardware and software, extensive training, job experience, and operational/system monitoring in a variety of LFA mission scenarios and acoustic environments.

The keys to SURTASS LFA success are:

- Assuring LFA Transmit System (LTS) reliability, maintainability, and availability through system maintenance, system shakedown and correction of deficiencies, and LTS training.
- Assuring the system hardware and software (processing, communications, support systems) reliability, maintainability, and availability through system interface testing, system function testing, system operational testing, system load testing, and the correction of deficiencies.
- Training of SURTASS LFA crew through at-sea training in diverse environments and missions.
- Updating the SURTASS LFA Employment Guidelines documentation.
- Testing and certification of the system performance in a variety of missions and environments. The environments should range from familiar acoustic environments during system shakedown to operationally significant environments for crew training.
- Successful system employment in a variety of tactical and strategic scenarios in diverse acoustic environments.
- Operational training with the HF/M3 sonar and compliance with all other applicable mitigation requirements.

4.1.1 R/V *Cory Chouest* Training Missions

Training missions for the R/V *Cory Chouest* consisted of ten missions covering a period of approximately 50.4 days with 88.9 hours of transmissions by the LFA array and included the operation of the HF/M3 sonar and compliance with all other applicable mitigation requirements. These missions occurred in the West and North Philippine Sea, the South China Sea, and near Guam from February 2005 to February 2006.

4.1.2 USNS IMPECCABLE Training Missions

Training missions for the USNS IMPECAABLE consisted of six missions covering a period of approximately 24.3 days with 43.5 hours of transmissions by the LFA array and included the operation of the HF/M3 sonar and compliance to the mitigation requirements. These missions occurred in the North and West Philippine Sea and the South China Sea from February 2005 to February 2006.

4.2 Estimates of Marine Mammal Stocks Potentially Affected

In its annual LOA applications, the Navy provides estimates of the percentage of marine mammal stocks that could potentially be affected in the biogeographic regions of proposed LFA operations for the 12-month period of the LOA(s). In this annual report, the Navy provides a post-operational assessment of whether incidental harassment occurred within the LFA mitigation and buffer zones and estimates of the percentages of marine mammal stocks possibly harassed incidentally using predictive modeling based on dates/times/location of operations, system characteristics, oceanographic/environmental conditions, and animal demographics. The basis for the methodology used for the acoustic modeling to analyze risk and produce the incidental harassment estimates was essentially the scientific analysis process used in the SURTASS LFA Final EIS (DON, 2001) and detailed in the Navy's second year application to NMFS for LOAs (DON, 2003).

During the period of this annual report, LFA operational missions were conducted in areas generally defined as Sites 2, 3, 4, and 7 in the LOA applications (DON, 2003; 2004; 2005b) and Provinces 53, 56, 64, and 69 as defined in the Final Rule section 216.180.

4.2.1 Pre-Operational Estimates of Marine Mammal Stocks Potentially Affected

Overall planning for operations during the LOA periods was based first on the identification of the general ocean areas where testing, training and routine LFA operations were desired, development of criteria for these mission areas, and then the determination of the best operational sites and seasons within these mission areas that would have the least potential for impacts on marine mammals while meeting the Navy's operational requirements. Potential mission sites within each mission area were then analyzed with regard to spatial and temporal factors. Based on operational requirements for LFA and the tailored Permanent Injunction as amended, the general ocean areas were within the Philippine Sea, northwest Pacific Ocean, Sea

of Japan, East China Sea and South China Sea. Marine mammal density and stock/abundance estimates were then assembled.

APPENDIX C provides information on how the density and stock/abundance estimates were derived for the operational areas shown in Figure 3. These data were derived from best available published source documentation, and provided general area information for mission areas, with species-specific information on the animals that could potentially occur in those areas, including estimates for their stock/abundance and density. Animal demographics (stocks and densities) are based on current literature reviews of the western North Pacific Ocean as cited in APPENDIX C.

Analyses for pre-operational estimates were performed at nominal potential operational sites, encompassing all four seasons, which provide a very conservative estimate of the potential for impacts to marine mammal stocks in those provinces where operations were proposed.

Operations occurred in sites 2, 3, 4, and 7 as shown in Figure 3. Tables 2 through 5 provide pre-operational risk estimates for marine mammal stocks in these operating areas (Sites 2 through 4 and 7) as presented in the Navy's application for LOAs (DON, 2004). These values supported the conclusion that all risk estimates for marine mammal stocks were below—for most cases, well below—the criteria delineated by NMFS in the Final Rule (67 FR 46785-89). Upon completion of the missions under the requested authorization, these estimates were refined and submitted to NMFS under the reporting requirements of the Final Rule and the conditions of the LOAs, as issued. The pre-operational estimates were based on the fourth year LOA application (DON, 2005b) for a nominal 9-day mission length.

4.2.2 Post-Operational Estimates of Marine Mammal Stocks Potentially Affected

SURTASS LFA operations during the period of this annual report comprised 16 missions totaling 74.3 days of operations with 132.4 hours of active transmissions by the LFA array. The general areas of these missions were the Philippine Sea in LOA Provinces 53 and 56, depicted in Figure 3 as Sites 2, and 3; Guam in LOA Province 56, depicted in Figure 3 as Site 4; and the South China Sea in LOA Provinces 64 and 69, depicted in Figure 4 as Site 7.

Tables 6 through 11 provide post-operational estimates of the percentage of marine mammal stocks affected by the 74.3 days of SURTASS LFA sonar operations both within and outside the 180-dB mitigation zone. The same methodology was utilized as that used for the pre-operational analysis discussed above in Sections 4.2 and 4.2.1, except that the durations of each mission were based on actual transmission times and oceanographic environmental conditions were based on the date/time/location of the actual operations. Animal density and stock/abundance estimates were updated based on current literature reviews of the western North Pacific Ocean operational areas shown in Figure 3 (see APPENDIX C).

4.2.3 Summary of Results

The percentage of marine mammal stocks estimated to be exposed between 120 and 180 dB for both pre- and post-operational estimates are shown in Tables 2 through 11. Tables 6 through 11

demonstrate that the post-operational estimates are below the 12 percent for any marine mammal stock, the maximum percentage authorized in LOA Condition 6 (g).

The post-operational incidental harassment assessments in Tables 6 through 11 demonstrate that there were no marine mammal exposures to received levels at or above 180 dB. These results are supported by the results from the visual, passive acoustic and active acoustic monitoring efforts discussed in Section 4.3. In addition, a review of recent stranding data from the National Science Museum of Tokyo, Japan and Internet sources did not indicate any stranding events associated with the times and locations of LFA operations.

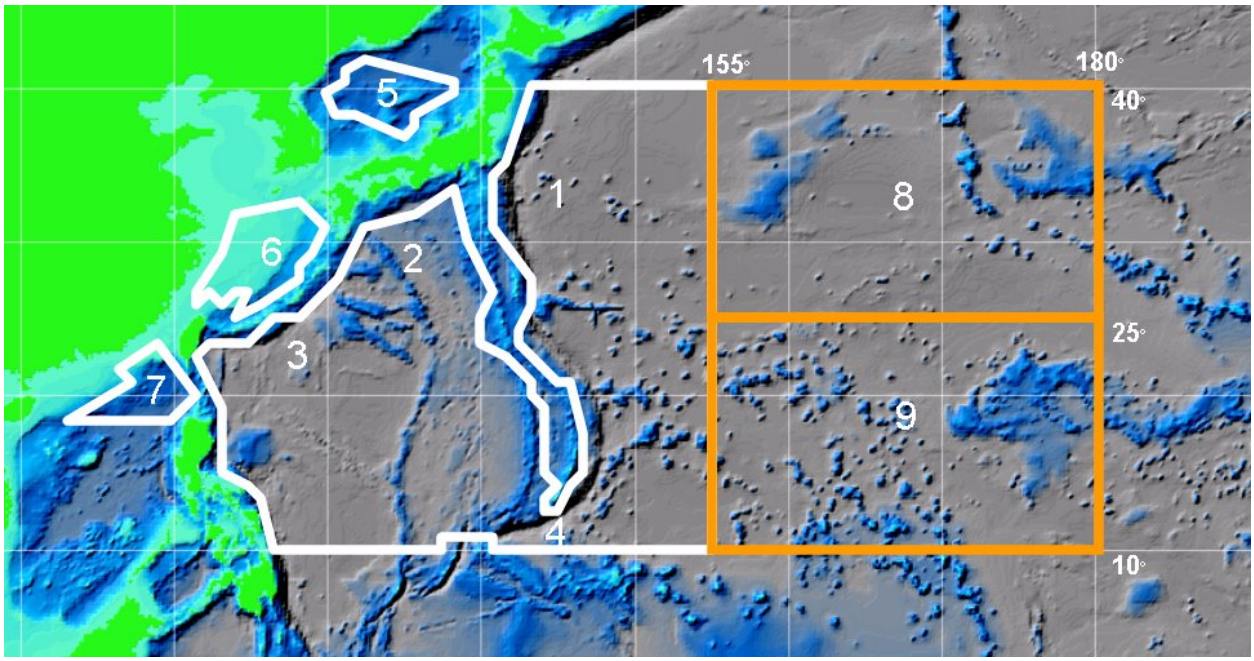

Figure 3. SURTASS LFA Sonar Western Pacific Operational Areas

Table 2. Pre-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 2

North Philippine Sea					
Site 2	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Bryde's whale	180	22000	0.27	0.00
	Minke whale	1080	25000	1.45	0.00
	N. Pacific right whale	3	922	0.12	0.00
	Sperm whale	300	102112	0.09	0.00
	Kogia	930	166553	0.17	0.00
	Cuvier's beaked whale	1620	90725	0.60	0.00
	Blainville's beaked whale	28	8032	0.63	0.00
	Ginkgo-toothed beaked whale	28	22799	0.22	0.00
	Killer whale	120	12256	0.35	0.00
	False killer whale	870	16668	1.88	0.00
	Pygmy killer whale	126	30241	0.75	0.00
	Melon-headed whale	360	36770	0.14	0.00
	Short-finned pilot whale	4590	53608	3.08	0.00
	Risso's dolphin	3180	83289	1.65	0.00
	Common dolphin	16860	3286163		
	Bottlenosed dolphin	4380	168791	1.12	0.00
	Spinner dolphin	150	1015059		
	Pantropical spotted dolphin	4110	438064	0.36	0.00
	Striped dolphin	9870	570038	0.66	0.00
	Rough-toothed dolphin	1770	145729	0.18	0.00
	Fraser's dolphin	1200	220789	0.08	0.00
	Pacific white-sided dolphin	3570	67769	0.79	0.00

Note: Pre-operational estimates were based on projected operations and marine mammal density and stock numbers from the LOA application (DON, 2004).

Table 3. Pre-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 3

West Philippine Sea					
Site 3	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.30	0.00
	Bryde's whale	180	22000	0.37	0.00
	Minke whale	540	25000	0.98	0.00
	Humpback whale (winter only)	0	394	0.00	0.00
	Sperm whale	300	102112	0.11	0.00
	Kogia	510	166553	0.11	0.00
	Cuvier's beaked whale	90	90725	0.04	0.00
	Blainville's beaked whale	150	8032	0.72	0.00
	Ginkgo-toothed beaked whale	150	22799	0.25	0.00
	False killer whale	870	16668	2.38	0.00
	Pygmy killer whale	630	30241	0.95	0.00
	Melon-headed whale	4290	36770	5.32	0.00
	Short-finned pilot whale	2280	53608	1.94	0.00
	Risso's dolphin	3180	83289	2.02	0.00
	Common dolphin	16860	3286163	0.26	0.00
	Bottlenose dolphin	4380	168791	1.37	0.00
	Spinner dolphin	150	1015059	0.01	0.00
	Pantropical spotted dolphin	4110	438064	0.47	0.00
	Striped dolphin	4920	570038	0.44	0.00
	Rough-toothed dolphin	1770	145729	0.61	0.00
	Fraser's dolphin	1200	220789	0.27	0.00
	Pacific white-sided dolphin	7350	100757	3.68	0.00

Note: Pre-operational estimates were based on projected operations and marine mammal density and stock numbers from the LOA application (DON, 2004).

Table 4. Pre-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 4

Guam					
Site 4	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affetced (w/mit) ≥ 180 dB**
	Blue whale	60	4048	0.85	0.00
	Fin whale	60	1898	1.82	0.00
	Bryde's whale	270	5765	2.92	0.00
	Minke whale	60	25000	0.15	0.00
	Humpback whale (winter only)	0	4005	0.00	0.00
	Sperm whale	300	39200	0.40	0.00
	Kogia	510	166553	0.16	0.00
	Cuvier's beaked whale	1620	90725	0.94	0.00
	Blainville's beaked whale	390	8032	2.56	0.00
	False killer whale	630	35132	1.38	0.00
	Melon-headed whale	2790	36770	5.83	0.00
	Short-finned pilot whale	600	89334	0.52	0.00
	Risso's dolphin	210	258084	0.08	0.00
	Bottlenose dolphin	750	299434	0.25	0.00
	Spinner dolphin	3000	1015059	0.27	0.00
	Pantropical spotted dolphin	31410	2195353	1.30	0.00
	Striped dolphin	18060	1820958	0.90	0.00
	Rough-toothed dolphin	1740	145729	1.09	0.00

Note: Pre-operational estimates were based on projected operations and marine mammal density and stock numbers from the LOA application (DON, 2004).

Table 5. Pre-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 7

South China Sea					
Site 7	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	3	500	0.00	0.00
	Bryde's whale	180	10000	0.65	0.00
	Minke whale	540	25000	0.78	0.00
	Gray whale (winter only)	0	100	0.00	0.00
	Sperm whale	113	50000	0.06	0.00
	Kogia	30	3000	0.26	0.00
	Cuvier's beaked whale	30	10000	0.09	0.00
	Blainville's beaked whale	30	5000	0.17	0.00
	Ginkgo-toothed beaked whale	30	5000	0.17	0.00
	False killer whale	540	9777	2.12	0.00
	Pygmy killer whale	30	10000	0.12	0.00
	Melon-headed whale	60	15000	0.15	0.00
	Short-finned pilot whale	2289	53608	1.64	0.00
	Risso's dolphin	3180	83289	1.92	0.00
	Common dolphin	3180	83289	1.74	0.00
	Bottlenose dolphin	4380	105138	2.10	0.00
	Spinner dolphin	4122	219032	0.86	0.00
	Pantropical spotted dolphin	4122	219032	0.86	0.00
	Striped dolphin	4929	570038	0.15	0.00
	Rough-toothed dolphin	510	145900	0.16	0.00
	Fraser's dolphin	4122	219032	0.86	0.00

Note: Pre-operational estimates were based on projected operations and marine mammal density and stock numbers from the LOA application (DON, 2004).

Table 6. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 2 in Spring/Summer/Fall

North Philippine Sea 5 Operations					
Site 2	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Bryde's whale	180	22000	0.22	0.00
	Minke whale	1080	25000	1.13	0.00
	N. Pacific right whale	3	922	0.08	0.00
	Sperm whale	300	102112	0.08	0.00
	Kogia	930	350553	0.06	0.00
	Cuvier's beaked whale	1620	90725	0.47	0.00
	Blainville's beaked whale	150	8032	0.49	0.00
	Ginkgo-toothed beaked whale	150	22799	0.18	0.00
	Killer whale	120	12256	0.28	0.00
	False killer whale	870	16668	1.48	0.00
	Pygmy killer whale	630	30214	0.59	0.00
	Melon-headed whale	360	36770	0.28	0.00
	Short-finned pilot whale	4590	53608	2.40	0.00
	Risso's dolphin	3180	83289	1.30	0.00
	Common dolphin	16860	3286163	0.16	0.00
	Bottlenosed dolphin	4380	168791	0.89	0.00
	Spinner dolphin	150	1015059	0.00	0.00
	Pantropical spotted dolphin	4110	438064	0.28	0.00
	Striped dolphin	9870	570038	0.53	0.00
	Rough-toothed dolphin	1770	145729	0.36	0.00
	Fraser’s dolphin	1200	220789	0.16	0.00
	Pacific white-sided dolphin	3570	67769	1.60	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

Table 7. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 3 in Summer/Fall

West Philippine Sea 2 Operations					
Site 3	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.25	0.00
	Bryde's whale	180	22000	0.31	0.00
	Minke whale	540	25000	1.58	0.00
	Humpback whale (winter only)	0	394	3.33	0.00
	Sperm whale	300	102112	0.08	0.00
	Kogia	510	350553	0.04	0.00
	Cuvier's beaked whale	90	90725	0.02	0.00
	Blainville's beaked whale	150	8032	0.57	0.00
	Ginkgo-toothed beaked whale	150	22799	0.21	0.00
	False killer whale	870	16668	1.91	0.00
	Pygmy killer whale	630	30214	0.76	0.00
	Melon-headed whale	4290	36770	4.25	0.00
	Short-finned pilot whale	2280	53608	1.54	0.00
	Risso's dolphin	3180	83289	1.60	0.00
	Common dolphin	16860	3286163	0.21	0.00
	Bottlenose dolphin	4380	168791	1.09	0.00
	Spinner dolphin	150	1015059	0.00	0.00
	Pantropical spotted dolphin	4110	438064	0.37	0.00
	Striped dolphin	4920	570038	0.35	0.00
	Rough-toothed dolphin	1770	145729	0.49	0.00
	Fraser's dolphin	1200	220789	0.23	0.00
	Pacific white-sided dolphin	7350	67769	4.37	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

Table 8. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 3 in Winter

West Philippine Sea 4 Operations					
Site 3	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.25	0.00
	Bryde's whale	180	22000	0.31	0.00
	Minke whale	1080	25000	1.58	0.00
	Humpback whale (winter only)	36	394	3.33	0.00
	Sperm whale	300	102112	0.08	0.00
	Kogia	510	350553	0.04	0.00
	Cuvier's beaked whale	90	90725	0.02	0.00
	Blainville's beaked whale	150	8032	0.57	0.00
	Ginkgo-toothed beaked whale	150	22799	0.21	0.00
	False killer whale	870	16668	1.91	0.00
	Pygmy killer whale	630	30241	0.76	0.00
	Melon-headed whale	4290	36770	4.25	0.00
	Short-finned pilot whale	2280	53608	1.54	0.00
	Risso's dolphin	3180	83289	1.60	0.00
	Common dolphin	16860	3286163	0.21	0.00
	Bottlenose dolphin	4380	168791	1.09	0.00
	Spinner dolphin	150	1015059	0.00	0.00
	Pantropical spotted dolphin	4110	438064	0.37	0.00
	Striped dolphin	4920	570038	0.35	0.00
	Rough-toothed dolphin	1770	145729	0.49	0.00
	Fraser's dolphin	1200	220789	0.23	0.00
	Pacific white-sided dolphin	7350	67769	4.37	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

Table 9. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 4 in Summer

Guam 2 Operations					
Site 4	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affetced (w/mit) ≥ 180 dB**
	Blue whale	60	9250	0.07	0.00
	Fin whale	60	9250	0.07	0.00
	Bryde's whale	270	22000	0.14	0.00
	Minke whale	60	25000	0.03	0.00
	Humpback whale (winter only)	0	4005	0.00	0.00
	Sperm whale	300	102112	0.03	0.00
	Kogia	510	350553	0.01	0.00
	Cuvier's beaked whale	1620	90725	0.17	0.00
	Blainville's beaked whale	390	8032	0.48	0.00
	False killer whale	630	16668	0.54	0.00
	Melon-headed whale	2790	36770	1.09	0.00
	Short-finned pilot whale	600	53608	0.16	0.00
	Risso's dolphin	210	83289	0.05	0.00
	Bottlenose dolphin	750	168791	0.09	0.00
	Spinner dolphin	3000	1015059	0.05	0.00
	Pantropical spotted dolphin	31410	438064	1.22	0.00
	Striped dolphin	18060	570038	0.54	0.00
	Rough-toothed dolphin	1740	145729	0.20	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

Table 10. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 7 in Summer/Fall

South China Sea 2 Operations					
Site 7	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.04	0.00
	Bryde's whale	180	22000	0.05	0.00
	Minke whale	120	25000	0.03	0.00
	Gray whale (winter only)	0	100	0.00	0.00
	Sperm whale	300	102112	0.01	0.00
	Kogia	510	350553	0.00	0.00
	Cuvier's beaked whale	90	90725	0.00	0.00
	Blainville's beaked whale	150	8032	0.09	0.00
	Ginkgo-toothed beaked whale	150	22799	0.03	0.00
	False killer whale	540	9777	0.34	0.00
	Pygmy killer whale	630	30214	0.13	0.00
	Melon-headed whale	2610	36770	0.44	0.00
	Short-finned pilot whale	2289	53608	0.27	0.00
	Risso's dolphin	3180	83289	0.31	0.00
	Common dolphin	13830	3286163	0.03	0.00
	Bottlenose dolphin	4380	105138	0.34	0.00
	Spinner dolphin	330	1015059	0.00	0.00
	Pantropical spotted dolphin	4122	219032	0.14	0.00
	Striped dolphin	4920	570038	0.06	0.00
	Rough-toothed dolphin	1200	145729	0.06	0.00
	Fraser's dolphin	1200	220789	0.04	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

Table 11. Post-Operational Estimates of Marine Mammal Stocks Potentially Affected In Site 7 in Winter

South China Sea 1 Operation					
Site 7	**Animal**	**# Animals in Area**	**# Animals Stock**	**% Affected (w/mit) 120-180 dB**	**% Affected (w/mit) ≥ 180 dB**
	Fin whale	60	9250	0.05	0.00
	Bryde's whale	180	22000	0.06	0.00
	Minke whale	240	25000	0.07	0.00
	Gray whale (winter only)	0	100	0.00	0.00
	Sperm whale	300	102112	0.02	0.00
	Kogia	510	350553	0.01	0.00
	Cuvier's beaked whale	90	90725	0.01	0.00
	Blainville's beaked whale	150	8032	0.11	0.00
	Ginkgo-toothed beaked whale	150	22799	0.04	0.00
	False killer whale	540	9777	0.45	0.00
	Pygmy killer whale	630	30214	0.17	0.00
	Melon-headed whale	2610	36770	0.59	0.00
	Short-finned pilot whale	2289	53608	0.35	0.00
	Risso's dolphin	3180	83289	0.41	0.00
	Common dolphin	13830	3286163	0.04	0.00
	Bottlenose dolphin	4380	105138	0.45	0.00
	Spinner dolphin	330	1015059	0.01	0.00
	Pantropical spotted dolphin	4122	219032	0.18	0.00
	Striped dolphin	4920	570038	0.08	0.00
	Rough-toothed dolphin	1200	145729	0.08	0.00
	Fraser's dolphin	1200	220789	0.05	0.00

Note: Post-operational estimates were based on the actual operating hours whereas the pre-operational estimates were based on projected operations over the course of each annual LOA. Post-operational marine mammal density and stock numbers were based on the most current data in the fourth year LOA application (DON, 2005).

4.3 Mitigation Effectiveness

Under LOA Condition 8(b)(i) the following assessment of the effectiveness of the mitigation measures is provided. We have no recommendations for mitigation improvements at this time.

4.3.1 LFA Mitigation and Buffer Zones

During the missions, the minimum radial distance to the safety zone from the LFA array was 1 km (0.54 nm). Therefore, the safety and buffer zones comprised a 2-km (1.08-nm) radius.

4.3.2 Visual Monitoring

Visual observers, trained in marine mammal identification, were posted as specified in LOA Condition 7(a)(i) and CNO executive directives (see Section 2.0). The personnel responsible for marine animal visual monitoring were trained in the proper methods, procedures, and protocols required to detect and to identify marine animals in accordance with Condition 7(c) of the LOAs. During the 16 missions, three sightings of marine mammals were noted.

During two operations on the USNS IMPECCABLE, there were two visual sightings, one of an unknown whale species and the second of two porpoises. During one operation on the R/V *Cory Chouest*, there was one visual sighting of dolphins.

4.3.3 Passive Acoustic Monitoring

The embarked military detachment (MILDET) and system support engineers monitored the SURTASS passive displays for marine mammal vocalizations as specified in LOA Condition 7(a)(ii). One passive acoustic detection coincided with a detection from the HF/M3. However, LFA was not active at this time.

4.3.4 Active Acoustic Monitoring

The HF/M3 sonar was operated continuously during the course of the missions in accordance with LOA Conditions 6(c) and 7(a)(iii). The HF/M3 sonar was “ramped-up” prior to operations as required. During ten of the 16 missions, there were 16 HF/M3 alerts that were identified as possible marine mammal or sea turtle detections. No additional correlating data were available to further verify, identify, or clarify these detections.

4.3.5 Delay/Suspension of Operations

Because the HF/M3 sonar detections noted above met the minimum shutdown criteria (two HF/M3 detection alerts within six seconds), the requisite protocols were followed under LOA Condition 6(b). LFA transmissions were delayed/suspended on 33 occasions. On the USNS IMPECCABLE, operations were delayed/suspended four times due to possible marine mammal or sea turtle detections on the HF/M3 and three times due to HF/M3 failures. On the R/V *Cory Chouest*, there were 12 delays/suspensions due to possible marine mammal or sea turtle

detections on the HF/M3, 13 times due to HF/M3 failure, and once due to a visual sighting of dolphins.

4.4 Assessment of Long-Term Effects and Estimated Cumulative Impacts

Because the impacts that were encountered during the period of this report are consistent with what was projected in the FEIS and supporting documentation, the Navy's assessment of the long-term and cumulative impact of employment of SURTASS LFA remain consistent with the analysis of such impacts in the FEIS.

5.0 LONG TERM MONITORING AND RESEARCH

As part of its continuing commitment to protect the environment, the Navy is carrying out a Long Term Monitoring (LTM) Program to assess and analyze the potential for effects of the employment of SURTASS LFA on the marine environment.

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

- Analyze and assess the effectiveness of proposed mitigation measures, and make recommendations for improvements where applicable, to incorporate them as early as possible, with NMFS concurrence;
- Provide the necessary input data for reports on estimates of percentages of marine mammal populations affected by SURTASS LFA sonar operations, using predictive modeling based on operating location, system characteristics, and animal demographics;
- Study the potential effects of Navy SURTASS LFA sonar-generated underwater sound on long-term ecological processes relative to LF sound-sensitive marine animals, focusing on the application of Navy technology for the detection, classification, localization, and tracking of these animals; and
- Collaborate, as feasible, with pertinent Navy, academic, and industry laboratories and research organizations, and where applicable, with Allied navy and academic laboratories.

The LTM Program consists of two parts—reporting and research.

5.1 Reporting Requirements Under the Final Rule and Letters of Authorization

The first part of the LTM Program consists of NMFS-directed reports under the MMPA Final Rule and LOAs. These reports provide information for assessments of whether incidental harassment of marine mammals occurred within the SURTASS LFA mitigation and buffer zones during operations, based upon data from the monitoring mitigation (visual, passive acoustic, active acoustic). Data analysis from the LTM Program and post-operation acoustic information are utilized to estimate the percent of marine mammal stocks potentially exposed to SURTASS LFA received levels below 180 dB.

During routine operations of SURTASS LFA, technical and environmental data are collected and recorded. These include data from visual and acoustic monitoring, ocean environmental measurements, and technical operational inputs. As part of the LTM Program and as stipulated in the MMPA Final Rule and LOAs, the following reports are required:

- Mission reports are provided to NMFS on a quarterly basis for each vessel, including all active-mode missions that have been completed 30 days or more prior to the date of the deadline for the report.
- The Navy submits annual reports to NMFS 90 days prior to expiration of the LOAs.
- The Navy will provide a final comprehensive report analyzing any impacts of SURTASS LFA sonar on marine mammal stocks during the 5-year period of the regulations.

5.2 Research

NMFS's original Letter of Authorization (67 FR 55818) and Final Rule (67 FR 46785) included the conduct of additional research involving the topics listed in Table 12 below. According to the first LOA, the U.S. Navy must conduct research in at least one of these areas. The research activities listed would help to increase the knowledge of marine mammal species and the determination of levels of impacts from potential takes.

5.2.1 Research Status

Table 12 below provides the status of research that has been conducted, is underway or is planned to address NMFS's research topics.

5.2.2 Navy-Sponsored Research

The Office of Naval Research sponsors significant research to study the potential effects of its activities on marine mammals. The Navy spends nearly $10M annually on marine mammal research at universities, research institutions, federal laboratories, and private companies. In 2004 and 2005, Navy-funded research produced approximately 65 peer-reviewed articles in professional journals. Publication in open professional literature thorough peer review is the benchmark for the quality of the research. This ongoing marine mammal research includes hearing and hearing sensitivity, auditory effects, dive and behavioral response models, noise impacts, beaked whale global distribution, modeling of beaked whale hearing and response, tagging of free ranging marine animals at-sea, and radar-based detection of marine mammals from ships. These studies, though not specifically related to LFA operations, are crucial to the overall knowledge base on marine mammals and the potential effects from anthropogenic noise.

5.2.3 Research on Fish

Dr. Arthur Popper (University of Maryland), an internationally recognized fish acoustics expert, investigated the effects of exposure to LFA sonar on rainbow trout (a hearing non-specialist related to several endangered salmonids) and channel catfish (a hearing specialist) using an element of the standard SURTASS LFA source array. Hearing sensitivity was measured using auditory brainstem response (ABR), effects on inner ear structure were examined using scanning electron microscopy, effects on non-auditory tissues were analyzed using general pathology and histopathology, and behavioral effects were observed with video monitoring. Exposure to 193 dB re 1 µPa rms received level in the LFA frequency band for 324 seconds resulted in a TTS of 20 dB at 400 Hz in rainbow trout, with less TTS at 100 and 200 Hz. TTS in catfish ranged from 6 to 12 dB at frequencies from 200 to 1000 Hz. Both species recovered from hearing loss in several days. Inner ear sensory tissues appeared unaffected by acoustic exposure. Gross pathology indicated no damage to non-auditory tissues, including the swim bladder. Both species showed consistent startle responses at sound onsets and changed position relative to the sound source during exposures. There was no fish death attributable to sound exposure even up to four days post-exposure.

Table 12. Research Status

NMFS Research Topics	Status
Behavioral reactions of whales to sound levels that were not tested during the research phase, specifically between 155 and 180 dB.	Preliminary assessment of the feasibility of conducting such research indicates that a Scientific Research Permit (SRP) under the Marine Mammal Protection Act, backed up with a National Environmental Protection Act environmental assessment would be required. The potential for acquiring authorization to intentionally expose marine mammals to received levels up to 180 dB would be expected to be extremely low. Moreover, it should be noted that for the Low Frequency Sound SRP conducted in 1997-98, where the goal was to expose blue, fin, gray and humpback whales to received levels up to 160 dB, even with total control of placement of the LFA source in relation to known animal locations and movements, it was rare to achieve received levels at the animals greater than 150 dB. Intentions are to hold discussions with NMFS on the practicability of future research of this nature.
Responses of sperm and beaked whales to LF sonar signals.	• Expert marine bio-acousticians agree that the conduct of controlled exposure experiments (CEEs) with sperm and/or beaked whales will prove to be extremely complicated and expensive. Nevertheless, the Navy is going forward with sponsoring the planning for beaked whale CEEs. • An April 2004 Beaked Whale Workshop organized by the Marine Mammal Commission in Baltimore, MD where there was unanimous support for CEEs as the top research priority to be used to gather critical information on beaked whale responses to sound. It was agreed that a workshop, involving scientists across several disciplines, should be held to coordinate and design CEEs that would obtain the most useful information possible. A Summary report of this workshop is available at: http://www.mmc.gov/sound/. • A November 2004 Beaked Whale Research Planning Workshop at St. Andrews University, UK, jointly funded by the University's Sea Mammal Research Unit (SMRU) and the UK Ministry of Defence (MoD); where SMRU provided a strawman proposal for conducting CEEs with beaked whales; and included discussions on: 1) sites for CEEs; 2) general requirements for conducting CEEs; and 3) interpretation of the results of CEEs. The Revised Report from this workshop is provided as APPENDIX A of the recent SURTASS LFA application for regulations and LOAs under the MMPA (DON, 2006). • A second SMRU/MoD meeting in October 2005 of the leading scientists in the fields of marine bio-acoustics and beaked whale research, in Oxford UK, produced a draft research strategy on The Effects of Anthropogenic Sound on Marine Mammals, which focuses on a risk assessment framework of 5 steps: 1) Hazard identification; 2) Animal exposure assessment; 3) Animal dose-response assessment; 4) Risk characterization; and 5) Risk management. The final research strategy report should be available in 2006. Navy funding supported this research effort. • The Navy is funding SMRU and QinetiQ (UK) to provide the framework for future national and international research (e.g., CEE) on the responses of beaked whales to LF sonar signals. QinetiQ's initial report on Recent Advances in the Knowledge of beaked whales is summarized in APPENDIX B of the recent SURTASS LFA application for regulations and LOAs under the MMPA (DON, 2006). • The Navy's goal for 2006 is to develop an agreed-upon experimental plan for follow-on field research (e.g., CEEs) with beaked whales in 2007. The Navy has scheduled an ad hoc scientific working group meeting for April 2006 to concentrate on the details of a 2007 beaked whale CEE; independent scientists from Cornell University, Woods Hole Oceanographic Institution, and St. Andrews University will attend, with the projected outcome to be a plan of action with milestones for the 2007 experiment. Navy funding is supporting this research effort.

NMFS Research Topics	Status
Habitat preferences of beaked whales.	A Navy-funded draft planning document from SMRU has identified three "top-tier," three "second-tier" and eight "third-tier" sites (i.e., habitat preferences of beaked whales), including discussion for each on: 1) scientific impact; 2) logistics and cost; 3) team qualifications; and 4) permits and politics. • Top Tier: Bahamas, Azores, Canaries. • Second Tier: Bay of Biscay, Hawaii, Ligurian Sea (Genoa Canyon). • Third Tier: Alboran Sea, Baja California, Western Greece, New Zealand, Tazmania, Japan (Yokosuka Bay), Washington State (Quinalt Canyon), Caribbean Sea (esp. eastern Puerto Rico and Virgin Islands). These data will be further examined and beaked whale experts consulted in determining the oceanic area and specific sites for the conduct of the proposed 2007 field research effort. Navy funding supports this research effort.
Passive acoustic monitoring for the possible silencing of calls of large whales using bottom-mounted hydrophones.	Two research efforts in the North Atlantic (NORLANT, 2004, 2005) have addressed this topic. The research reports for both tasks are classified, but unclassified summaries are provided at APPENDIX C of the recent SURTASS LFA application for regulations and LOAs under the MMPA (DON, 2006). At least one and possibly two further research efforts are scheduled in the same North Atlantic vicinity for 2006. Navy funding has supported and continues to support these research efforts.
Long-term, cumulative effects on a stock of marine mammals that is expected to be regularly exposed to LFA and monitor it for population changes throughout the five-year period.	This topic will be addressed in the final report for the first five-year Rule.

5.2.4 Incident Monitoring

This LTM Program element comprises two parts: (1) recreational or commercial diver incident monitoring, and (2) marine mammal and sea turtle stranding incident monitoring. The Navy coordinates with the principal clearinghouse for information on diver-related incidents, Divers Alert Network (DAN). The Navy also monitors and reviews data on strandings from federal, state, and international organizations.

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APPENDIX A

Letter of Authorization Governing the Take of Marine Mammals Incidental to the U.S. Navy's Operation of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar on the R/V *Cory Chouest*, Office of Protected Resources, National Marine Fisheries Service, August 12, 2005

APPENDIX B

Letter of Authorization Governing the Take of Marine Mammals Incidental to the U.S. Navy's Operation of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar on the USNS IMPECCABLE, Office of Protected Resources, National Marine Fisheries Service, August 12, 2005

APPENDIX C

Background for Marine Mammal Density and Stock Estimates for SURTASS LFA Fourth Annual Report

Background for Marine Mammal Density and Stock Estimates for SURTASS LFA LOAs 3 and 4 Annual Report

Stipulation Area #2 North Philippine Sea/Spring, Summer & Fall

Specific Species Information:

Bryde's whale: Yoshida and Kato (1999) identified 3 stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific. Ohizumi et al. (2002) conducted winter sighting surveys, observing Bryde's whales at about 20°N, which is the southern limit of their summer range. Bryde's whales do not exhibit substantial migratory trends; therefore, the same density estimate is used year round based on the best available data for this region. Density estimates were derived from scouting vessels sighting data (Ohsumi, 1977). Barlow (2003) observed Bryde's whales around Hawaiian Islands, deriving comparable density estimates. The IWC website is source of stock estimate for the western North Pacific stock (22,000).

minke whale: The south coast of Honshu and Shikoku were whaling grounds for this species (Ohsumi 1978). Minke whales are migratory animals, with a summer distribution extending north to the Chukchi Sea and a winter distribution extending south to near the equator (Perrin and Brownell 2002). Two stocks of minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al. 1998). Animals in this region are believed to be part of the "O" stock. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk. Density estimates were derived from encounter rates and effective search widths for the offshore population (Standard Error (SE) = 0.17). The IWC website is source of stock estimate for the western North Pacific/Sea of Okhotsk stock (25,000). Ferguson and Barlow (2001, 2003) computed density estimates in offshore areas of the eastern tropical Pacific an order of a magnitude lower.

North Pacific right whale: The western North Pacific right whale population is considered distinct from the eastern population, arbitrarily separated by the 180° line of longitude (Best et al. 2001). The Okhotsk Sea, Kuril Islands, and eastern Kamchatka coast represent major feeding grounds for the western population (Brownell et al. 2001) where animals are typically found May through September (Clapham et al. 2004). Various areas have been proposed for breeding and calving grounds, including the Ryukyu Islands, Yellow Sea, Sea of Japan, offshore waters far from land, and the Bonin Islands, but a lack of winter sightings (December-February) makes a definitive assessment impossible (Brownell et al. 2001). Clapham et al. (2004) note the extensive offshore component to the right whale's distribution in the 19th century data. Movement north in spring (peak months of February-April) and south in fall (peak months September-Dececember) suggest the possibility of two putative sub-populations in the western population that are kept apart by the Japanese islands, though this seems unlikely (Brownell et al. 2001, Clapham et al. 2004). Data from Japanese sighting cruises in the Okhotsk Sea provide an abundance estimate of 922 animals (CV=0.433, 95% CI=404-2,108) (Best et al. 2001) for the western North Pacific population. The western population may be affected by proposed LFA operations in the spring, fall and winter in the North Philippine Sea.

sperm whale: Three stocks are recognized in U.S. EEZ waters, a North Pacific stock that migrates between Alaska and the western North Pacific, a central North Pacific stock around Hawaii, and a California/Oregon/Washington stock off the U.S. west coast (Angliss and Lodge 2002). Preliminary data indicate the best abundance estimate for the western North Pacific is 102,112 (CV=0.155) (Angliss and Lodge 2002). Sightings collected by Kasuya and Miyashita (1988) suggest that that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands and winter off Hokkaido and Sanriku, and the southwestern North Pacific stock with females that summer in the Kuroshio Current System and winter around the Bonin Islands. The males of these two stocks are found north of the range of the corresponding females, i.e., in the Bering Sea and in the Kuril Islands/Sanriku/Hokkaido, respectively, during the summer. Therefore, this site (29° N) in spring, summer, and fall is located in between the concentrations of southwest females and southwest males. As such, the density estimate is considered comparable to Mobley's estimate ($0.0010/km^2$) where sperm whales were generally seen in the outer 5% of survey effort (Mobley et al. 2000) and $0.0029/km^2$ from Barlow (2003).

Kogia: Evans (1987) reported records of *Kogia* spp. off the Japanese coast with primarily an oceanic distribution, not believed to be concentrated anywhere. Summing the abundances of *Kogia breviceps, Kogia simus, and Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001), an overall abundance of 350,553 animals was computed in the eastern tropical Pacific. At this northern latitude, only expect *Kogia breviceps*. Reviewing density estimates calculated in the eastern Pacific Ocean at about 30° N (Ferguson and Barlow 2003), a density estimate of $0.0031/km^2$ and an abundance estimate of 166,553 was modeled.

Cuvier's beaked whale: No density or stock estimate data are available for this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that best data available are a density estimate ($0.0054/km^2$) and an abundance estimate of 90,725 animals from the eastern Pacific (Ferguson and Barlow 2003).

Blainville's beaked whale: Miyazaki et al. (1987) reported 2 strandings on Taiwan and one stranding on the southern Ryukyu Archipelago. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate. The *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate is 8,032.

ginkgo-toothed beaked whale: Miyazaki et al. (1987) reported 5 strandings of *M. ginkgodens* from the east coast of Japan and 2 strandings from the east coast of Taiwan. Of the 15 known strandings of *M. ginkgodens*, Palacios (1996) reported 8 off Taiwan and Japan. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data on *Mesoplodon* spp. from the eastern Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

killer whale: A few schools have been seen off the southeast coast of Honshu (off Taiji) in April, October, and November; however, none have been taken in the drive fisheries (Miyashita 1993). Without any data for the western North Pacific, best available data are from the long-term

time series is the eastern tropical Pacific (Ferguson and Barlow 2001, 2003); density estimate (0.0004/km^2) and abundance estimate (12,256).

false killer whale: Miyashita (1993) estimated abundance of false killer whales from 34 sighting cruises associated with the Japanese drive fishery (16,668 (CV=0.263)). He also derived density estimates in 1° latitude by 1° longitude boxes from which an average was derived for the modeled site.

pygmy killer whale: Kishiro and Kasuya (1993) reviewed the historical catches of Japanese drive fisheries. No pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan), but Leatherwood and Reeves (1983) reported that they were seen relatively frequently in the tropical Pacific off Japan. Without data available in the western North Pacific, a density estimate (0.0021/km^2) and abundance estimate (30,214) from eastern Pacific (Ferguson and Barlow 2003) were used.

melon-headed whale: Leatherwood and Reeves (1983) reported that melon-headed whales are not observed frequently anywhere except in the Philippine Sea, especially near Cebu Island. Abundance estimated from eastern Pacific (36,770 animals) (Ferguson and Barlow 2001, 2003). A density estimate from similar latitudes in the eastern Pacific (Ferguson and Barlow 2001, 2003) was used (0.0012/km^2). This value is very similar to the estimate from Mobley et al. (2000): 0.0021/km^2.

short-finned pilot whale: Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 (CV=0.224)). He also derived density estimates in 1° latitude by 1° longitude boxes from which an average was derived for the modeled site.

Risso's dolphin: Miyashita (1993) reported an abundance estimate (83,289 (CV=0.179)) and density estimate off southern Japan/east Taiwan (0.0106/km^2).

common dolphin: There are no data on density or abundance estimates for this species in the western Pacific (Miyashita 1993). Common dolphins are gregarious, and it is not unusual to find them associated with Pacific white-sided dolphins in eastern North Pacific feeding grounds. They are pelagic, offshore creatures encountered along or seaward of the 183-m (100-fm) contour, and found in waters of temperature 10-28°C (50-82.4ºF). These animals are very widely distributed, occurring in all oceans to the limits of tropical and warm temperate waters (Leatherwood and Reeves 1983). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern Pacific (Ferguson and Barlow 2001, 2003) at the same latitudes are appropriate.

bottlenose dolphin: Miyashita (1993) reports an abundance estimate (168,791 (CV=0.261)) and density estimate off southern Japan (0.0146/km^2).

spinner dolphin: Gilpatrick et al. (1987) did not report any sightings from the Pacific coast of Japan, and this species was not mentioned in historical Japanese whaling records (Kishiro and Kasuya 1993). No data on density or abundance estimates are available (Miyashita 1993).

Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

pantropical spotted dolphin: Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Taiwan and in the Philippine Sea. An abundance estimate (438,064 (CV=0.174)) and density estimate off southern Japan/east Taiwan (0.0137/km^2) were used (Miyashita 1993). The density estimate is comparable to or lower than density estimates at similar latitudes in the eastern North Pacific, but the abundance estimate is twice that for offshore pantropical spotted dolphins in the eastern North Pacific (Ferguson and Barlow 2001, 2003).

striped dolphin: There are two concentrations in western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is also the potential for three populations in the area: one south of 30°N, one inshore north of 30°N, and one offshore north of 30°N, east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita 1993). Therefore, Miyashita (1993) derived a total population estimate (570,038 (CV=0.186)). The density estimate off southern Japan/east Taiwan (0.0329/km^2) was used.

rough-toothed dolphin: This species has a primarily pelagic distribution in tropical to warm temperate waters. They are seen from time to time with bottlenose dolphins and short-finned pilot whales, and are reportedly rare off Japan and in the heavily studied eastern tropical Pacific. There are no data on abundance or density estimates for the western North Pacific; therefore, a density estimate (0.0059/km^2) from eastern Pacific waters was used (Ferguson and Barlow 2001, 2003)**.**

Fraser's dolphin: Being a highly gregarious species, groups of a hundred to a thousand Fraser's dolphins have been observed. They are occasionally found mixed in herds of spotted dolphins and observed in company of false killer whales, sperm whales, striped dolphins, and spinner dolphins. Their diet consists of squid, crustaceans, and deep-sea fish (Leatherwood and Reeves 1983). Kishiro and Kasuya (1993) reported catches off the Pacific coast of Japan in drive fisheries. Dolar et al. (2003) reported Fraser's and spinners found together in the eastern Sulu Sea, Philippines. Comparing the feeding ecology of spinner and Fraser's dolphins, spinners feed primarily in upper 200 m (656 ft) but maybe as deep as 400 m (1312 ft), whereas Fraser's are more diverse, feeding from the surface to as deep as 600 m (1968 ft). Without any data on abundance or density estimates for the western North Pacific, it is roughly estimated that data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

Pacific white-sided dolphin: No data on density or abundance estimates are available in the western North Pacific (Miyashita 1993). A gregarious species, these pelagic, offshore creatures are encountered along or seaward of the 183-m (100-fm) contour. They feed at night on the deep-scattering layer and have a primarily temperate distribution, found north of tropical waters and south of arctic waters (Leatherwood and Reeves 1983). Density estimate from same latitudes in eastern Pacific waters was used (Ferguson and Barlow 2001, 2003)**.**

Stipulation Area #3 West Philippine Sea/Winter, Summer & Fall

Specific Species Information:

fin whale: Fin whales winter to about 20°N, including waters along the Pacific coast of Japan. Since fin whales migrate south from offshore waters of the northwest Pacific, density and stock estimates were derived from encounter rates of Japanese scouting boats in the northwest Pacific (Masaki 1977, Ohsumi 1977, Tillman 1977). These data are comparable to density estimates in offshore areas of the eastern tropical Pacific (Ferguson and Barlow 2001, 2003).

Bryde's whale: Animals found around the Bonin Islands are an offshore morph of *Balaenoptera edeni*. 3 stocks are currently recognized in the western North Pacific: Solomon Islands/Southeast Asia, East China Sea, and offshore western North Pacific (Yoshida and Kato 1999). Ohizumi et al. (2002) conducted winter sighting surveys, observing Bryde's whales at about 20°N, which is the southern limit of their summer range. Bryde's whales do not exhibit substantial migratory trends; therefore, the same density estimate is used year round based on the best available data for this region. The density estimate was derived from annual catch statistics in the offshore waters of the western North Pacific (Ohsumi 1977). The stock estimate is for the western North Pacific stock (22,000) (IWC website). Barlow (2003) observed Bryde's whales around the Hawaiian Islands, deriving a comparable density estimate.

minke whale: The south coast of Honshu and Shikoku were whaling grounds for the minke whale (Ohsumi 1978). Animals are migratory from the offshore western North Pacific waters. Two stocks of minke whales are recognized in the western North Pacific, the "O" stock in the Okhotsk Sea and off the eastern side of Japan and the "J" stock around the Korean peninsula and in the Sea of Japan (Pastene et al. 1998). Animals in this region are believed to be part of the "O" stock. Buckland et al. (1992) conducted sighting surveys in July and August in the western North Pacific and Sea of Okhotsk. Density estimates were derived from encounter rates and effective search widths for the offshore population (Standard Error (SE) = 0.17). The IWC website is source of stock estimate for western North Pacific/Sea of Okhotsk stock (25,000). Ferguson and Barlow (2001, 2003) computed density estimates in offshore areas of the eastern tropical Pacific an order of a magnitude lower.

humpback whale: Humpback whales are only expected in this region during the winter, and they are typically found in water depths of less than 183 m (100 fm). Humpback wintering grounds in the western North Pacific are the Ryukyu Islands, Formosa and Bonin Islands (Evans 1987). Three populations of humpbacks are recognized in U.S. EEZ waters, the third being the (quoted from Angliss and Lodge 2002): "winter/spring population of Japan which, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991) - referred to as the Western North Pacific stock. Some recent exchange between winter/spring areas has been documented (Darling and McSweeney 1985, Baker et al. 1986, Darling and Cerchio 1993), as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Darling et al. 1996, Calambokidis et al. 1997)." The best

abundance estimate for the western North Pacific stock is 394 (CV=0.084) (Angliss and Lodge 2002).

sperm whale: Three stocks are recognized in U.S. EEZ waters, a North Pacific stock that migrates between Alaska and the western North Pacific, a central North Pacific stock around Hawaii, and a California/Oregon/Washington stock off the U.S. west coast (Angliss and Lodge 2002). Preliminary data indicate best abundance estimate for the western North Pacific is 102,112 (CV=0.155) (Angliss and Lodge 2002). Sightings collected by Kasuya and Miyashita (1988) suggest that that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands and winter off Hokkaido and Sanriku, and the southwestern North Pacific stock with females that summer in the Kuroshio Current System and winter around the Bonin Islands. The males of these two stocks are found north of the range of the corresponding females, i.e., in the Kuril Islands/Sanriku/Hokkaido and in the Kuroshio Current System, respectively, during the winter and in the Bering Sea and in the Kuril Islands/Sanriku/Hokkaido, respectively, during the summer. As such, the density estimate is considered comparable to Mobley's estimate (0.0010/km^2) where sperm whales were generally seen in the outer 5% of survey effort (Mobley et al. 2000) and to the Barlow (2003) estimate of 0.0029/km^2.

Kogia: *Kogia* spp. occur in tropical and warm temperate waters throughout the world. They have been documented on the east and west coasts of Taiwan (Chou 1989, Wang et al. 2002), though no data on abundance or density estimates have been reported. Summing the abundances of *Kogia breviceps, Kogia simus, and Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001), an overall abundance of 350,553 animals was computed in the eastern tropical Pacific. At this latitude, expect *Kogia breviceps* and *Kogia simus*. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N (Ferguson and Barlow 2003), a density estimate of 0.0017/km^2 was modeled.

Cuvier's beaked whale: No data are available for Cuvier's beaked whales in this region. Considering habitat preferences (e.g., water temperature, bathymetry), it was determined that best data available are a density estimate (0.0003/km^2) and an abundance estimate of 90,725 animals from the same latitudes in the eastern Pacific (Ferguson and Barlow 2003).

Blainville's beaked whale: Miyazaki et al. (1987) reported 2 strandings on Taiwan and one stranding on the southern Ryukyu Archipelago. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate. The *Mesoplodon densirostris* abundance estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate is 8,032.

ginkgo-toothed beaked whale: Miyazaki et al. (1987) reported 2 strandings of *M. ginkgodens* from the east coast of Taiwan. Of the 15 known strandings of *M. ginkgodens*, Palacios (1996) reported 8 off Taiwan and Japan. Leatherwood and Reeves (1983) stated that some hunting of this species apparently takes place in Taiwan. Since no data on density or stock estimates are available for this species, it was roughly estimated that the density and abundance estimates for *Mesoplodon* spp. at the same latitudes in the eastern Pacific (Ferguson and Barlow 2001, 2003) are approximate.

false killer whale: Miyashita (1993) estimated the abundance of false killer whales from 34 sighting cruises associated with the Japanese drive fishery (16,668 (CV=0.263)). He also derived density estimates in 1° latitude by 1° longitude boxes from which an average was derived for the modeled site.

pygmy killer whale: Kishiro and Kasuya (1993) reviewed the historical catches of Japanese drive fisheries. No pygmy killer whales were caught in Taiji fisheries (located on the south coast of Kii Peninsula of Japan), but Leatherwood and Reeves (1983) reported that they were seen relatively frequently in the tropical Pacific off Japan. Without data available in the western North Pacific, a density estimate (0.0021/km^2) and abundance estimate (30,214) from eastern Pacific (Ferguson and Barlow 2003) was used.

melon-headed whale: Leatherwood and Reeves (1983) reported that melon-headed whales are not observed frequently anywhere except in the Philippine Sea, especially near Cebu Island. Density and abundance estimates from the eastern Pacific (Ferguson and Barlow 2003) were used.

short-finned pilot whale: Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 (CV=0.224)). He also derived density estimates in 1° latitude by 1° longitude boxes. There was limited coverage of the Philippine Sea, but Kishiro and Kasuya (1993) reported a southern limit to the short-finned pilot whale range of approximately 20°N; therefore, a density estimate was derived as one-half the density estimate of the area south of Japan. Kasuya et al. (1988) suggest that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). However, the northern form has not been harvested by Japanese drive fisheries (Kishiro and Kasuya 1993), and it was therefore not included in the above analyses (Miyashita 1993).

Risso's dolphin: Miyashita (1993) abundance estimate (83,289 (CV=0.179)) and density estimate off southern Japan/east Taiwan (0.0106/km^2) were used.

common dolphin: There are no data on density or stock estimates for this gregarious species (Miyashita 1993). It is not unusual to find common dolphins associated with Pacific white-sided dolphins in eastern North Pacific feeding grounds. These pelagic, offshore creatures are encountered along or seaward of the 100-fm contour and are found in waters of temperature 10-28°C (50-82.4°F). They are very widely distributed, occurring in all oceans to the limits of tropical and warm temperate waters (Leatherwood and Reeves 1983). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

bottlenose dolphin: Miyashita (1993) abundance estimate (168,791 (CV=0.261)) and density estimate off southern Japan (0.0146/km^2) were used.

spinner dolphin: Gilpatrick et al. (1987) reported a high density of sightings in the Korea Strait, but none were reported from the Philippine Sea. Spinners are also not mentioned in historical Japanese whaling records (Kishiro and Kasuya 1993), and no data on density or abundance estimates are available (Miyashita 1993). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

pantropical spotted dolphin: Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Taiwan and in the Philippine Sea. The Miyashita (1993) abundance estimate (438,064 (CV=0.174)) and density estimate off southern Japan/east Taiwan (0.0137/km^2) were used.

striped dolphin: Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. However, the stock structure of these populations has not been resolved; therefore, a population estimate combining both concentrations (570,038 animals (CV=0.186)) was derived (Miyashita 1993). One-half the density estimate from off southern Japan/east Taiwan was used for this site (0.0164 animals/km^2) since striped dolphins were just recently added to the species list of Taiwan and are not considered common anywhere in the region (Perrin et al. 2002). The density estimate is comparable to the lower end of density estimates in the eastern North Pacific and the abundance estimate is about half of that for the eastern North Pacific (Ferguson and Barlow 2001, 2003).

rough-toothed dolphin: Their distribution is primarily pelagic, in tropical to warm temperate waters. Rough-toothed dolphins are seen from time to time with bottlenose dolphins and short-finned pilot whales, and are reportedly rare off Japan and in the heavily studied eastern tropical Pacific. No data on stock or density estimates for the western North Pacific are available; therefore, a density estimate (0.0059/km^2) and an abundance estimate from the eastern tropical Pacific (145,729) were used (Ferguson and Barlow 2001, 2003)**.**

Fraser's dolphin: Kishiro and Kasuya (1993) reported takes of Fraser's dolphin off the Pacific coast of Japan in the Japanese drive fisheries. Dolar et al. (2003) reported Fraser's and spinners found together in the eastern Sulu Sea, Philippines. Amano et al. (1996) also stated that Fraser's dolphins are common in Philippine waters. A highly gregarious species, groups of a hundred to a thousand have been observed, are occasionally found mixed in herds of spotted dolphins, and observed in the company of false killer whales, sperm whales, striped dolphins, and spinner dolphins. Their diet consists of squid, crustaceans, and deep-sea fish (Leatherwood and Reeves 1983). A comparison of the feeding ecology of spinner and Fraser's dolphins indicates that spinners feed primarily in upper 200 m (656 ft), but maybe as deep as 400 m (1312 ft), whereas Fraser's dolphins are more diverse, feeding from the surface to as deep as 600 m (1968 ft). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

Pacific white-sided dolphin: There are no data on density or stock estimates available for this species (Miyashita 1993). These pelagic, offshore animals are encountered along or seaward of the 100-fm contour, and feed at night on the deep-scattering layer. Pacific white-sided dolphins

have a primarily temperate distribution, found north of tropical waters and south of arctic waters (Leatherwood and Reeves 1983). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate.

Stipulated Area #4 Guam/Summer

General Area Information:

There has been no recent research of marine mammals in the vicinity of Guam (Dr. J. Mobley, Jr., Univ. of Hawaii-West Oahu, pers. comm.). Eldredge (1991) compiled the first list of published and unpublished records, reporting 19 species from the region. Since there are no data on density or stock estimates for animals found in this region, the density and abundance estimates from western North Pacific and the NOAA Fisheries Southwest Fisheries Science Center surveys of the eastern tropical Pacific were applied to this area as the best available data (Ferguson and Barlow 2001, 2003). Guam references currently available are Kami and Lujan (1976), Donaldson (1983), and Eldredge (1991).

Specific Species Information:

blue whale: A Hawaiian stock of blue whale is recognized for U.S. management purposes, though they are extremely rare in the area (Carretta et al. 2002). It is hypothesized that blue whales that feed along the Aleutian Island chain in the summer spend the winter north of Hawaii, though only one visual sighting of blue whales has been recorded (Carretta et al. 2002). Further evidence of their occurrence in the area exists in acoustic recordings. Stafford et al. (2001) showed that recordings made near Kaneohe, Hawaii from August 1992 through April 1993 consisted of approximately 30% of the northwest Pacific blue whale call type and 70% of northeast Pacific call type. Other papers on acoustic censusing of blue whales in the eastern North Pacific are Moore et al. (1997) and Stafford et al. (1999). Because of the limited data available for the Hawaiian stock and the current uncertainty in blue whale stock delineation in the North Pacific (IWC recognizes only one stock in North Pacific; NOAA Fisheries delineates two stocks in U.S. EEZ waters, though up to five populations are believed to exist in the entire North Pacific basin (Reeves et al. 1998); and acoustic data suggest two populations), a data on fin whales are most appropriate to apply to blue whales. The density estimate is 0.0002/km^2 and the stock estimate is 9250. These data are comparable to density estimates in offshore areas of the eastern tropical Pacific (ETP) (Ferguson and Barlow 2001, 2003).

fin whale: These animals are typically not expected south of 20°N, so it is unlikely that they would be encountered near Guam. One Hawaii stock is recognized (Carretta et al. 2002), and there has been one sighting in Hawaiian waters in recent years (February) (Mobley et al. 1996). There has been acoustic evidence for fin whale presence in fall and winter (Thompson and Friedl 1982, Moore et al. 1998). Because of the limited data available for the Hawaiian stock, and no data available for the Guam region, density estimates and stock abundance were derived from data on the eastern North Pacific stock (Ferguson and Barlow 2003). The stock estimate is 9250 for animals outside of the Gulf of California, and a density estimate of 0.0002/km^2 based on one-half the density offshore of CA/OR/WA was derived. It is conservative to use the eastern North

Pacific data because McDonald and Fox (1999) derived an average calling whale density estimate of 0.027 animals per 1000 km^2 (0.000027/km^2) based on recordings made north of Oahu, Hawaii – a value an order of magnitude less than what was modeled. The seasonal maximum calling whale density was about three times the average, or 0.081 animals/1000 km^2 (McDonald and Fox 1999), still considerably less than the modeled density.

The following table from McDonald and Fox (1999) gives a sense of the variability in the derivation of call density estimates. Based on the chosen methodology and parameters, the call density ranged from 0.011/1000 km^2 to 0.106/1000 km^2.

TABLE I. Relation of average call density estimate to time constant and range (From McDonald and Fox 1999)

SNR	Range (km)	Number of Detections		Call Density/1000 km^2	
		time constant=4h	time constant=8h	TC=4h	TC=8h
1.0–1.5	16.0–24.0	143	85	0.042	0.025
1.5–2.5	9.6–16.0	54	36	0.031	0.020
2.5–5.0	4.75–9.6	15	10	0.016	0.011
5.0–10	2.25–4.75	11	8	0.038	0.027
>10	0–2.25	9	7	0.106	0.083
Average Call Density/1000 km^2 Weighted by number of detections				**0.040**	**0.027**

Bryde's whale: One Hawaii stock is recognized (Carretta et al. 2002), and the IWC website is source of stock estimate for the western North Pacific stock (22,000). There have been no recent observations of Bryde's whales in the region, though historical evidence suggests they might be present (Carretta et al. 2002)**.** Data from the ETP (Ferguson and Barlow 2003) for density estimates (0.0009/km^2) were used.

minke whale: They are not abundant anywhere in the Pacific except in the Bering and Chukchi seas and in the Gulf of Alaska. A Hawaii stock is not recognized (Carretta et al. 2002). There is an Alaska stock that is considered migratory and a "resident" CA/OR/WA stock that establishes home ranges (Dorsey et al. 1990). The IWC identifies three Pacific stocks – one in the Sea of Japan/East China Sea, one in the remainder of western Pacific west of 180°, and one east of 180°. The modeled stock estimate is the IWC stock estimate for the western North Pacific stock (Approximate point estimate of 25,000, Approximate 95% confidence limits of 12,800-48,600) (IWC website http://www.iwcoffice.org/Estimate.htm accessed 15 June 2003). This is conservative because it is significantly higher than the limited data available on the CA/OR/WA stock. Barlow (2003) acoustically identified the "boing" as minke whales, suggesting that they are more common than previously thought. No density or abundance estimates were provided from the visual data, but are forthcoming from the acoustic data.

humpback whale: Humpback whales are only expected in this region during the winter, and they are typically found in water depths of less than 183 m (100 fm). A central North Pacific stock has been identified as individuals that migrate from summer/fall feeding grounds of

northern British Columbia and southeast Alaska (Prince William Sound west to Kodiak), to winter/spring breeding and calving grounds of the Hawaiian Islands (Carretta et al. 2002). Some exchange between winter/spring areas has been documented, as well as movement between Japan and British Columbia, and Japan and the Kodiak Archipelago (Calambokidis et al. 1997). Recent acoustic surveys (Norris et al. 1999) suggest a northbound migration heading of approximately magnetic north (10° true), with a "migration corridor" of 150-160°W. Animals are cycling through the breeding grounds with an average residency of approximately 30-45 days. The best abundance estimate for the central North Pacific stock is 4005 (CV=0.095) (Angliss and Lodge 2002). Mobley et al.'s (2001) aerial surveys observed that 64% of humpback whales were found in waters of depths less than 183 m (100 fm). Density estimate for waters greater than 183 m (100 fm) were derived from survey results.

sperm whale: Three stocks are recognized in U.S. EEZ waters, a North Pacific stock that migrates between Alaska and the western North Pacific, a central North Pacific stock around Hawaii, and a California/Oregon/Washington stock off the U.S. west coast (Angliss and Lodge 2002). Preliminary data indicate best abundance estimate for the western North Pacific is 102,112 (CV=0.155) (Angliss and Lodge 2002). Sightings collected by Kasuya and Miyashita (1988) suggest that that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands and winter off Hokkaido and Sanriku, and the southwestern North Pacific stock with females that summer in the Kuroshio Current System and winter around the Bonin Islands. The males of these two stocks are found north of the range of the corresponding females, i.e., in the Kuril Islands/Sanriku/Hokkaido and in the Kuroshio Current System, respectively, during the winter. A density estimate is taken from Mobley's surveys (Mobley et al. 2000, Carretta et al. 2002). These data are comparable to that observed by Barlow (2003) in a larger region around Hawaii.

Kogia: Mobley et al. (1999) saw 2 pods for a total of 5 individuals during his 1993-1998 survey efforts. No density or abundance estimates were derived. Hawaiian stocks of pygmy and dwarf sperm whales are recognized (Carretta et al. 2002). Ferguson and Barlow (2003) derived an abundance estimate of 350,553 and density estimate of 0.0017/km^2 for this latitude in the eastern North Pacific.

Cuvier's beaked whale: The best data available on density and abundance estimates are from the eastern tropical Pacific (ETP) at the same latitude: 0.0054/km^2 and 90,725 animals (Ferguson and Barlow 2003).

Blainville's beaked whale: The best data available on density (0.0013/km^2) and abundance estimates are from the eastern Pacific (Ferguson and Barlow 2003). The *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate is 8,032.

false killer whale: Miyashita (1993) estimated abundance of false killer whales from 34 sighting cruises associated with the Japanese drive fishery (16,668 (CV=0.263)). The best data available on density (0.0021/km^2) in the eastern North Pacific at similar latitudes and distance from the mainland (Ferguson and Barlow 2003) were used.

melon-headed whale: The best data available on density (0.0093/km^2) and abundance estimate in the eastern North Pacific (36,770) (Ferguson and Barlow 2003) were used.

short-finned pilot whale: : Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 (CV=0.224)). The best data available on density (0.0020/km^2) in the eastern North Pacific at similar latitudes (Ferguson and Barlow 2003) were used.

Risso's dolphin: Mobley et al. (2000) did not have enough sightings to derive density or abundance estimates. One Hawaiian stock is recognized, though animals appear to be rare in the area (Carretta et al. 2002)**.** Carretta et al. stated, **"**Based on the locations of interactions with the Hawaiian longline fishery, it is likely that Risso's dolphins primarily occur in pelagic waters tens to hundreds of miles from the main Hawaiian Islands and are only occasionally found nearshore." Leatherwood and Reeves (1983) stated that there is a sighting hiatus at about 20°N along the western coast of the U.S. where Risso's have been intensely studied. This sighting hiatus may extend out to the main Hawaiian Islands which are centered at about 20°N, and contribute to the rarity of their sightings. Miyashita (1993) reports a western North Pacific stock estimate (83,289 (CV=0.179)) Density estimate (0.0007/km^2) is from surveys in the eastern North Pacific (Ferguson and Barlow 2003).

bottlenose dolphin: : Miyashita (1993) reports an abundance estimate (168,791 (CV=0.261)).The best data available on density (0.0025/km^2) in the eastern North Pacific at similar latitudes and distance from the mainland (Ferguson and Barlow 2003) were used.

spinner dolphin: The best data available on density (0.0100/km^2) and abundance estimate for whitebelly spinner (1,015,059) from the eastern tropical Pacific (Ferguson and Barlow 2003) were used**.**

pantropical spotted dolphin: Gilpatrick et al. (1987) cited a known distribution of pantropical spotted dolphins east of Japan. Miyashita (1993) reports an abundance estimate (438,064 (CV=0.174)) and density estimate east of Japan (0.0259/km^2). The best data available on density (0.1047/km^2) for offshore spotted dolphin in the eastern North Pacific (Ferguson and Barlow 2003) was used.

striped dolphin: Two concentrations exist in the western North Pacific, one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for two populations in the area: one inshore north of 30°N, and one offshore north of 30°N, east of 145°E. However, the boundaries between these populations have not been resolved (Miyashita 1993). Therefore, Miyashita (1993) derived a total population estimate of 570,038 (CV=0.186). The best data available on density (0.0602/km^2) in the eastern North Pacific at similar latitudes and distance from the mainland (Ferguson and Barlow 2003) were used.

rough-toothed dolphin: The best data available on density (0.0058/km^2) and abundance estimate in the eastern North Pacific (145,729) (Ferguson and Barlow 2003) were used.

Stipulation Area #7 South China Sea/Winter, Summer & Fall

Specific Species Information:

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

Bryde's whale: Yoshida and Kato (1999) identified 3 stocks of Bryde's whales in the western North Pacific: Solomon Islands/Southeast Asia stock (mainly Philippine waters and the Gulf of Thailand), East China Sea, and offshore western North Pacific. Animals found in this area are considered part of the southeast Asia stock of Bryde's whales, which includes waters of the Philippine Sea and Gulf of Thailand (Yoshida and Kato 1999) and which is separate from both the East China Sea and western North Pacific populations. Animals in this region are the offshore form of *Balaenoptera edeni*. De Boer (2000) sighted Bryde's whales during his cruise. No data specific to this stock were reported. With limited data in the South China Sea, the most appropriate density estimate is from annual catch statistics in the western North Pacific (Ohsumi 1977), which is comparable to summer/fall density estimates around Hawaii (Barlow 2003) and the eastern tropical Pacific (Ferguson and Barlow 2001, 2003). The stock estimate is for the western North Pacific stock (22,000 animals) (IWC website).

minke whale: As a cosmopolitan species, minke whales are expected to be present in the South China Sea, though De Boer (2000) did not observe them during his recent cruise through the area. Individuals are believed to be from the J-stock (Gong 1988, Butterworth et al. 1996), migrating into the region in the winter. However, there are limited data on density and stock estimates. Therefore, estimated encounter rates similar to the favored whaling grounds of the western North Pacific and IWC stock estimate were used (Okamura et al. 2001). These estimates are an order of magnitude higher than any calculated in the eastern North Pacific (Ferguson and Barlow 2001, 2003).

gray whale: Gray whales would only be expected to be in this area during the winter season. Exact wintering grounds of this species are not known, though believed to winter in the South China Sea, in the vicinity of Korea and China (Evans 1987, Omura 1988). Presumably they maintain a shallow water/nearshore affinity throughout the southern portion of their range. The exact migration route is not known, but they are believed to migrate directly across the East China Sea, which is one of the few times that they leave their shallow, nearshore habitat (Omura 1988). During this time, they may be found up to 400 nm (741 km) offshore (Weller et al. 2002). Weller et al. (1999) conducted photo-id studies in the Sakhalin region to begin to characterize

this population. It is believed that the total population size is less than 100 individuals. As such, a density estimate in the area is designates as “very low-level species”.

North Pacific right whale: There has been limited search effort in the South China Sea, but no observations of right whales have ever been reported in the area (Clapham et al. 2004). In addition, right whales migrate further north during the spring, summer, and fall, and are not expected in the area at these times of year. The only possibility of a right whale encounter would be during the winter season.

sperm whale: De Boer (2000) sighted sperm whales in the South China Sea, and suggested that animals seen west of the Balabac Strait might be migrating between the South China Sea and the Sulu Sea. No data on density estimates or stock estimates were provided. Because this region is found in the lower latitudes, it is most probable that females and juveniles would be in the area. Since this site is on the edge of the concentration of southwest females, the density estimate is considered comparable to Mobley’s estimate (0.0010/km^2) where sperm whales were generally seen in the outer 5% of his survey effort (Mobley et al. 2000). This is also comparable to the density estimate (0.0029/km^2) calculated from the summer/fall survey off Hawaii in 2002 (Barlow 2003). Abundance estimate is for the North Pacific stock that migrates between Alaska and the western North Pacific (Angliss and Lodge 2002).

Kogia: Smith et al. (1997) reported that *Kogia* were found in “whale temples” in nations surrounding the South China Sea. No density or abundance estimates are available. No sightings of *Kogia* spp. were made by De Boer (2000). Summing the abundances of *Kogia* spp. in the geographic strata defined by Ferguson and Barlow (2001), an overall abundance of 350,553 animals is computed in the eastern tropical Pacific. At this latitude, expect *Kogia breviceps* and *Kogia simus*. Reviewing density estimates calculated in the eastern Pacific Ocean at about 20°N (Ferguson and Barlow 2003), a density estimate of 0.0017/km^2 was modeled.

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

Blainville's beaked whale: Miyazaki et al. (1987) did not report any strandings of *M. densirostris* from the South China Sea. De Boer (2000) and Miyashita et al. (1996) did not observe any *M. densirostris* during their research cruises. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate. The *Mesoplodon densirostris* estimate added to one-fifth of the *Mesoplodon* spp. abundance estimate is 8,032.

ginkgo-toothed beaked whale: Miyazaki et al. (1987) report no strandings of *M. ginkgodens* from the South China Sea, and De Boer (2000) and Miyashita et al. (1996) did not observe *M. ginkgodens* during their research cruises. Since no data on density or stock estimates are available for this species, it was roughly estimated that the density (0.0005/km^2) and abundance

estimates (22,799 animals) for *Mesoplodon* spp. at the same latitude in the eastern Pacific (Ferguson and Barlow 2001, 2003) are approximate.

false killer whale: Miyashita (1993) suggests that animals summering in the Sea of Japan are probably from a different stock, by analogy of Pacific white-sided dolphins. Animals in the East and South China seas are probably part of this inshore archipelago stock. Kishiro and Kasuya (1993) cited Miyashita (1986) as estimating the population wintering in the East China Sea at 3,259 animals. Since these data represent only about one-third of the habitat of false killer whales in the South China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (9777 animals). False killer whales are sighted infrequently in the South China Sea (Miyashita et al. 1996, Smith et al. 1997, De Boer 2000). There are no data on density estimates for the South China Sea. Miyashita (1993) derived density estimates in 1° by 1° boxes from 34 sighting cruises associated with the Japanese drive fishery from which a weighted-average was derived for the Pacific coast of Japan. Since false killer whales are sighted infrequently in the South China Sea, the western North Pacific density estimate is halved for South China Sea. This estimate is higher than that calculated for around Hawaii (Barlow 2003) ($0.0001/km^2$) and within the range of estimates in the eastern North Pacific (Ferguson and Barlow 2001, 2003).

pygmy killer whale: Leatherwood and Reeves (1983) stated that this species is not abundant in any particular area, but is widely distributed in tropical waters. Pygmy killer whales are seen relatively frequently in the ETP, especially near Hawaii. Pygmy killer whales were seen by De Boer (2000) during his research cruise through the South China Sea, known from historical "whale temples" (Smith et al. 1997), but not seen by Miyashita et al. (1996). No mention of these animals exist in Japanese whaling records (Kishiro and Kasuya 1993). There are no data on density or stock estimates off Japan or Taiwan (Miyashita 1993), or nearshore Hawaii (Mobley et al. 2000). An estimate of $0.0003/km^2$ was calculated in offshore waters of Hawaii (Barlow 2003). Without data available in the western North Pacific, a density estimate ($0.0021/km^2$) and abundance estimate (30,214) from the eastern Pacific (Ferguson and Barlow 2003) was used.

melon-headed whale: Leatherwood and Reeves (1983) stated that melon-headed whales are rare except in the Philippine Sea. Distributed in tropical and subtropical waters, preferring equatorial water masses, they have been observed in the South China Sea (De Boer 2000) and in "whale temples" on islands surrounding the South China Sea (Smith et al. 1997). However, they were not observed by Miyashita et al. (1996). A density and abundance estimate from similar latitudes in the eastern Pacific (Ferguson and Barlow 2003) were used. These values are greater than estimates in Hawaii ($0.0012/km^2$ (Barlow 2003); $0.0021/km^2$ (Mobley et al. 2000)).

short-finned pilot whale: Smith et al. (1997) reported that short-finned pilot whales are found in "whale temples" on islands surrounding the South China Sea. De Boer (2000) did not observe pilot whales during his research cruise, but Miyashita et al. (1996) did observe them in the western North Pacific. With limited data for this particular region, data from the Pacific coast of Japan were used. Miyashita (1993) estimated abundance of short-finned pilot whales from 34 sighting cruises associated with the Japanese drive fishery (53,608 (CV=0.224)). He also derived density estimates in 1° latitude by 1° longitude boxes. Kishiro and Kasuya (1993) reported a southern limit to the short-finned pilot whale range of approximately 20°N; therefore, a density

estimate was derived as one-half the density estimate of the area south of Japan. Kasuya et al. (1988) suggest that there might be more than one stock of short-finned pilot whales off the Pacific coast of Japan and Taiwan, since there is a southern form found south of the Kuroshio Current front (south of 35°N) and a northern form found between the Kuroshio Current front and the Oyashio Current front (from approximately 35-43°N). However, the northern form has not been harvested by Japanese drive fisheries (Kishiro and Kasuya 1993), and therefore, it was not included in the above analyses (Miyashita 1993). The modeled estimate was in the range of other density estimates in eastern North Pacific (Ferguson and Barlow 2001, 2003) and Hawaii (0.0036/km^2 (Barlow 2003); 0.0237/km^2 (Barlow 2003)).

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

common dolphin: Common dolphin has been found in "whale temples" in nations along the South China Sea (Smith et al. 1997). There are no data on density or stock estimates (Miyashita 1993). This is a gregarious species, not unusual to find associated with Pacific white-sided dolphins in eastern North Pacific feeding grounds. These dolphins are pelagic, offshore creatures encountered along or seaward of the 183-m (100-fm) contour, and found in waters of temperature 10-28°C (50-82.4°F). They are very widely distributed, occurring in all oceans to the limits of tropical and warm temperate waters (Leatherwood and Reeves 1983). Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate. Common dolphins were not sighted around Hawaii in recent surveys (Mobley et al. 2000, Barlow 2003).

bottlenose dolphin: Smith et al. (1997) reported that bottlenose dolphins are found in "whale temples" in South China Sea nations. Miyashita (1993) reports that reproductive differences suggest that animals from the Pacific and East China Sea are different stocks. Kishiro and Kasuya (1993) cite Miyashita (1986) as estimating the abundance of the stock in the East China Sea as 35,046. Since these data represent only about one-third of the habitat of bottlenose dolphins in the East China Sea, the population estimate is multiplied by 3 for the inshore Archipelago stock estimate (105,138). It is assumed that animals found in the Sea of Japan and South China Sea are of the same stock. No density estimates are available for this stock; therefore, a density estimate was derived from the southeast Pacific coast of Japan/east of Taiwan (Miyashita 1993) (0.0146/km^2). This is within the range of densities estimated in the eastern North Pacific (Ferguson and Barlow 2001, 2003) and higher than those around Hawaii (0.0103/km^2 Mobley et al. (2000), 0.0013/km^2 (Barlow 2003)).

spinner dolphin: Gilpatrick et al. (1987) reported a high density of sightings in the Korea Strait and adjacent waters to the north, but none were reported from the South China Sea or Philippine Sea. Spinner dolphins are not mentioned in historical Japanese whaling records (Kishiro and Kasuya 1993), reported during the De Boer (2000) research cruise, or encountered in historical "whale temples" (Smith et al. 1997). There are no data on density or stock estimates available (Miyashita 1993). Because of the multispecies/subspecies data confounding the eastern tropical Pacific density estimates (Ferguson and Barlow 2001, 2003), and the offshore nature of the experiment site, the offshore Hawaii density estimate (0.0011/km^2) (Barlow 2003) rather than the nearshore Hawaii estimate (0.0443/km^2) (Mobley et al. 2000) was used.

pantropical spotted dolphin: These animals have been reported during the De Boer (2000) research cruise, observed in winter (Jan-Feb) in South China Sea (Miyashita et al. 1996), and reported from historical "whale temples" (Smith et al. 1997). Gilpatrick et al. (1987) summarized one report from west of Taiwan in the northern portion of the South China Sea. Miyashita (1993) summarized data from 34 sighting cruises conducted as part of the Japanese drive fishery. There is no discontinuity in sightings to suggest different stocks, though based on data from the ETP, it is possible that multiple populations exist in the western North Pacific (Miyashita 1993). In the western North Pacific, total population size was 438,064 (CV=0.174), density estimate was 0.0137/km^2. It was estimated that the population in South China Sea was one-half the abundance of the western North Pacific stock (219,032) with the same density estimate of 0.0137/km^2. This is within the range of densities estimated in the eastern North Pacific (Ferguson and Barlow 2001, 2003) and around Hawaii (0.0407/km^2 Mobley et al. (2000), 0.0042/km^2 (Barlow 2003)).

striped dolphin: These animals were not reported during the De Boer (2000) research cruise in March-April, but seen by Miyashita et al. (1996) in the South China Sea are Jan-Feb cruise. No data on density or abundance estimates for the South China Sea is available. Two concentrations of striped dolphin are recognized in the western North Pacific: one south of 30°N and the other in the offshore waters north of 30°N. There is the potential for three populations in the area: one south of 30°N, one inshore north of 30°N, one offshore north of 30°N, east of 145°E though the boundaries between these populations have not been resolved (Miyashita 1993). Therefore, Miyashita (1993) derived a total population estimate (570,038 (CV=0.186)). One-half of the density estimate off southern Japan/east Taiwan for this site (0.0164/km^2) was used. This is greater than density estimates around Hawaii (0.0016/km^2 (Mobley et al. 2000) and 0.0042/km^2 (Barlow 2003)).

rough-toothed dolphin: Rough-toothed dolphins have a primarily pelagic distribution in tropical to warm temperate waters. They are seen from time to time with bottlenose dolphins and short-finned pilot whales, and are reportedly rare off Japan and in the heavily studied eastern tropical Pacific. These animals have been found in "whale temples" in South China Sea nations (Smith et al. 1997). Without data available in the western North Pacific, a density (0.0040/km^2) and abundance estimate (145,729) from eastern Pacific (Ferguson and Barlow 2001, 2003) was used. This is within the range of density estimates around Hawaii (0.0081/km^2 (Barlow 2003) and 0.0017/km^2 (Mobley et al. 2000)).

Fraser's dolphin: Highly gregarious groups of a hundred to a thousand dolphins have been observed, and occasionally have been found mixed in herds of spotted dolphins. Fraser's

dolphins have also been observed in the company of false killer whales, sperm whales, striped dolphins, and spinner dolphins. Their diet consists of squid, crustaceans, and deep-sea fish (Leatherwood and Reeves 1983). Comparing the feeding ecology of spinner and Fraser's dolphins, spinner dolphins feed primarily in upper 200 m (656 ft), but maybe as deep as 400 m (1312 ft), whereas Fraser's are more diverse, feeding from the surface to as deep as 600 m (1968 ft). Kishiro and Kasuya (1993) report catches off the Pacific coast of Japan in drive fisheries. Dolar et al. (2003) report Fraser's and spinners found together in the eastern Sulu Sea, Philippines. Without any data on stock or density estimates for the western North Pacific, it is roughly estimated that the data from the eastern tropical Pacific (Ferguson and Barlow 2001, 2003) are appropriate, though Fraser's dolphins were not observed at this latitude; all observations were south of 10°N.

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